CARF-Models “Mephisto”

Preliminary Instruction manual

Landing Gear Installation

The landing gear of the CARF-Models Mephisto is laid out very special. All 3 struts retract forward. The advantages are that the wing does not need big openings across the direction of airflow, which would cause aerodynamic turbulence if not covered by gear doors. Large gear doors create all sorts of further problems, such as not closing properly or flying off at high speeds.

The gear doors of the Mephisto are slim, do not require considerable leverage and do not give the air any edge to catch.

Furthermore the wheels do not retract fully, allowing the Mephisto sitting on its wheels even with the gear retracted, making it easy to handle the front fuselage in the shop and at the field, also allowing a gear up landing with no or minimal damage.

The Mephisto retracts are especially designed by ELECTRON for this airplane The center block has a special shape so that the strut can pass the wing tube right in front of the gear. The mounts in the airplane are made from heavy duty plywood in an interlocking design, glued into ribs and formers before the molds get joined. Main and nose gear should drop right in. The wood is hard and strong, so that the easiest and best way to mount is the use of self-tapping screws, without pre-drilling any holes. These screws are included in the kit. The strength of these screws is fully sufficient and you do not need to look for alternatives. Stick with the kit contents!

Still an important note have to be made: Before you permanently screw the gear units in place and attach the struts to the gear unit with the hard steel pins, apply a little drop of blue Loctite to the grab screws and then tighten them very well. You do **not** need to grind flat spots to the steel pins, **except one**: The steering arm! Since the steering arm has only one single grab screw, a **small** flat spot in the nose gear steel pin at that place is absolutely mandatory!

Follow these work steps and your Mephisto should sit on its gear in only a few hours.

1) The main gear should right drop in. Once the gear units are in their final location, measure the strut position to be able to grind the U-shaped notch into the small carbon gear cover. Trial fit the gear cover and make sure the cutout is big enough so that the **strut is not hitting or catching any edge**. In case there is some grinding necessary on the little wood blocks for the self tapping screws, or the plywood lips where the cover sits on… feel free to remove a little here and there with a dremel grinder to make the fit easier.

2) Make sure that the fiberglass edge around the wheel cutout, when gear retracted, has **a clearance of 2-3 mm around**. If this clearance is too tight, the wheel can catch the edge and the electric gear might switch off during the retraction or extension cycle, causing unreliable retraction cycles and gear door crashes.

3) Install gear door servos of standard size, with not too much torque. 10-12 kg are absolutely sufficient. Too powerful servos will destroy linkages and arms when the gear door cycle gets messed up e.g. during programming. The servo mounts are readily glued in, any standard servo will fit. Use very short servo arms (15-18mm is enough). In order to allow the servo to over-center in the closed position of the door (guaranteed load free in flight, so that no current can be drawn or servo be burnt) you should use the old fashioned way of a Z-bend on the servo side. The linkage is included in the hardware bag. Install the ball with the M2 bolt and nut and tighten **with a drop of CA glue**, so that this ball cannot come lose over time! Turn the plastic ball link on the thread so that you can adjust the length by 2-3 mm each way if necessary. Set the servo arm and linkage length with the help of a servo tester so that the door is closed when the servo arm is exactly 180 degree in line with the linkage. That way the servo is 100% load free in flight. When the door is open, make sure that the door's edge is **clear of the strut by at least 10 mm**, when the strut is passing by.

4) It's recommended to make an adapter cable to test cycle the gear. You can test run the gear with a **single cell** LiPo battery or a 4cell NiCd/NiMh. Just make sure you always pull the plug immediately once the gear has reached its end position. Reverse polarity to reverse travel direction.

5) Now it's time to assemble gear unit, strut, wheel and brake permanently. Use Loctite as mentioned above. It will be difficult to access some of the grab screws when the gear is installed, so **do it now!**

6) Pull the leads for retract and brake through the wing to the rear center opening, then install the gear unit permanently with the self-tapping screws. Do not pre-drill holes, or if doing so, use only a very small diameter drill bit. That will ensure a strong grab of the screws. You will see they are going to hold the gear in so tight, you won't feel that you need to have any more strength in this.

7) At this time you should take care of any extensions of the gear door servo leads. Also install now the aileron servo leads, which can be fixed in the wheel bay with some wire ties, so that they would not tangle with the strut and a servo lead socket is accessible through the root rib.

8) Pull all leads open ended towards the front of the center wing, exiting in the top skin in the leading edge area, in front of the front wing spar . Protect the fiberglass edge with a rubber tube in case the wire can rub. It is advisable that you also use a protective sleeve over the strand of wires where they are guided through the center wing, so that no rib or carbon sheeted spar would be able to rub or cut the insulation.

9) The nose gear should also drop right in. Install the steering servo into the servo bracket and build the steering linkage. Make sure that the servo arm, steering arm and linkage do not catch the gear mount anywhere. Install the servo with the **lead exiting forward**, so that it would not get caught by the retract frame when retracting.

10) Assemble the gear properly, grind a flat spot into the steel pin for the steering arm grab screw, install the wheel and then use Loctite to secure all grab screws. Finally screw it in place with the self-tapping screws included in the hardware bag.

11) Make sure that the wheel clears the edges of the gear doors and front fuselage skin by 2-3 mm. Grind the edges where necessary.

12) Now install the nose gear door servos. It is advisable to use two 11-12 mm wing servos with side mount tabs, to keep the installation of servos and linkages very simple. You can install the servo base plate on top of the fuselage (from outside) or inside the fuselage so that they are not visible. Anyway make sure the servo arms over-center when the doors are closed, to keep the servo load free under any circumstances in flight. Install the balls of the ball links to the phenolic horns of the gear doors with the M2 bolts and nuts (use CA glue to secure them properly). Turn the plastic ball links on to the linkages so that they can be adjusted 2-3 mm each way during final setting. Cut the linkages at the proper length and do a Z-bend at the end to connect to the servo arm.

13) Run all servo and retract leads in a protective sleeve back to the center of the fuselage, approx. where the tray for the receiver/gyro/power expander is going to be mounted, as that is the place where also the retract controller will be installed.

14) This completes the gear installation for now, only the final connection of all leads from the center wing to the gear controller and receiver/gyro/power expander in the fuselage is left to be done later.

You can install the center wing to the front fuselage for a test and you will realize right away how great and easy the 3-piece wing improves the way to handle your Mephisto in the shop, in the car or trailer, and at the flying field. Put it on its gear and continue to work on the plane like that. You won't want to miss this feature anymore!

Wings, Flaps, Ailerons

To understand the function of the 3-piece wing and the very special flap attachment insert a carbon tube into the the sleeve of the center wing and slide one outer wing onto the carbon tube. Leave the flap alone at this time. You will see that there is a 2-3mm gap at the leading edge, while at the flap area the wing parts contact already. This is designed to make sure the wing stays under slight tension when the knurled plastic nut is tightened. The threaded stud is pre-installed in the outer wing in the wheel area, where access to the knurled nut is very easy through the wheel opening. Being held together quite far in the front, this tension is important to pull the outer wing tight against the center wing along the entire root rib.

Release the knurled nut now, pull the outer wing approx.. 15 mm off and insert the flap. Slide the two aluminum pins of the flap rotation disk into the two holes in the flap root. It is the easiest if you rotate the disk so that the flap would extend approx. 25-30 degree. Once the flap sits tight against the disk,

slide the outer wing towards the center, while aligning the outer flap pin with the preinstalled hinge post. Once you've done this a few time, you will get the feel of this procedure quickly. While you are on it, install the winglet to the outer wing and see how the joint is designed. The magnet is holding the winglet on the wing. If over time the fit of the pins in the sockets gets a bit lose, you can use a little drop of CA glue floating on the surface of the carbon pin. After that has cured, you can carefully sand the added material until the fit in the socket is nice and tight again…

After that little lesson to understand the principle, take things apart once more and start with the following work steps to install flap linkage, as well as flap and aileron servo.

1) The upper aluminum pin of the phenolic flap disc (with the ball mounted on the opposite side) has not been finally tightened. For a reason.

2) Prepare 2 very solid aluminum servo arms with a 3mm hole at 18-20 mm distance from center. Trial fit an M3 ball link with an M3 bolt and nut on that servo horn, but do not fix it yet. Don't use "chinese" soft aluminum arms as they WILL bend.

3) Create the very short linkage between the flap disc and the servo with 2 M3 plastic ball links. The length of this linkage should be set so that the flap would deflect down 50-55 degree when the servo arm is all the way back, touching the bottom skin of the center wing, so that the linkage almost over-centers along the servo arm. This will take most of the load off the servo at full flap down deflection.

4) Make sure that the length of this linkage can be adjusted 2-3 mm later. Do not bottom out the M3 all thread, allow 2-3 mm clearance inside the plastic ball sockets for later adjustment.

5) Now trial install flap servo and servo linkage, so that when the servo horn is all the way back (flaps down), the flap is deflected 50-55 degree. Then move the flap into neutral position, the servo and linkage should not bind anywhere and the servo should travel approx. 100 – 110 degree forward. This will allow you to use the maximum servo travel when using 110-120% of ATV on your transmitter.

6) Make sure that right and left flap are 100% identical when the flap servo horns are both all the way back. Please note that **this flap position will only be adjustable by mechanically adjusting the linkage length**, and NOT by ATV in your transmitter! Use your ATV settings to set the servo travel so that the servo arm just touches the bottom skin of the center wing. Then set the the flap position by adjusting the length of the linkage. The flap up position will then be adjustable by ATV in your transmitter.

7) Due to the short arm length the load on the aluminum servo arm is immense. **Use only high quality aluminum servo arms**, as lower quality arms WILL BEND and might then foul the flap movement, which can result in very critical flight situations.

8) Last but not least, take things apart, use Loctite to finally tighten the M3 bolt into the aluminum pin of the flap disk, while the linkage is in one piece, then install other ball link permanently to

the servo arm. Finally, permanently mount the servos in their sockets You can shim the servos against the skin and the rib with very thin plywood pieces to lock the servo in. The less movement you allow in the rubber grommets, the more precise your flaps will work. **BUT DO NOT YET INSTALL the servo arm on the spline of the servo**. This should only be done during the setup of the airplane with your transmitter, during the programming phase. A servo arm accidentally installed in the wrong position on the servo can destroy the servo mount and the flap disk if it is powered up, over-travelling the mechanical end points of the system.

9) For a little check-up when this work is done, assemble the 3 wing parts with flaps completely and deflect the flaps manually fully down. Both should rest at exactly the same deflection angle, when the servo arms hit the bottom skin of the center wing. Then move the flaps up until they are in line with the wing's trailing edge. The two flap servos should travel the same amount and their arms should point precisely in the same direction, exactly vertical or still slightly backwards. They should have from end to end position more than 90 degree (100-110 degree is best). Then you have chosen the correct servo arm length for maximum torque and understood the required geometry for correct setup and flawless operation. Last but not least, you secure the carbon axle in the bearings from the rear with the brass sleeve, which you tack glue with a drop of epoxy or silicone, preferably so that you can remove it once more, if necessary.

10) Opposed to the tricky flap servo mount the aileron servo mounts straight forward. Use carbon reinforced servo arms, drill a 3mm hole for the aluminum clevis at 30-35mm from center. Do not use single sided ball links on the servo. Create the linkage from the equipment supplied in the hardware bag: all thread stud, aluminum clevis on servo side and plastic ball link on the aileron side. **Use a drop of silicone oil on the aluminum pin of the clevis, if you use an aluminum servo arm!**

11) Route the servo leads (extended as fit) to the root rib. Think of where you want to bring the aileron servo lead in the center wing and there you fix the connector in the outer wing with a cable tie.

12) Before you install the servo permanently, find the center position (1500 signal length) with a servo tester and have the servo arm mounted at 90 degree. Then fit the servo hatch. Since the servo arm is very close to the edge of the servo cover, cut a notch to allow the servo arm travel freely 45 deg both ways. Then attach it with 4 sheet metal screws.

13) At 45 deg servo travel (100% ATV) you should get approx. 35-40 mm deflection of the aileron at the root trailing edge.

Tailerons

1) First get familiar with the installation of the taileron itself. The left hand taileron has the carbon tube fixed with an M4 allen bolt. The right hand taileron is rotating freely on the carbon tube and is held in place with the special M4 bolt with shoulder. Please carefully keep this special bolt

safe, we recommend to keep the two taileron halves always mounted to the tube and transport them as one unit. This will also avoid misplacing the two carbon washers, which need to stay between taileron and fuselage on each side. Please use a slight amount of grease to lubricate the stab tube in the fuselage and the rotating taileron half to avoid wear.

2) There has been a lot of thought put into the connection beween pushrod and taileron. Do not try to change this without thinking it through fully. The steel clevis has a polished steel pin which is secured with a spring clamp. It allows to install and remove the tailerons without any additional tools. The wide single control horn is made from phenolic material because it is self-lubricating and the hole for sure will NEVER show wear for many years of flying. Just leave it alone and trust that this horn/linkage pairing is going to work flawlessly for you.

3) We recommend to use two ganged servos for each taileron, not only for safety purposes, but also to minimize any slop in the system. You can apply a little tension between the two servos which will take out any gear play, and it still doubles the torque. Therefore you do NOT have to use a 40 or 50 kg servo, 2 reliable 20kg servos are fully sufficient, as these usually also develop less gear play over time and do not put so much load on the servo mount.

4) Ideal servo arm length is 40 mm from center to hole. The M4 metal ball link mounts with an M3 allen bolt and counter nut and should ONLY be installed to a strong aluminum servo arm! The ball link **should be attached from the bottom side to the servo arm!** That's necessary for the alignment of the pusrod and the slot in the fuselage.

5) The two servos are ganged together with a short M3 linkage and 2 M3 plastic ball links. This can be installed inside of the main pushrod at 25-28mm from the center hole, either from the top or from the bottom to the servo arms. Make sure that the two holes they attach to, are exactly at the same arm length to avoid binding. As a little help for creating these 4 short linkages, the all thread should be 45 mm long and the complete linkage from eye to eye 68mm. If installed properly and a high quality servo pair is used, this works without binding via a Y-connection into the same channel. Using a match box between the two is at your own choice.

6) Building the pushrods is critical. Length from eye to eye is ~650 mm, but it still depends on the geometry of the servo used, thus please measure carefully before you cut the carbon tube! Install the metal ball links and the metal clevises to the short all thread studs and secure them with counter nuts. Allow a few mm for later adjustment, so do not bottom out the threads. Drill 4x 1 – 1.5mm holes across the tubes in the area where the all threads will be glued. This will create a form-locking connection when the glue has set. Apply some 30 min epoxy or Hysol into the carbon tube and on the threaded stud, then slide the threaded stud into the tube turning it ANTI CLOCKWISE. This will help to work glue into the tube, along the thread. There will be sufficient glue everywhere as soon as glue exits all the cross holes. The glue is now creating a form locking medium between the thread and the tube and is a 100% safe connection. Adjust the length of 650 mm (+/-) before the glue sets and let it cure overnight.

7) After the glue has set, install the tailerons, the servos, and the pushrods permanently and make sure they operate without binding. You might have to slightly adjust the slots and the support holes in the forward vertical fin former. Once everything moves without binding, glue the milled plywood half-rings on to the vertical former to create a support for the pushrods which keeps them tight in position. However, they should have 1mm play inside the hole in order not to bind. Before you connect the servos to power DISCONNECT the short pushrod between the two servos. Run the servos by transmitter or a good servo tester from center position to full deflection and make sure the travel is identical before you finally connect them to each other via the M3 pushrod with the plastic ball links.

8) After many flights with the prototypes we have found that an elevator deflection of 55 mm, measured at the end of the root rib (inside of the 45 deg champfer at the trailing edge) is best. To reach this deflection, unfortunately it is necessary to modify the cut-out on the root rib towards edge, so that the taileron would clear the pushrod at full up deflection. This has surfaces only after lots and lots of flying our prototypes, it is a little extra work to do and it is corrected at the latest versions of the Mephisto kit.

9) It is absolutely mandatory to balance each taileron with 100 gram of lead! The lead will make the tailerons slightly nose heavy, which means, the taileron's leading edge will be slightly heavier than the trailing edge. This is important for the safe operation of your Mephisto. Use thickened resin (30 min epoxy) to glue 100 g tire balance lead (plus approx. 5 gram of glue) into the leading edges of the tailerons! Un-balanced tailerons might flutter at high speeds or break servo gears during hard landings or other violent maneuvers.

Vertical Fin and Rudder

1) Fit the fin to the rear fuselage and locate the M5 bolt. Please note that the two aluminum tubes are not the same length! The shorter one is in the in rear! It is advisable to use a permanent marker and mark the two tubes front and rear! It will also be helpful if you insert the bolt through the hole in the fin, then slide a rubber O-ring or a very short piece of tygon tubing on to the bolt so that that bolt will never fall out and get lost. There is enough room between the plywood rib and the rear fuselage's top skin for this O-ring. So you'll never lose the bolt.

2) Install the rudder servo as usual. Have a 35-40 mm servo arm. Drill the servo arm 3 mm for the aluminum clevis pin and adjust the push rod accordingly. Use the plastic ball link and an M3 bolt to attach the push rod to the dual rudder horn. Once the system is working without binding, reinforce the M3 pushrod with a 3mm carbon tube or brass tube. The pushrod is a little too long to keep it unsupported. Optionally attach the fiberglass fairing over the linkage to give it a smooth look. You should use 5 very small sheet metal screws to keep it removable.

3) Feed the servo lead forward and let it exit in front of the front aluminum tube. Glue a connector socket into the fiberglass surface of the rear fuselage in the fin area that will allow easy single-handed connection and disconnection. Once the fin is installed and bolted down, you might

notice that it can lift off the rear fuselage for a few mm when you pull hard. Please don't be worried, this is no problem! The fin will stay secure!

Tumble Tube

1) Bolt the stainless steel tumble tube to the carbon entry cone (bell mouth). Use at least 6 3mm rivets or 6 M3 bolts. Make sure the bell mouth is perfectly aligned to the thrust tube. Drill the stainless tube first in 60 degree segments. Slide the tube on to the bell mouth and drill one by one through the carbon, insert a bolt/rivet and go on to the next one. Do 3 in 120 degree segments first, then do the other 3.

2) Then install the carbon bridge under the flange of the rear fuselage. Do not only use glue, please also use 1-2 counter sunk bolts per side. Your entire thrust tube will be held by this cross bridge and the vector steering forces will be significant. Never rely only on glue. The single mounting bolt to connect the bell mouth with the cross bridge will be installed AFTER the engine and carbon bypass is installed and the bell mouth is aligned perfectly to the carbon bypass. Therefore the engine installation must be completed.

3) Fit the foam former for the rear thrust tube support into the tail. It should be rested against the stab tube sleeve. Please note, the seam of the thrust tube should be at the bottom, so the yaw control arm is on the right side (in flight direction). It is a good idea to permanently glue this former AFTER the vector servos are installed, as it is easier to access them from the rear while this former is not in the way.

4) Assemble the vector servo mounts and trial fit them to the base plates (6mm light plywood) with the M4 x 10 allen bolts and T-nuts. Then install the servos with 35-40 mm long servo arms (carbon reinforced plastic is OK, as long as you use the included high quality spring steel clevises).

5) Build the push rods in the same style as the taileron push rods, with the difference that you use M3 all tread studs and spring steel clevises on both sides. Use the 500 mm long carbon tubes included in the kit.

6) Then trial install the trust tube, attach the push rods to the control arms of the vector, attach the servos to the front end of the push rods and trial fit the servos to the fuselage sides as they fit best. The front edge of the bell mount should protrude the front face of the rear fuselage (at the joint area) by 25mm (1"). Fix the thrust tube in this position with some duct tape to the cross bridge. Then use 30 min epoxy and glue the base wood with the installed servo mounts and servos to the fuselage top/side/bottom and let it cure sufficiently. After the glue has set, you can disconnect the push rods and remove the thrust tube, then double check on the glue joints of the base plates. You can then also remove the servo mounts and permanently and properly install the servos. Note: The stainless control arms on the vector are very secure and proven. They work fine with the stainless clevises! But the rear clevises should receive a small

cable tie or a safety wire wrap to make sure they don't open at high deflections of the vector. Finally glue in the foam support former for the tumble tube in the tail.

Engine Installation

1) Mount the engine to the engine rails so that it is symmetrical to the mounting surface. Some engines have fully symmetrical engine mounts, some other engines have the moutning tabs several mm off center (e.g. JetCat 6mm off center). Compensate this off center position with plywood spacers. We have included 2 6mm light ply spacers in case a JetCat engine is installed. For a fairly small engine you might have to add wood inside the stock rails to allow the small engine mounts to span from right to left moutning rail. Since there are so many engine choices, some custom fitting will be required! After the engine is trial fitted, remove it and install the bottom half of the carbon bypass to the engine rails. Then put the spacers, if any, on top of the carbon bypass.

2) Cut out the top half of the carbon bypass to accept the engine mount and, if applicable, the support spacers for the engine. Then mount the top half with 2 M3 bolts on each side. The rear ones can go all the way through the engine moutning rails (T-nuts from below), the front ones should be at the front edge of the two bypass flanges. There you should glue a T-Nut inverted against the bottom bypass half on each side. If necessary, you can drill holes into the fuselage flange as long as they will be later covered by the fuselage hatch, to insert an allen key vertically above the particular bolt you want to tighten or remove. Some of the bolts can be accessed through the slots for the hatch hooks, though.

3) When everything is installed, look at the assembly from exactly behind and make sure that the engine is perfectly centered in the carbon bypass. Then cut notches into the thrust tube's bell mouth to give room for the support rails, where the engine is mounted. Allow a few mm clearance. Then slide the rear fuselage on and see that the bell mouth slides correctly over the bypass. You might need a few tries to make this slide smoothly in place. Do this job carefully and thoroughly because it will be the key condition for a quick and easy removal and attachment of the rear fuselage at the field.

4) Once the fuselage is joined, insert the M4 bolts (short ones from top, long one from bottom) and tighten. Then double check the perfect fit of the bell mouth to the carbon bypass. Before you drill one hole through the cross bridge and through bell mouth for that single M4 bolt, make sure that the vector's axis are exactly vertical and horizontal. If the axis are not aligned correctly you will have an elevator component on every rudder input and vice versa. The plane will always feel out of trim! To bridge the gap between the bell mouth and the carbon bridge, apply some packing tape to the bottom surface of this carbon bridge, wax this tape well. Then use a blob of thickened resin to create a flat spot on the outside of the bell mouth right where later the bolt goes through, and temporarily fix it in place until it is cured. Now you can drill the hole through the bell mouth. When the rear fuselage is removed from the front, insert the M4 bolt and tighten that bolt permanently against an M4 T-nut. Glue this T-nut reversed on to the carbon

bridge. You do not want to lose this bolt, imagine the consequences, and use Loctite to permanently fix the thrust tube!

5) Last but not least, install the ducting liner between the intake duct and the carbon bypass. Allow 12-15 mm overlap (1/2”) on each side and then secure it with one single sheet metal screw into the thick resin, which fills the gap between right and left intake.

Final plumbing

1) Remove engine, duct and liner to install the main fuel tanks. The rear mount is already glued in place, the front mount is included in the hardware bag. This is because you can purchase fuel tanks in various sizes (different length). Glue the front support in place to hold the fuel tank in the right position and then use a 20x20mm balsa block each side, shape it to fit the rear end of the fuel tanks and glue it against the fuselage sides, so that the tanks cannot slide backwards.

2) Assemble the smoke tank tray and mount it to the fuselage with 4 M4 bolts and T-Nuts. Be careful, the space is very tight under the fuselage hatch, test fit the tank with the Velcro and attach the hatch. Move the smoke tank tray as far forward as possible, just behind the to-be-installed hopper tank. You might have to trim the rear of the base plate and the rear vertical tank formers a little to get the fuselage hatch to slide without touching the smoke tank mount.

3) Assemble the fuel and smoke tank with the brass tubes, the rubber stopper and the aluminum cover. Install a brass tube into the clunk line where the baffle is located. Solder barbs on every brass tube. Connect the two tanks in parallel. Use Tygon tubing for the clunk line and install the felt clunks. They are safe also for big engines, because the fuel flow comes from two tanks, so that only half of the needed fuel of a thirsty engine has to pass through each felt clunk.

4) For engines up to 200 N you can use our standard hopper tank, for bigger engines it is recommended to use a high quality hopper, such as an Intairco I-Trap or similar units. It should preferably have two inflows so that a T-Fitting between the two main tanks can be eliminated. The hopper tank should be installed in the center of the mouting board behind the big round hole in the fuselage.

5) The vent lines, however, should be connected via T-fitting, and they should be looped high up, before they go down to the fuselage bottom, to avoid self-drainage. If every tank gets its own drain, unconnected to each other, drainage can occur from one tank via hopper tank into the other, which may result in one tank emptying completely, unnoticed, through the main drain.

6) **We consider the builder of this airplane to be proficient in plumbing a fuel and smoke system of a large turbine Sport Jet!**

7) Install the turbine fuel pump on one side of the hopper tank and the turbine ECU on the other side of the hopper tank. This will be the cleanest install for the engine, keeping it neatly away from any RC installation.

Final electrical rigging

1) We recommend to use the large EMCOTEC multi pin “CLICK” connectors. They are available as 12pin and 16 pin. For the connection to the wing you need one 12 pin for the servos and one 16 pin for the gear/brakes. For the connection to the rear fuselage you need one 16 pin if you use a y-harness for each taileron servo pair, or a 20 pin connector if you want to go separate with every servo. This also depends on the type of radio you use. A Jeti Box 200 e.g. will not give you enough connetions for 4 separate taileron servos… but still is a recommended component, in combination with two satellite receivers.

2) Equipment placement: Depending on the choice of engine, you will have to place batteries. For 300N engines you could place the receiver batteries all the way in the nose. For 250N engines you place them behind the powerbus / gyro platform. All gyro supported equipment should be placed on this platform in the of the fuselage, as this surface is exactly at horizontal level. We have used Powerbox Mercury, Powerbox Royal with Graupner HoTT and Futaba, Cortex Pro with JetiBox 200, and combinations of the aforementioned, but of course many other equipment pairings are possible and suitable. BUT: Make sure you only combine equipment which is proven to work well together. Ask the equipment manufacturer of every key equipment for possible interference with other equipment you decide to use!

3) In order to strengthen the mounting surface, glue light plywood reinforcements from inside, where you want to install any equipment. These should span from the right to the left edge of the fuselage.

4) Locate the connector to the rear in the top of the turtle deck front face in the rear fuselage. Locate the connectors for the wing either in the center wing top surface or in the fuselage top surface. Always mount one side solid and keep the other side loosely on the wiring harness. That will keep the wiring secure and guarantee easy connection and disconnection.

5) If you use cable ties to hold wires in place, add a silicone tubing or some other protection around the wires BEFORE you attach them with a cable tie. Cable ties can cut into insulation of the wires and cause shorts.

6) Be very careful with routing the wires in the rear fuselage, as the thrust tube will get hot and you have to avoid under any circumstances that wires can get into contact with the hot thrust tube.

Settings:

We recommend a certain procedure to get your Mephisto set up for the first flight. From experience with all our prototype flying this should be followed, and only then you should start making individual adjustments, if you feel it's necessary. This procedure should be:

(1) Set the CG > (2) set the basic programming/mixing in your radio > (3) set and measure the High Rate Deflections and set low rates > (4) initialize and set the Gyro > (5) adjust the specific Mephisto values in the Gyro > (6) set the gear sequencer

1) Set the Center of Gravity

The CG is 300-310 mm (12") in front of the fuselage separation! Especially with a good Gyro system the CG can be moved further back, but there is a catch. Only do that if you are an experienced 3D flyer, as once the plane flips or snaps or tumbles a bit out of control, it will not neutralize and take its nose down as the gyro will want to hold its current attitude. Even without Heading Hold mode (which we strictly oppose) this can result in very strange, sometimes dangerous flight situations. Start with a slightly nose heavier airplane and move the CG back slowly, flight by flight, and play with 3D maneuvers to learn how far to go and where to stop!

NOTE: In this manual you'll find a printed template to help you create a CG setting jig for a CG of 300 mm in front of the fuselage separation line. In later kits this will be included as a pair of CNC milled plywood parts.

2) Set your basic Programming/Mixing

Besides the usual channel mapping and basic programming, make sure to create the following specific Mephisto mixes and other requirements.

a) a switchable mix of yaw vector to rudder
b) a switchable mix of pitch vector to elevator
c) a taileron mix (besides the regular ailerons on the outer wings)
d) a Gyro on/off switch
e) a Gyro rate switch (2 rates)

Based on your type of radio you can set these via flight modes. At least 3 flight modes are recommended (gyro high – gyro low – rates low), if the Gyro on/off switch is global. Or a 4th flight mode "Gyro Off" could be set. This has the advantage that you can increase considerable expo on the 3 main functions aileron, elevator and rudder, when the Gyro is off. Gyro on/off and Gyro high/low should be 2 different switches, easy to differentiate between them during flight.

3) Control Surface Deflections:

In the manual we already suggested suitable servo arm lengths. The following is the setting for high rates, reminding you of these servo arm lengths, too. It is important that the High Rates are set to this value if you want to take advantage of our Gyro programming help. Without having these deflections at high rate, you cannot copy our recommended gyro settings as they will not match your settings:

Ailerons: Servo horn 30-35 mm Deflection + 30 mm (up), - 33 mm (down)

Elevator/Taileron: Servo horn 40 mm, pitch deflection +/- 55 mm and roll deflection +/- 40 mm

Flaps: Servo horn 18 mm, deflection 25 mm for takeoff, 110 – 120 mm for landing

Rudder: Servo horn 40 mm, deflection 80 mm +/-

Vector: Servo horn 40 mm, maximum possible without binding

For low rates you could reduce all above mentioned deflections (except flaps) by 30-40%. Then you should adjust all rates to your personal liking while making the first flights. You might find that you want to combine the low rate mode with the low gyro mode, and the high rate mode with the high gyro mode. That is our recommendation!

We also recommend to keep taileron and vector always switched on. Control the sensitivity feel of the plane only with your rates. Otherwise you create various different flight characters and will never get the locked-in feeling you need. Only for an emergency situation you should be able to switch off the vector. Basically for all flying taileron function and ailerons should be coupled. For special maneuvers such as snap rolls, do need the vector tube and high rate aileron. If your transmitter has the possibility via flight mode prgramming to set a programmable Expo CURVE on your ailerons, you could set it soft and quite linear all the way up to 90% of your stick and then jump to full deflection at over 90% stick value. (similar to snap roll switch programming) For snaps you need only low rate elevator and rudder as long as you use vector with it.

4) Initialize the Cortex Pro

Set your rates to high rate, make sure your taileron mix and vector mixes are active and your gyro on/off switch is in off position.

Then follow the sequence given in the Cortex Manual. Plug in the programming jumper and follow the blink codes to do Aileron right/left - Elevator down/up - Rudder right/left - gyro switch on/off) You can repeat that as often as you wish if you are not sure if all has worked. Check the directions to be sure the Cortex compensates any movement correctly!!!

5) Program the specific Mephisto values into your Cortex Pro

If you do not fly Jeti, where you can program your Cortex Pro via transmitter, connect a laptop to your Cortex Pro (of course it needs to have the Cortex software installed). Adjust the BANK values according to the following table

Bank1 Aileron	**Bank2 Elevator**	**Bank3 Rudder**
Normal (Heading OFF)	Normal (Heading OFF)	Normal (Heading OFF)
Sensitivity 8	Sensitivity 4	Sensitivity 20
Stick Priority 20	Stick Priority 12	Stick Priority 25
Lock 3	Lock 1	Lock 5

Then enter the single channel tuning screen and you will see, according to your channel mapping, your two aileron channels (often 2+5) your two elevator channels (often 3+8), your two vector channels (often 9+10) and your nose gear servo channel (maybe 13 or 14). Anyway all of the channels where the Cortex is active on, show the value 100. Here you reduce the value to 75 on rudder, aileron and nose gear channels and to 70 on elevator channels. Make sure to keep the value of 100 on the vector channels. This is increasing the gyro authority of the thrust vector.

Now set the sensitivity on your switch (flight mode high and low). With the settings given above, you should set the sensitivity to 35% for normal flying (normal speed of the airplane) and to 85% for 3D maneouvers. That's why the switch should be well accessible during flight, as you will flip this switch just before you enter 3D maneouvers such as hovers, torque rolls, spins, tumbles or cartwheels… For all other maneouvers the gyro should be set to the low value (35%). This sensitivity switch could be also the flight mode switch between 3D and Normal, switching also between the high and low rates.

6) Gear door sequencer:

We recommend to close the gear doors when the gear is extended, this will keep the inside of the plane clean from grass, water or any other dirt. The sequence should be:

DOOR OPEN > GEAR UP > DOOR CLOSE and vice versa DOOR OPEN > GEAR DOWN > DOOR CLOSE

The steering servo is automatically switched off when the gear is in retracted position, due to the functionality of the GS-200 controller of the Electron Gear. The GS-200 provides also a gyro supported steering and braking function, which is absolutely not necessary with the Mephisto. Ground handling is excellent without Gyro support. Still, if you experience e.g. the brakes to be not 100% synchronized, you can make use of this Gyro for the smoothest possible deceleration on the runway.

The final word: The CARF-Models Mephisto is a unique Jet with unique performance. There'll be nothing left you can't do with it, if you are capable of doing it. Please be advised that your Mephisto would not tumble, not snap, not do all the crazy things if it was like many of the other large sport jets with small control surfaces, thick and unstallable airfoils and low wing loading. The Mephisto lets you do all these things because it does stall, snap, tumble if you want to. If you don't control it right, it might bite you back. Keep that ALWAYS in mind when you practice with your Mephisto to discover its full and unique potential. Only YOU are the limit of what your Mephisto will or will not do…