

Instructional Manual

REV 2.0

Congratulations on your purchase of the “ Vortex-RC VT-Speedster” / “ Vortex-RC VT-Speedster PRO” . Flying Wings have always been fun to fly. However they require precise design and calculations to get them fly just right. Vortex-RC is proud to introduce the VT-Speedster and the Pro editions. Designed and built to perfection , The Speedsters have ‘just’ the right airfoil, taper, sweep, twist and CoG. Build is super easy and we are sure the Speedsters will be loads and loads of fun to fly with.



Please take time to read through this manual in detail as well as watch our videos that illustrate the build steps.

Flying wings need to be built as designed so please follow the measurements as accurately as possible. Unlike traditional airplanes, flying wings fly real bad even if the CoG is off by 10 mm. So please follow instructions as accurately as possible. We recommend that you read several steps ahead and test fit parts without using glue and once you double check everything then only use the adhesive. Our precision laser cutting and CNC hot wire cutting techniques ensures you will need minimal or no modifications to parts for a fit, and that all fits are tight and accurate. If you find any part that does not fit properly, please read the instructions and see pictures again to reorient/align correctly before using any glue.

We have written this manual so that the kit can be built individually as well as by groups of students/builders. Please follow the build in the order as written below.

Additionally we have given 2 check mark places besides each step.

Check mark the first box when you complete the step. Check mark the second one, after you double check the step, or when doing group builds have your project coordinator inspect and check it for you.

Watch our build videos, now on Youtube.

From unboxing to the maiden flight, we have it all on videos for you to see, learn and follow to ensure you get the most out of the Speedsters.

Search Vortex-RC on Youtube, or follow the link : <http://goo.gl/GMhxgG> or scan the QR-code on the right.



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Important Measurements/Specifications:

Wingspan: Speedster : 990mm Speedster Pro: 1180mm

Wing-area: Speedster : 460 sq in. Speedster Pro: 520 sq in.

Recommended All out Flying weight: Speedster: 650 gms Speedster Pro: 850-900gms.

Wing loading: Speedster ~7 oz/ sq ft. Speedster Pro: ~9 oz/sq ft.

CG Location: Speedster: 175-180mm Speedster Pro: 180mm back from the root leading edge.

Elevon Dimensions:

- 6cm parallel to trailing edge. All the way from tip to root . This will make the elevon.
- 14cm (**10 cm for Speedster Pro**) from the root parallel to the root. 3cm from the inside of elevon to the 1/3 point of Elevo (approx 13cm). This tapers the elevon and gives the wing better flight characteristics.

Battery Bay cutout dimension (only for VT-Speedster):

From the leading edge : 2cm

Bay depth: 1 cm

Bay length: 10.2cm

Bay width: 1.5cm

Control Throws:

Measured at Trailing edge on Tip (where Max deflection occurs)

Neutral: ~1cm UP

Max Up : 2.25-2.75 Cm

Max Down: ~2.5 Cm

Document Revision History

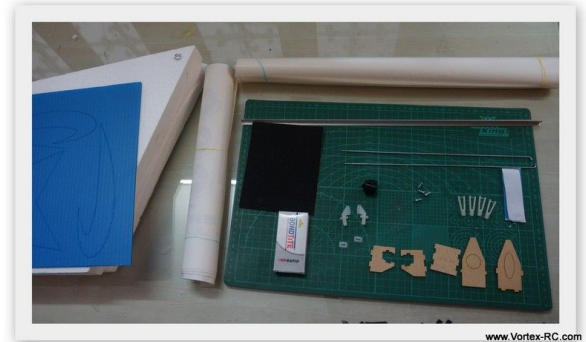
Rev 1.0 - June 9th 2014

Rev 1.1 - July 23rd 2014

Rev 2.0 - August 6th 2014

What's in the kit.

- 1 Nos. Laser Cut Coro Sheet
- 1 Nos. CNC Left Wing Foam Panel w/wing bed
- 1 Nos. CNC Right Wing Foam Panel wing bed
- 1 Nos. Aluminium T- Spar
- 1 Nos. 5 minute Epoxy
- 2 Nos Lamination Sheets.
- 2 Nos. Control Horns
- 4 Nos. Clevis
- 2 Nos. Pushrods
- 1 Nos Laser Cut Motor mount.
- 1 Nos Battery Strap
- 4 Machine Screws
- 1 nos Velcro Hook and Loop Material
- 1 nos 320 grit Sand Paper strip
- 2 Nos Decal Sheets
- Elevon Neutral Deflection Gauge *New



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For Speedster PRO you also get :

- 12 cm wide center Bay
- Laser Cut Camera Mount for FPV and GoPro Camera

Electronics Package (Optional) includes:

- 2 Nos. 9 gm Servos
- 1 Nos. 18Amp Brushless ESC (Speed controller)
- 1 Nos. 2822/14 1450KV Brushless Motor
- 3 Pair 3.5mm Bullet connectors
- 1 Nos. XT60 Male Connector
- 1 Nos. 8x6 **Balanced** Propellor
- 2 Nos 15cm Servo Extension wire
- 4 pairs Heat Shrink Tube Red and Black



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In order to complete the kit you will need the following

(check mark against each once you collect the items) :

- | | |
|---------------------------------------|--|
| <input type="checkbox"/> Screw Driver | <input type="checkbox"/> 90 deg Set Square |
| <input type="checkbox"/> Hobby Knife | <input type="checkbox"/> Hot Glue gun and glue stick |
| <input type="checkbox"/> Metal Ruler | <input type="checkbox"/> Clear Packing tape |
| <input type="checkbox"/> Marker Pen | <input type="checkbox"/> Scissor |

You also need a clear and a flat table/surface or floor to work with. This is very important. Having a flat surface will ensure your build goes straight and true.

You will also need the following to fly :

- 2200/3300 mah 3S Lithium Polymer Battery
- 1 Nos Lithium Polymer Battery Charger.
- 4 Channel or above radio set (Tx and Rx) (with Elevon mixing feature)

About EPS Styrofoam

EPS, or Expanded Polystyrene , is commonly known as Thermocol and Styrofoam, is a closed cell rigid and tough foam. EPS foam is available in various densities and we use a high density EPS foam for CNC cutting our wing panels. EPS foam is perfectly suited for hot wire CNC cutting, as it warps minimally and when cut the material is absorbed in the outer layers of the foam and does not bead, like XPS foam, which is prone to warping and beading.

EPS foam melts with CA adhesive, but Epoxy adhesives work great with it. Also, EPS foam can be strengthening by laminating it with clear packing tape.

When laminating, lay out parallel strips of packing tape, overlapping each line with around 2 mm. Lightly iron the tape for better adhesion. Be sure the iron temperature is low enough to not warp out the wing.

We ship the wing panels in their original wing beds. The wing beds not only provide protection during shipping, but also should be used as jigs, when laminating and sparring to reduce the chances of wing warping.

Hinging Technique.

Please follow the hinging technique as described below. If followed properly the resultant hinge would be very strong, yet light and easy to do. Follow the steps as below:

- After lamination, using a straight edge draw a line and cut where you want the control surface to be
- ON the control surface, bevel the underside as illustrated
- Use 2 small pieces of clear packing tape to hold the control surface in place
- Now bend the control surface to 45 degrees and apply a full length of clear packing tape along the joint. Half of the tape would be on the wing and half on the control surface
- Now turn the control surface on its back and use a small tape to hold it in place.
- On the underside put a full length of tape along the hinge joint, as illustrated,

Try to ensure that there is minimal hinge gap and that the control surface is kept as straight as possible,

Lets start the build !


Building the Speedsters is lots of fun and can be done in about 4 hours. Read the manual and understand each step before actually doing it. You may also see our videos that will assist greatly.



Note: The Speedster Pro is built using exactly the same way as Speedster. There are some differences only in a few steps and we shall highlight them below as we proceed with the building in these yellow boxes.

Build Steps:

1. Identify the parts and cut out the Coro parts from the sheets.
2. Apply Decals and Laminate the wing
3. Cut out and the Elevons and the Battery bay
4. Bevel and hinge the elevons
5. Join the Wing panels
6. Assemble and install the motor mount
7. Install servos and electronics
8. Install the Winglets and the skids
9. Final Measurement checks.
10. Go Fly !

Step 1: Cut out the Coro parts

 15 mins

  Cut out the four skid parts and the two winglets from the coro sheets carefully. The 4 skid parts are doubled up to make 2 skids. Note that two skids parts have horizontal flutes and two have vertical flutes. After the parts are cut out, glue one horizontal and one vertical skid to each other using a few

drops of CA. Likewise make the second skid.



Repeat steps 2,3 4 for each wing panel

☐ ☐ Step 2. Laminate the wing

🕒 30 mins

Lightly sand the panels using the 320 grit sand paper strip provided. Sanding removes the fine layer of surface foam, which leads to better adhesion of the tape. Sand very lightly so as to not to modify the airfoil . Once sanded, the foam will be smooth to touch.

Cut open the wing beds into top and bottom halves and label them accordingly. Place the wing over the bed during the sanding and laminating process. This ensures that you do not induce a warp in the wings.



Before Laminating, install the decals, as shown below. The reason why we choose to install the decals first is that the lamination will seal the decals and it adds to the longevity of the decals.



The supplied 2 sheets of lamination material are adequate to cover both the panels. However follow instructions carefully so you do not run short of it.

Place the wing over the lamination sheet as shown below aligning the root and tip ends. Accurately cut the lamination film near the leading edge



The remaining material shall be used for the other wing panel top. To cut the bottom wing panel, repeat the above step with the other lamination sheet. This time keeping the wing upside down. So you shall have 4 sets of diagonally cut lamination sheets.

Laminate the bottom wing panel first. Place the wing over the top wing bed, upside down, and from the trailing edge laminate till the leading edge. Using a ruler cut the excess off. Keep about 5mm of the laminating material excess from the trailing edge.

You can trim off the sides, but do not trim off the trailing edge material yet.

Now invert the panel and put it the right way up on the bottom wing bed. Again laminate from the trailing edge, keeping about 10mm excess material on the trailing edge. Take care to avoid forming any wrinkles. Overlap on the leading edge by about 10mm and using a straight edge, cut the laminating material off.

Be sure to keep the wing panels over the beds to avoid warping.

The trailing edge material will stick from the top and bottom sides and create a seal. Using a straight edge this can now be trimmed out.

☐☐ **Step 3. Cut out the battery bay and the elevons**

🕒 **15 mins**

The battery bay is cut out on the root side of both the wing panels. Follow the measurements as noted below and cut out the bay accurately using the knife. The bay is designed to fit a 2200mah 3S.

From the leading edge : 2cm

Bay depth: 1 cm

Bay length: 10.2cm

Bay width: 1.5cm

Draw a line with a pen as below and cut out accurately.

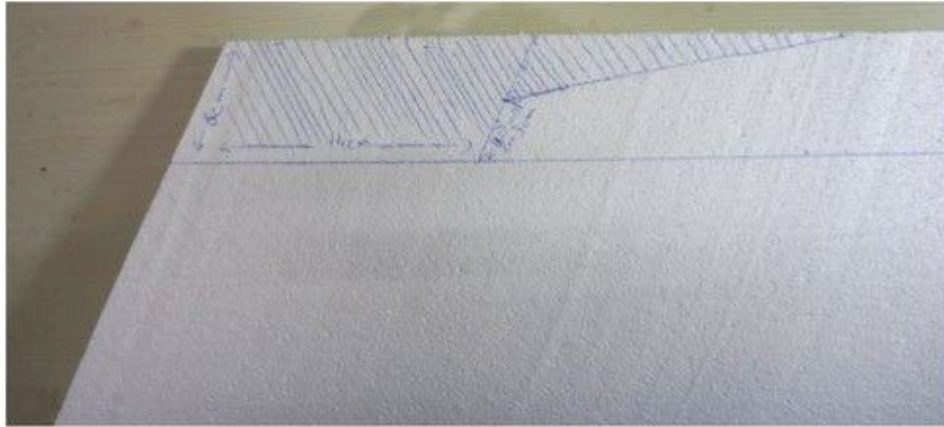


For the Elevons, Draw out lines as noted below:

- 6cm parallel to trailing edge. All the way from tip to root . This will make the elevon.
- 14cm from the root parallel to the root. This cuts of space for the prop
- 3cm from the inside of elevon to the $\frac{1}{2}$ point of Elevo (approx 13cm)n. This tapers the elevon and gives the wing better flight characteristics.

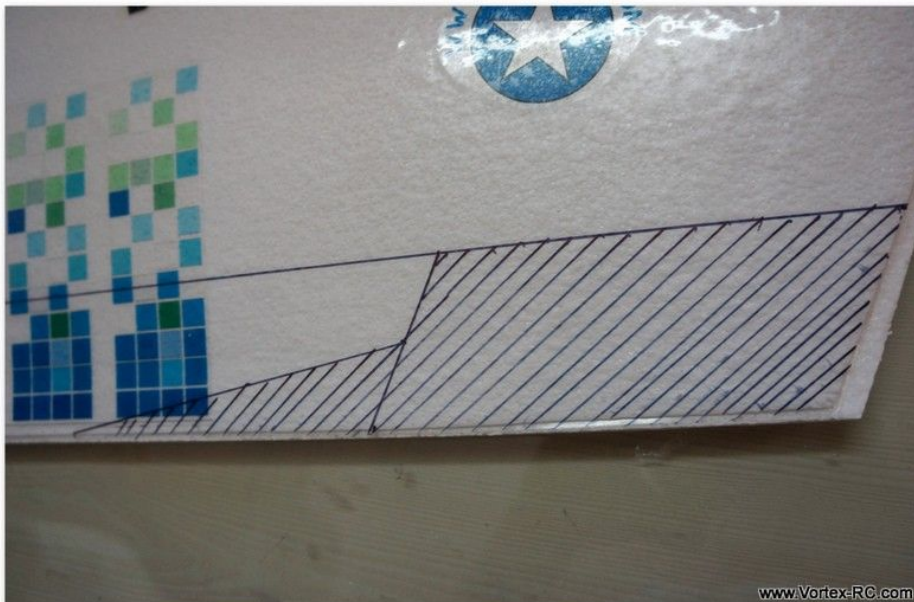
For Speedster Pro :

- 6cm parallel to trailing edge. All the way from tip to root . This will make the elevon.
- **10cm** from the root parallel to the root. This cuts of space for the prop
- 3cm from the inside of elevon to the $\frac{1}{2}$ point of Elevo(approx 13cm). This tapers the elevon and gives the wing better flight characteristics.



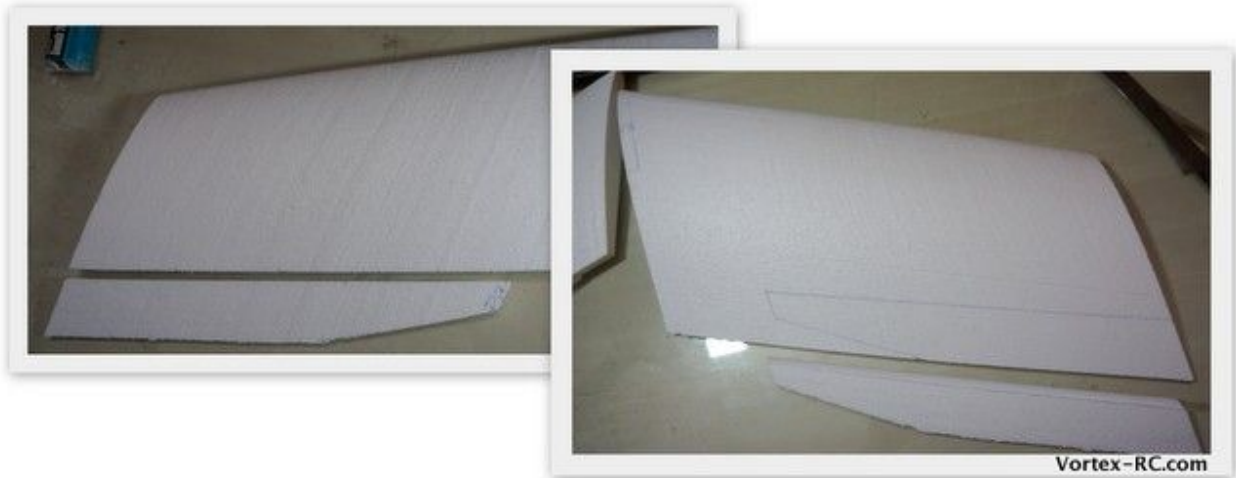
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Use a knife with a sharp/new knife to cut out the lines. As illustrated above the area with the parallel lines is scrapped.



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Once cut out, use the elevon to trace out the pattern on the other panel and cut out. Its very important to have identical elevons. This step will make you have both elevons in the same size and shape.



OK, so both the Elevons are cut out. Lets bevel them out and hinge them Read all the steps ahead and do this patiently. Good hinging will make your plane really nice to fly . Want me to say this again in Chinese ? IMP: Hinge properly Plane fly good. Lol !

Step 4: Bevel and hinge the elevons

 30 mins

The next step is to bevel the ailerons. Mark a 45 degree line from the top of the elevon on the side as shown. The idea is to bevel the bottom side so that the hinge line will be created on the top edge. Put the elevon back side up draw a line, parallel to the length of the elevon about 1 CM behind the leading edge. Carefully cut out the lamination material from this line. Sand carefully so that the bevel is created uniformly across the length of the elevon .



For Hinging, Follow these 4 steps to create a slop free, tight and reliable hinge joint:

- A. Use 3 small pieces of tape to hold the aileron tightly in place and fully deflected in Down position. Make sure the top line is aligned properly
- B. While keeping the aileron deflected apply a length of clear tape along the joint.
- C. Flip the Aileron the other side, and tape in place using a small piece.
- D. Apply some more packing take along the joint from the other side.



Repeat the above steps for the second panel.

☐ ☐ **Step 5: Join the wing panels**

 20 mins

The Speedster PRO wing panels are joined differently, scroll down to see the steps to follow for the PRO version

Working on a flat table, Align the panels together accurately so that both the leading edge and trailing edges match up and the wing lies flat on the table. You may also use the **wing beds** in this step.

If needed lightly sand the Roots so that the left and right sides mate perfectly.

Mix up some 5 Minute epoxy and apply to both sides and glue the left and right panels together. Use packing tape to reinforce the entire center joint. Double check to make sure the wing panels are straight and lie on the flat table.



Once the glue is cured, we shall install the spar. The spar is installed on the bottom side of the wing. The supplied T-Spar section is 44Cm. Mark the center point.


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Do the following steps very accurately.

- Mark a point on the center joint **18 cm** from the leading edge. **This has to be on the wing center joint.**
- Draw a straight line from here that extends 22cm into each panel. Make sure the line is straight by measuring the ends of the line against the wing's leading edge.
- Use a knife to cut the Spar slot .
- Enlarge the cut slightly, by sliding the T-Spar across the length of the cut
- Test fit the T-Spar. Be gently, but firm.
- Once satisfied, mix up some epoxy and glue in place

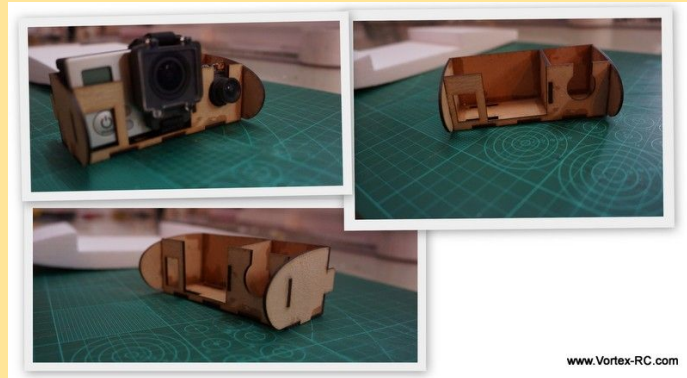


Step 5: Join the wing panels for Speedster PRO

 20 mins

Prepare the Center Bay and Gopro mount.

If you plan to mount the GoPro and FPV Camera mount, build the camera mount by seeing the picture below. Align all notches carefully. Everything has been designed and cut accurately so should fit in without any modification



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On the center bay, cut of the leading edge 3.5cm from the forward edge.Keep the cutout as this will be required later.



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Join the Center bay to the panels

Keeping the wing panel over the beds, join one panel to the bay and once cured glue the other side to the bay. Apply some tape to hold this in place till the epoxy cures. Be sure to make sure the wings lay flat on the beds and that the center bay fits properly.

Install the T-Spar

The Spar supplied is ~54cm in length. Mark the center mount and measure 18 cm accurately from the leading edge of the panel (not from the cut out center bay.)

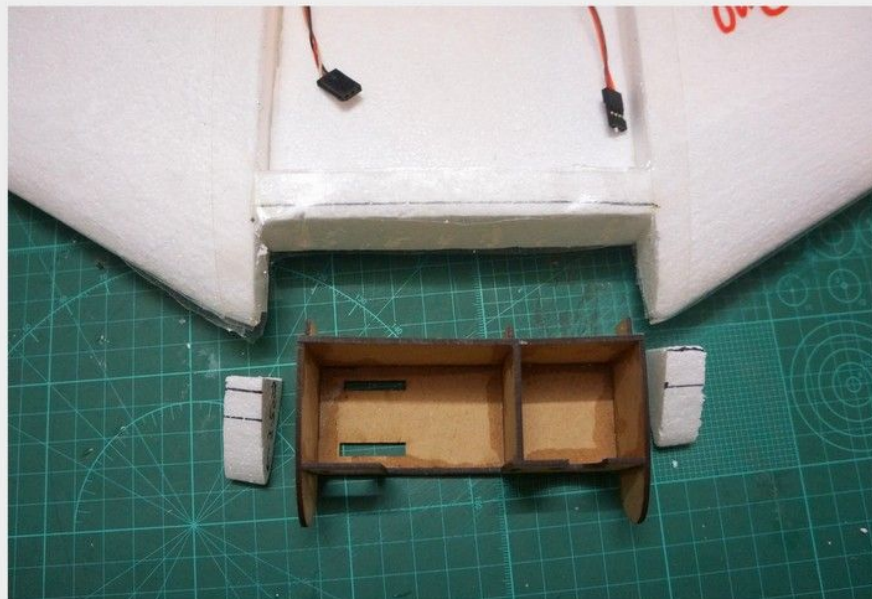
Draw a line 54cm in length making sure the line is absolutely straight. Double check everything. and then cut out the line drawn. Gently increase the size of the slot and fit the T-Spar in place. Be sure to keep the wing panels on the beds to avoid warping. When satisfied, mix up some epoxy and glue the spar in place . Add some packing tape over the entire spar for added strength and protection.



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Prepare and Install the GoPro Camera Mount

Carefully install the assembled Gopro/Camera mount. Use the cut out remaining from the previous step to create a fillet on both sides of the mount.



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Step 6: Assemble and install the motor mount

 15 mins

Use CA glue to assemble the motor mount. Ensure all notches fit as shown

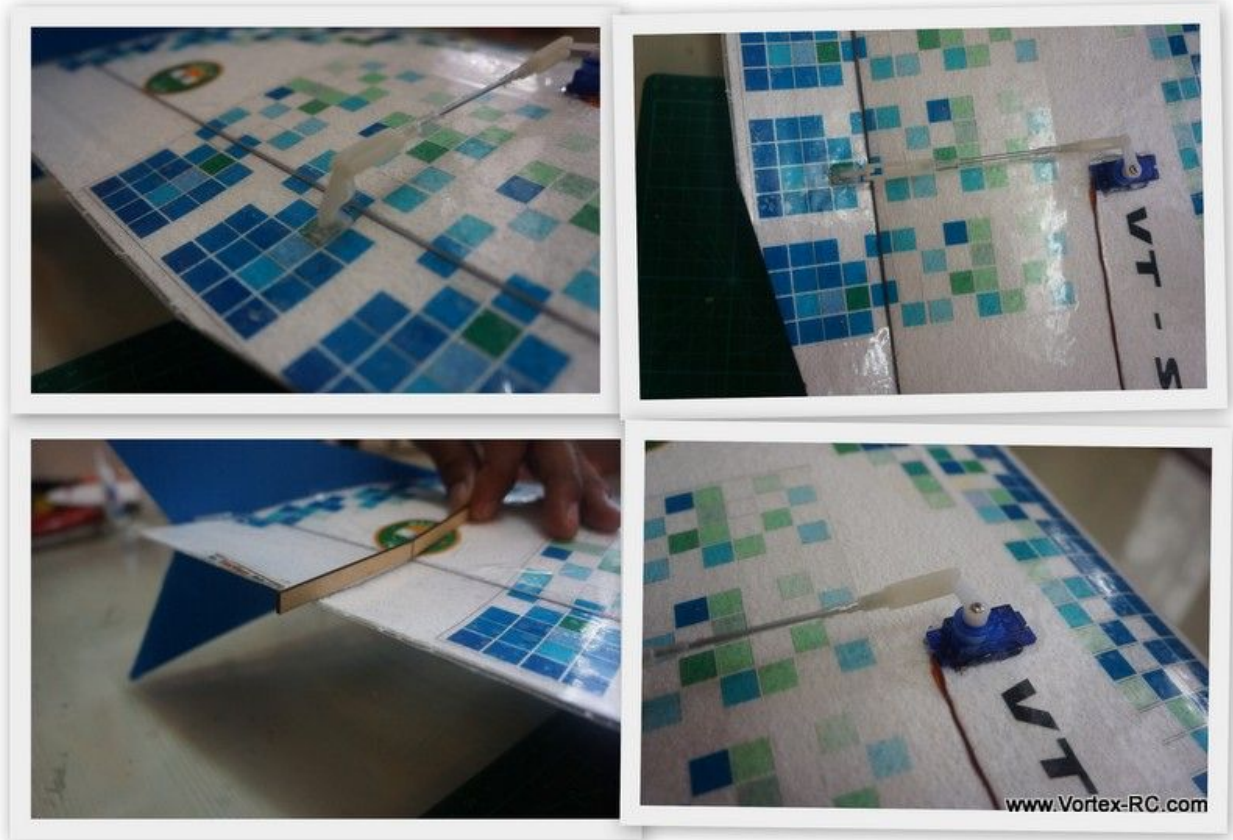


Use Epoxy to install the motor mount to the center of the Wing panel. Ensure the motor mount is straight and is centered. For Speedster PRO you will need to draw a centerline to ensure the mount is glued in straight, Also cut out the lamination before glueing so that the Epoxy adheres to the foma, and not to the tape.

Step 7: Install servos and control linkages

 25 mins

Install the servos as shown below. The servos can be installed anywhere between 30-40 cm from the panel root end. Just ensure both wing panels have the servos installed symmetrically and that they are mounted in the same direction (Servo spline towards the leading or trailing edge). Glue the control horns and attach the clevis to the pushrods. Use the supplied gauge to ensure the elevons are in a slightly up-deflected position. See pictured below:

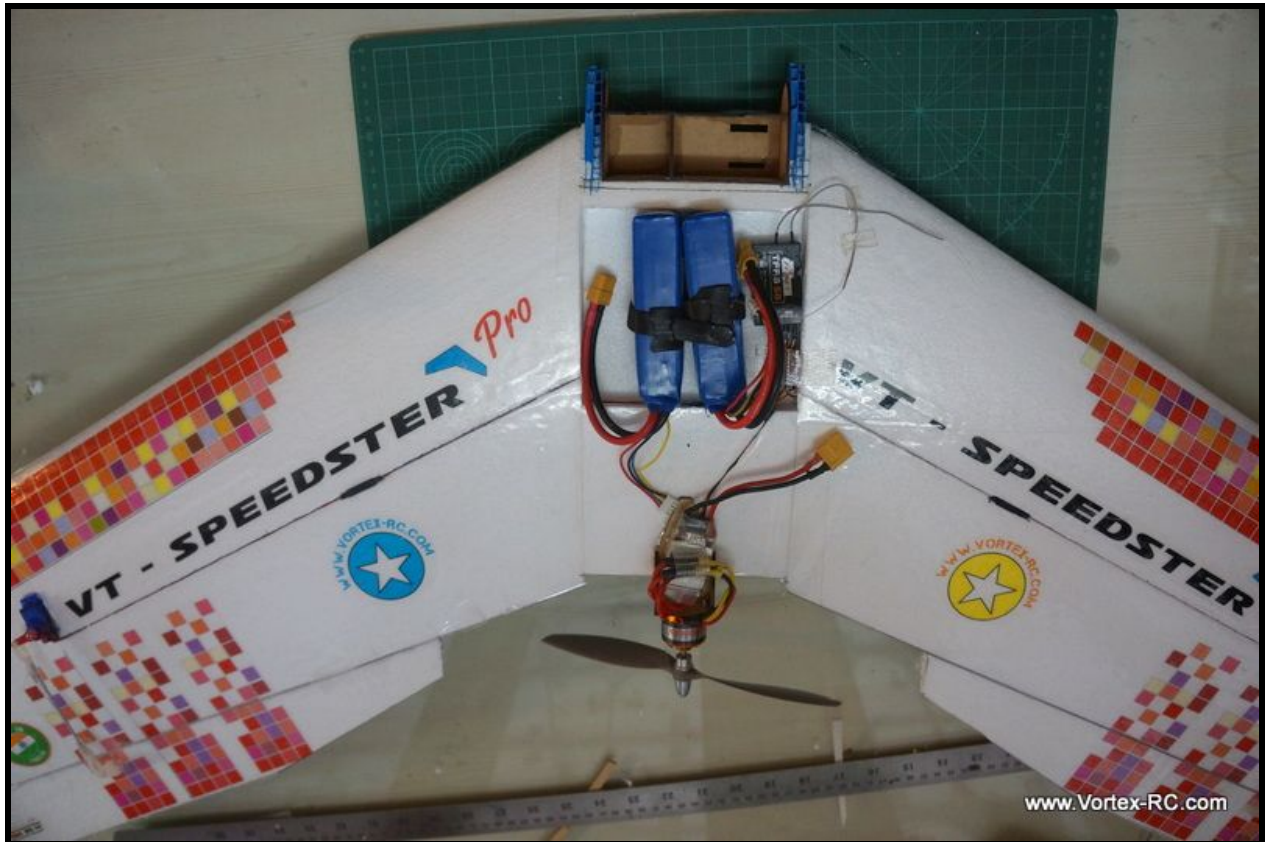


Repeat the above for the other panel


Step 8: Install motor, Rx ESC , and battery strap

 15 mins

Measure and cut bays for the ESC and Receiver. The battery bay should be reinforced with some fiberglass tape, and a battery strap threaded through to the other side.



Step 9: Install winglet and skids

 **15 mins**

Install the winglets to either side of the wing. Align as shown in pictures below. Use Hot glue to secure in place. Install the skids to either side of the leading edge. Again use Hot glue to secure in place. The skids and winglets can be made stronger by putting some hot glue on the underside. For further longevity, apply a bead of hot glue to the entire length of the skid area that will touch the ground and glue a long ziptie along the length with its locking part cut off.



Step 10. Measurement checks.

 **30 mins**

As noted earlier Flying wings are super sensitive to CoG . Accurately measure 180 mm from the leading edge (should be the spar). With the battery installed hold the wing with two fingers to see if the wing balances. Using standard recommended gear, the CG should be close if not, then try to reposition the battery to achieve the correct CG or else use small weights to balance. You **MUST** have the CG correctly before attempting to fly.

Any CG location outside 175-180mm from the panel leading edge will render this model unflyable.

Set up the radio mixing so that when:

UP elevator is given - Both Elevons move up **~2.5cm Up**

Down elevator is given - Both Elevons move down **~2.5cm Down**

Left Aileron is given: Left Elevon goes up and right goes down

Right aileron is given: Right elevon goes up and the left one goes down.

Also double check that when the control are neutral, both elevons are slightly up and match up to the angle set by the gauge. So that the elevons move around 5 degrees UP. (**1cm UP**)

Note: Deflections are to be measured at the extreme tip at the trailing edge, here maximum deflection occurs.

Step 11. Go out and enjoy !!

But responsibly. Find out a large open field, free from trees, buildings, obstructions and people. Ensure you comply with local regulation laws.

Before flying your model, it is recommended you have an experienced flier from your region test fly the model and trim it out for you . In case you have no such help, do not despair.

We suggest you go and do some computer simulation practice (Realflight G4.5 , Phoenix RC etc) afterwards this airplane should be easy enough for you to fly.

Follow all of the Preflight checks mentioned below. Double check the control surfaces. They should all be neutral and check again for control reversing. Check for wind direction. The airplane is always launched and landed against the wind. So move to a location in your field from where you have a clear area ahead against the wind to launch.

To launch the plane, watch our videos first. You should hold it on your right hand, near the leading edge just near the skids. Give it a gentle toss under half power at about 20degree angle and it should fly out. The model should go straight out on a climb. If it turns, give gentle stick commands. Reduce throttle as need to reduce the climb rate. Always keep the model within sight and within the confines of your flying field and within visual range.



Appendix A : Field packing checklist

- o Airplane
- o Full charged batteries
- o Radio
- o Neckstrap
- o Battery Tester
- o Toolbox containing : Screwdriver, Allen set, Pliers, scissors, knife
- o Tapes: Clear tape, Fiber Tape, Double sided, paper tape
- o Adhesives: CA and 5 minute epoxy
- o Extra props and prop saver rubber bands
- o First Aid kit (Believe me, this is important !)

Appendix B Preflight checklist

- o All servos are secure, and linkages to servo and control surfaces are secure.
- o Servo and control horns are secure and not loose.
- o Servo linkages are able to move freely and are not binding on anything.
- o All servo connections to the receiver, battery pack and ESC are secure and correct.
- o The receiver and motor battery pack are securely fixed and cannot move during flight.
- o Receiver antenna (aerial) is correctly positioned and not damaged.
- o The propeller and its prop adaptor is securely mounted
- o The wing, tailplane and the vertical fin are secured properly, as per the instructions
- o All control surfaces move in the correct sense i.e. moving the rudder stick left moves the rudder to the left.
- o All control surface hinges are secure i.e. you can't pull the control surface away from its respective flying surface.
- o The motor power works correctly, and stops when you want it to.
- o Check Motor vibration
- o Check CG
- o Do a Range Check
- o Check battery voltage
- o Check for wind direction and conditions. Always launch/land against the wind.

Appendix 3 Trimming guide.

1. 1) Trim in calm conditions.
2. 2) Make multiple tests before making adjustments.
3. 3) If changes are made, go over previous steps and verify or readjust as necessary.

To Test For	Test Procedure	Observations	Adjustment
1. Control neutrals	Fly model straight and level	Adjust the transmitter trims for hands off straight and level flight	Adjust clevises to center transmitter trims
2. Control throws	Fly model and apply full deflection of each control in turn	Check the response of each control	*Aileron Hi-rate: 3 rolls in 4 seconds. *Lo-rate: 3 rolls in 6 seconds. *Elevator Hi-rate: to give smooth square corner. *Lo-rate: to give a loop of approx. 130' dia.. *Rudder Hi-rate: approx. 30-35 degrees for stall turns. *Lo-rate to maintain knife edge flight.
3. Decalage	Power off vertical dive. Release controls when model is vertical (elevator must be neutral).	A. Does the model continue straight down? B. Does the model start to pull out (nose up) ? C. Does the model start to tuck in (nose down)?	A. No adjustment B. Reduce incidence C. Increase incidence
4. Center of gravity	Method 1: Roll model into near vertically banked turn. Method 2: Roll model inverted.	A. Nose drops B. Tail drops C. Lots of down elevator required to maintain level flight D. No down elevator required to maintain level flight, or model climbs	A. Add weight to tail B. Add weight to nose C. Add weight to tail D. Add weight to nose
5. Tip Weight (course adjustment)	Fly model straight and level upright. Check that aileron trim maintains wings level. Roll model inverted, wings level. Release aileron stick	A. Model does not drop a wing B. Left wing drops C. Right wing drops	A. No adjustment required B. Add weight to right tip C. Add weight to left tip
6. Side Thrust	Fly model away from you into any wind. Pull it into a vertical climb (watch for deviations as it slows down).	A. Model continues straight up B. Model veers left C. Model veers right	A. No adjustment needed B. Add right thrust

			C. Reduce right thrust (move thrust line left)
7. Up/Down Thrust	Fly model on a normal path into any wind. Parallel to strip, at a distance of around 100m from you (elevator trim should be neutral as per test No.3). Pull into a vertical climb & neutralize elevator.	A. Model continues straight up B. Model pitches up (goes towards top of model) C. Model pitches down (goes towards bottom of model)	A. No adjustment needed B. Add down thrust C. Reduce down thrust
8. Tip Weight (fine adjustment)	Method 1: Fly model as per test No.6 and pull it into a reasonably small dia. inside loop (1 loop only). Method 2: Fly the model as per test No.6 and push it down into an outside loop (1 loop only & fairly tight).	A. Model comes out with wings level B. Model comes out right wing low C. Model comes out left wing low	A. No adjustment needed B. Add weight to left tip C. Add weight to right tip
9.(a) Aileron Differential Method 1:	Fly the model towards you, before it reaches you, pull it up into a vertical climb. Neutralize controls, then half roll the model	A. No heading changes B. Heading change opposite to direction of roll commands (ie. heading veers to models & your left after right roll). C. Heading changes in direction of roll command	A. Differential OK B. Increase differential C. Reduce differential
9.(b) Aileron Differential Method 2:	Fly the model on a normal pass and do 3 or more rolls	A. Roll axis on model center line B. Roll axis off to same side as roll command (ie. right roll, roll axis off right wing tip) C. Roll axis off to opposite side of model as roll command	A. Differential OK B. Increase differential C. Reduce differential