

# Switchback Sport Builder's Manual



Thank you for purchasing the Switchback Sport. The Switchback Sport has been designed for the novice to intermediate pilot who wants a plane with good performance that will fly in a limited space. The Switchback Sport can also accept the Switchback 3D wing, turning it into a highly aerobatic airplane.

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## Required Equipment

- ❑ Xacto with #11 blades
- ❑ Thin and Thick CA – Cyanoacrylate glue (Super Glue)
- ❑ 5 minute epoxy
- ❑ Sanding block with 200 grit sandpaper
- ❑ Smooth, flat work table
- ❑ Wax paper to protect plans while gluing
- ❑ Needle nose pliers
- ❑ Wire cutters
- ❑ Hobby Iron for applying covering – also called a sealing iron
- ❑ Four channel radio
- ❑ Three micro servos: Hitec HS55s or GWS Picos recommended
- ❑ GWS EPS 100 A motor with 10x8 propeller. For higher performance, the EPS 300 C or EPS 370 C can be used with a 10x8 propeller.
- ❑ Electronic Speed Control (ESC) capable of handling at least 5 amps (10-15 amps for the EPS300).
- ❑ Battery pack: 8 cell 300 or 720mAH Nickel Metal Hydride recommended for the EPS 100 motor. 8 cell 720mAH NiMH or 600AE Nicad for EPS 300.

## Parts List

- 2 ea – 3/32” laser cut balsa sheet
- 2 ea – 1/32” laser cut balsa sheet
- 2 ea – 1/16” laser cut balsa sheet
- 1 ea – 1/8” laser cut balsa sheet
- 1 ea – 1/16” laser cut plywood sheet
- 1 ea – 1/32” laser cut plywood sheet
- 1 ea – 1/64” plywood center wing cover sheet
- 1 ea – 1/8"round x 19” hard wood leading edge
- 1 ea – 1/8"round x 17” hard wood leading edge
- 1 ea – 3/32” x 13.5” landing gear wire
- 4 ea – 1/32” x 18” thin music wire for tailskid and pushrods
- 1 ea – Plastic Canopy
- 1 ea - Covering

### Bagged Parts:

- 1 ea – 6” x 3/32” Heat shrink tubing for pushrods
- 1 ea – 1/2” x 1/8” Heat shrink tubing for wheel retainers
- 1 ea – 6” Velcro strip for mounting the battery and receiver
- 1 ea – 2 Tires
- 1 ea – Motor Mount 1/16” ply sheet
- 3 ea – 1/8"round x 2.75” hard wood dowel
- 1 ea – Canopy magnet and tack
- 1 ea - Tyvek for Canopy Hinges and tail wheel reinforcement.
- 1 ea – Tail Wheel Rubber
- 1 ea – 4-40 screw and blind nut for landing gear

## Specifications

Wingspan: 35”

Wing Area: 300 sq. in.

Weight: 8 ounces without battery

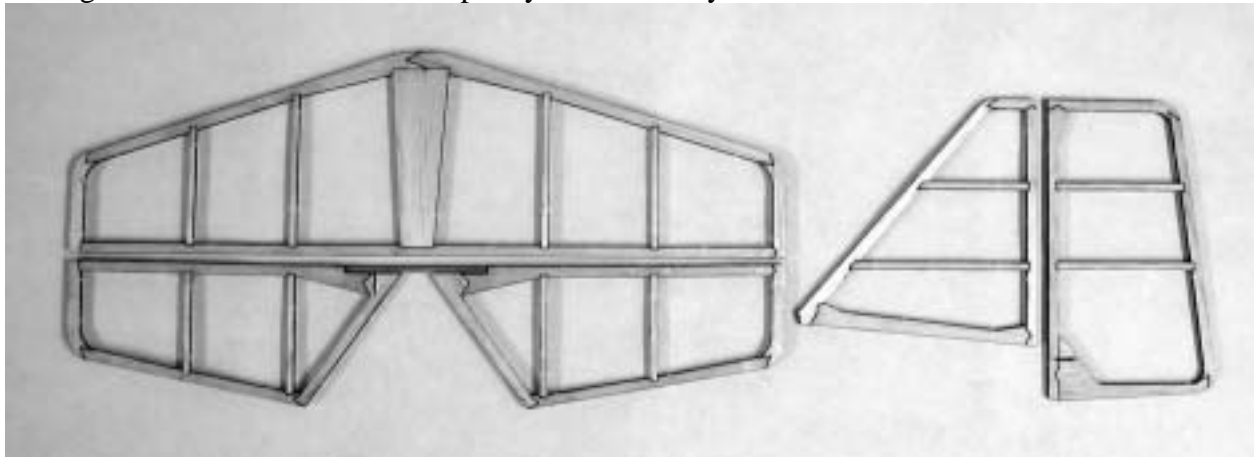
Wing Loading: 5-6 oz/sq. ft. depending on battery

# Switchback Assembly

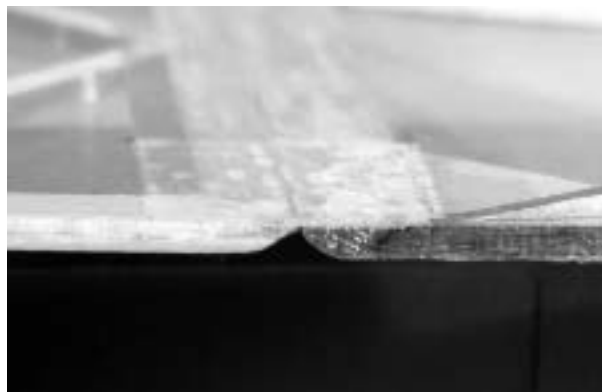
## ***Stabilizers, Rudder, Elevator, and Aileron Assembly***

The tail assemblies and ailerons are made up from the 3/32" and 1/8" laser cut sheet. Lay the plans out on a flat worktable and tape them down, and then lay a sheet of wax paper over the plans. This will protect the plans from the glue. The pieces of balsa are positioned over the plans and glued together. Each joint can be glued by holding the two pieces in place and applying a drop of thin CA to the joint. In the past, you may have used pins to hold parts down, but I find this process to be faster and you don't have to worry about the pin damaging the balsa. You do have to worry about keeping your fingers far enough away from the joints or your fingers will become part of the model. Build one part at a time, removing only that part from the balsa sheet so that you don't mix the parts up.

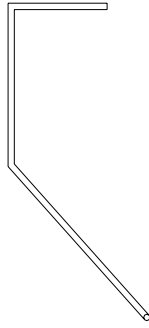
Note that the torque rod attaching the two elevator halves is one of the 1/8" x 2.75" hardwood dowels. It should be glued with thick CA. Give it plenty of time to dry.



Once the parts are dry, carefully remove them from the wax paper then sand them. Round all the edges EXCEPT the bottom of the vertical stabilizer where it will be glued to the fuselage. Also, the rear of the stabilizers, the front of the elevator, the front of the rudder, and the front of the ailerons need to have a 40 degree bevel sanded in to them. How you sand the bevel in the ailerons determines whether the aileron will be for the right or left side. Make sure you make one left and one right.



- ❑ Shape the tail wheel wire as shown in the picture. The first bend will create the axle. The second bend will go over the edge of the wheel, with the third bend running parallel with the wire between the first and second bends.

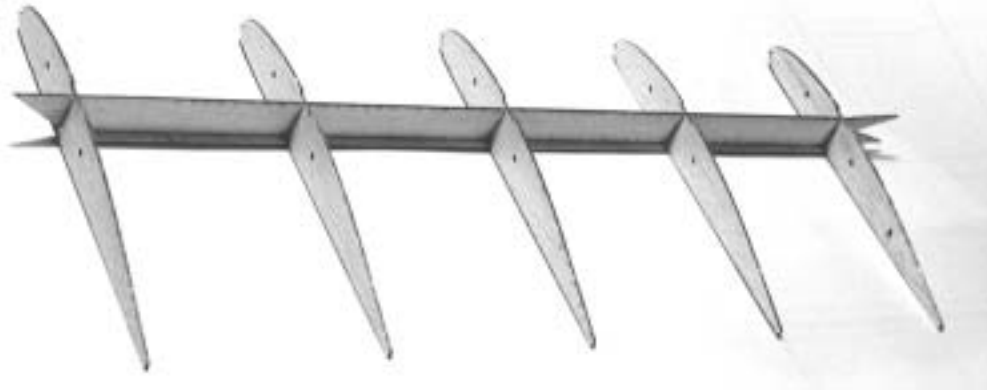


- ❑ Measure 5/8" from the bottom edge of the rudder and drill a 1/32" hole in the center of the leading edge. Gently push the tail wheel wire into the hole. Glue a piece of Tyvek material around the tail wheel wire where it enters the leading edge of the rudder.

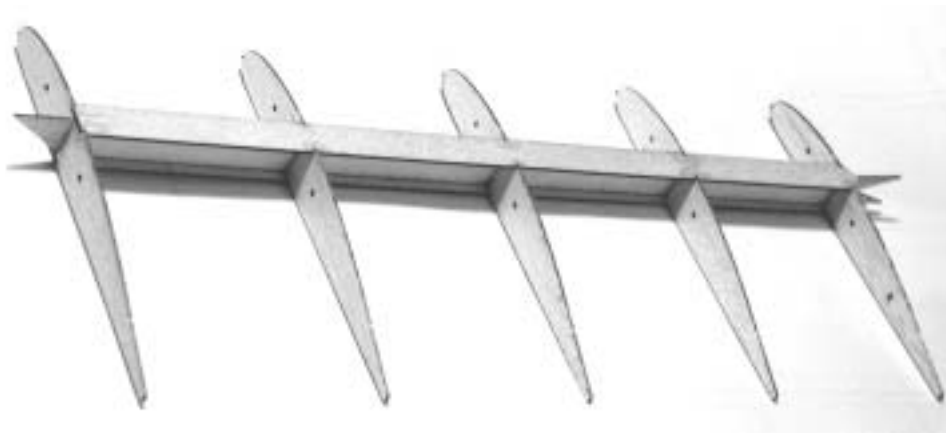


## **Wing Assembly**

- ❑ Tape a sheet of wax paper over the plans to protect the plans and to prevent glue from sticking to them.
- ❑ Remove the two vertical spars from the 1/16" balsa sheet. You will note that they fit together with a V joint to form the center wing. **Be very careful to make a left and a right wing.** It doesn't matter which vertical spar forms the left or right side.
- ❑ Slide the ribs into the vertical spars. The 3/32" rib goes in the innermost position. Do not glue yet.
- ❑ Position the lower spar caps (the narrower ones) so that they line up with the notches in the ribs. Ensure that the end of the bottom spar with the arrow shape is towards the center of the wing, that everything is tight, that the ribs fit fully into the lower spar and that the vertical spar is touching the lower spar. Once everything is aligned, flow some thin CA into all the joints.



- ❑ Position the top spar caps over the ribs. Position as before and glue with thin CA.



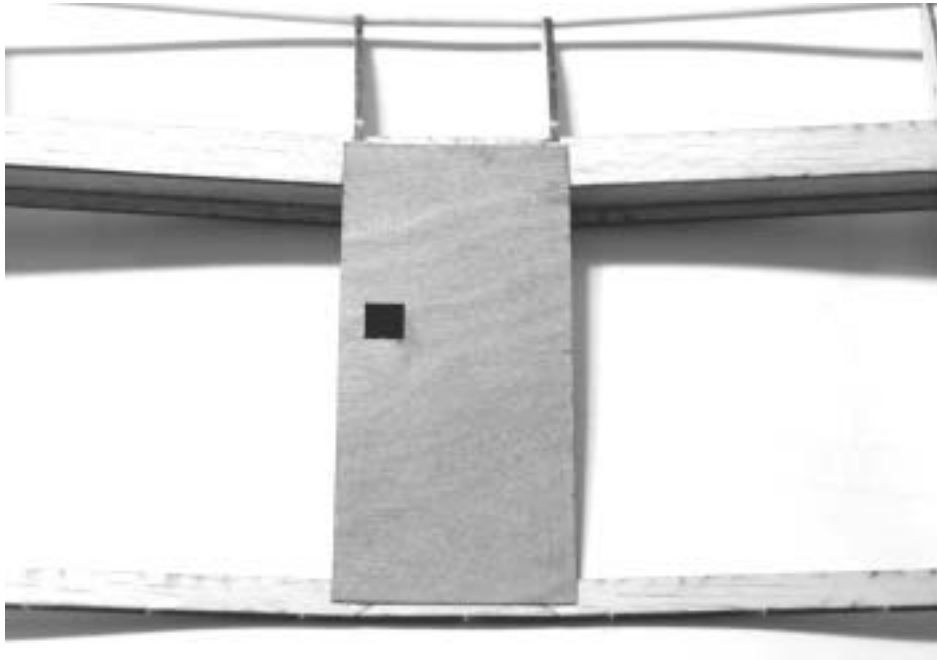
- ❑ Position the 1/8" trailing edge so that it is flush with the bottom of the ribs and that it is pushed as far forward as possible. The end that is shaped like an arrow goes towards the center of the wing. Glue with thin CA.
- ❑ Measure and cut the 1/8" hardwood leading edge dowel so that it is flush with the outer edge of the outermost rib and only goes halfway through the innermost rib. We only go halfway through the innermost rib to leave room for the short center leading edge dowel. Glue in place with thin CA.



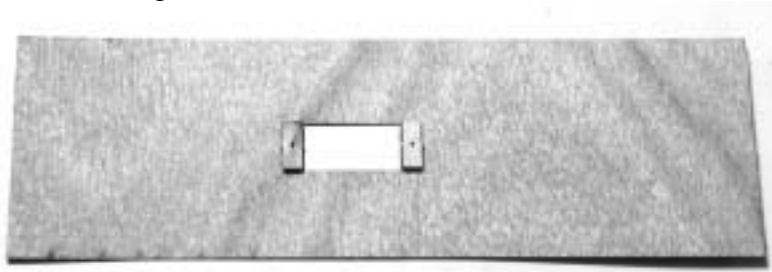
- ❑ Glue the wingtips as shown in the photos. It is easiest to glue from the spar to the trailing edge then, once the glue has set, raise the leading edge of the wingtip towards the leading edge dowel and glue in place.



- ❑ We will now glue the two wing halves together. Start by placing the 3/32"x 1.9" x .6" rectangle with the tab on either end in the slots in the center ribs. Now join the two vertical spars together and glue with thin CA.
- ❑ Glue the top and bottom center spar in place. Make sure you have a good joint and that the top and bottom spars are well glued to the vertical spars.
- ❑ Glue the center trailing in place.
- ❑ Cut and glue the center 1/8" hardwood dowel leading edge.
- ❑ Glue the smaller 1/64" plywood sheet to the top of the center wing such that it is 1/16" behind the front of the top spar. The hole should be closer to the front. **Take special care to ensure that the plywood is well bonded to the top spar, especially at the edges of the plywood where it is outside the center ribs.**



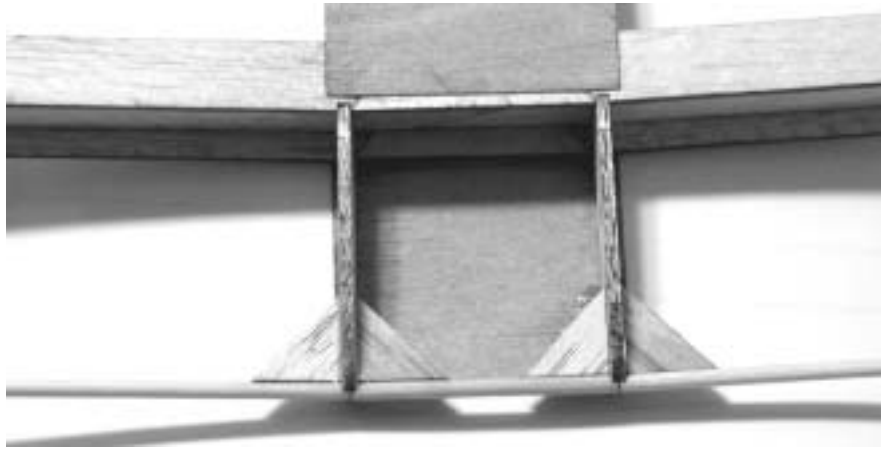
- ❑ Glue the two 1/16" plywood servo reinforcements to the 1/64" plywood sheet as shown. Take care to not fill the holes with glue.



- ❑ Glue this 1/64" plywood sheet to the bottom of the center wing such that it is flush with the back of the trailing edge and centered. The opening should be towards the front. **Take special care to ensure that the plywood is well bonded to the bottom spar, especially at the edges of the plywood where it is outside the center ribs.**



- ❑ Glue four 3/32" balsa braces to the leading edge dowel and the center ribs as shown.



- ❑ Glue two 3/32" balsa braces to each of the outer ribs as shown.



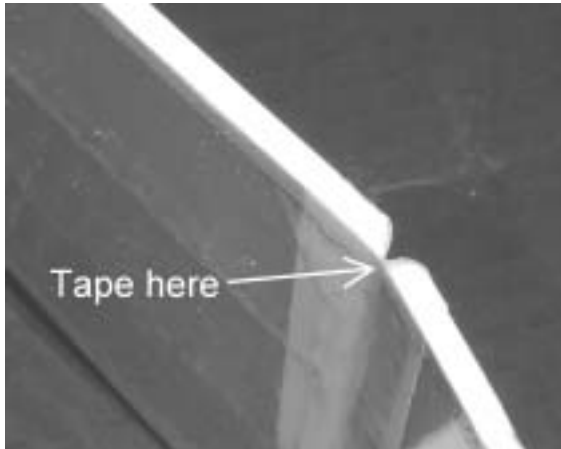
- ❑ Verify that the top and bottom spars are glued to the vertical spar completely and that there are no gaps in the glue joints.
- ❑ Lightly sand the wing to remove any bumps and glue

### ***Covering the Wing and Tail***

The Switchback kit comes with a clear, paintable covering called Doculam which is actually a laminating film. The frosted side has a heat activated adhesive. Unlike most coverings, Doculam does not have a backing sheet. Compared to SoLite (Solarfilm Lite – another excellent choice for the Switchback), Doculam is stronger, heavier, and needs a higher temperature to adhere and to shrink. It should also be painted which will add weight. We will cover one half of the wing at a time.

- ❑ Lay the wing on the table and cut a piece of covering so that it starts at the inner rib of the opposite wing and overlaps the wingtip and the leading and trailing edges by ~2". The first piece will cover the center wing.
- ❑ Tack one corner of the trailing edge then the other corner of the trailing edge with a covering iron, ensuring that the covering is tight.
- ❑ Pull the covering tight and straight then tack the two corners of the leading edge.
- ❑ Tack down the entire leading and trailing edge. Wrap the covering around the back of the trailing edge and tack it down across the back of the trailing edge.
- ❑ Pull the covering tight across the high point of the wingtip and tack.
- ❑ Here's the fun part: work the covering around the curve of the wingtip so that the wrinkles are evenly distributed. This will make shrinking the wrinkles out easier.
- ❑ Tack down the covering to the inner rib.
- ❑ Trim the covering so that there is a 1/8"- 1/4" overlap around the inner rib. Tack down the overlap to prevent the covering from pulling away when you shrink it.
- ❑ Cover the other side. This side does not need to cover the center wing but should overlap the other sides covering by at least 1/4" to ensure a good bond.

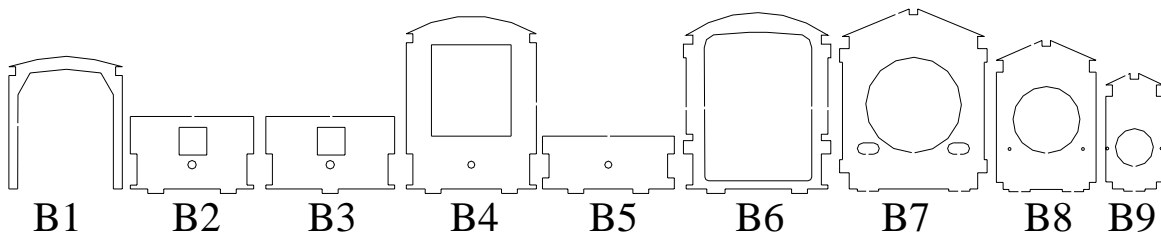
- ❑ Once both sides of the wing are covered, shrink the covering with a covering iron or heat gun. If you are using the supplied clear covering, you will need a fair amount of heat to shrink the covering but too much heat will result in a hole.
- ❑ Tack the covering down around the servo hole then cut the hole out with a sharp Xacto.
- ❑ You can paint the supplied Doculam covering with Testors Pactra Racing Finish car body paint, which has been specifically designed for lexan car bodies. Krylon spray paint will also work.
- ❑ Cover the tail surfaces and ailerons in the same manner you did with the wings.
- ❑ Apply the hinges to the control surfaces. I have had excellent results using packing tape sliced down to 3/4" as a hinge. Ensure the control surfaces move freely. Don't hinge the rudder to the vertical stab yet. We will do that when we install the tail wheel.



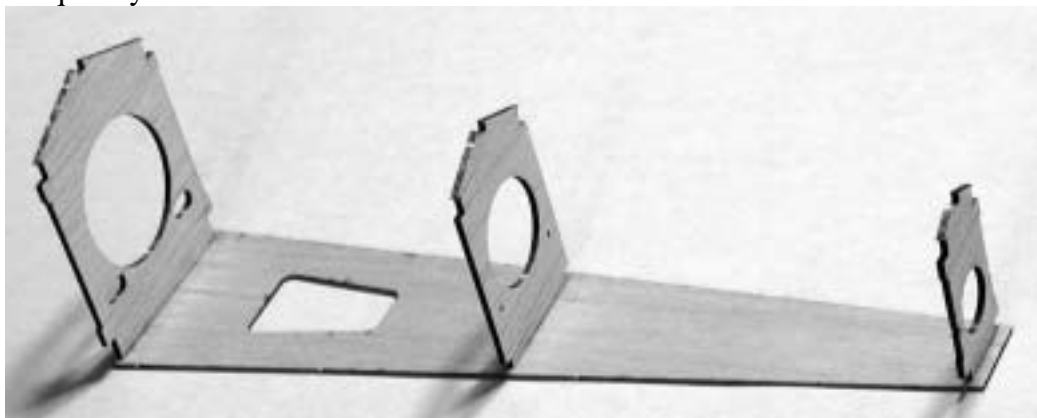
View of the top of the rudder

- ❑ Cut covering from the slots for the control horns and glue the control horn in place with thin CA. The rudder horn will be placed on the opposite side as the elevator horn.

### ***Fuselage Assembly***

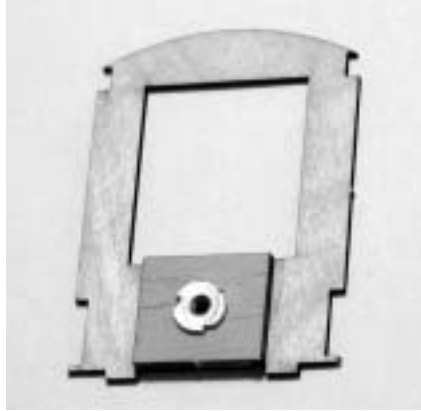


- ❑ Position the bulkheads B7, B8, and B9 in the 1/32" rear bottom fuselage. Ensure they are seated fully and squarely. Glue with thin CA.





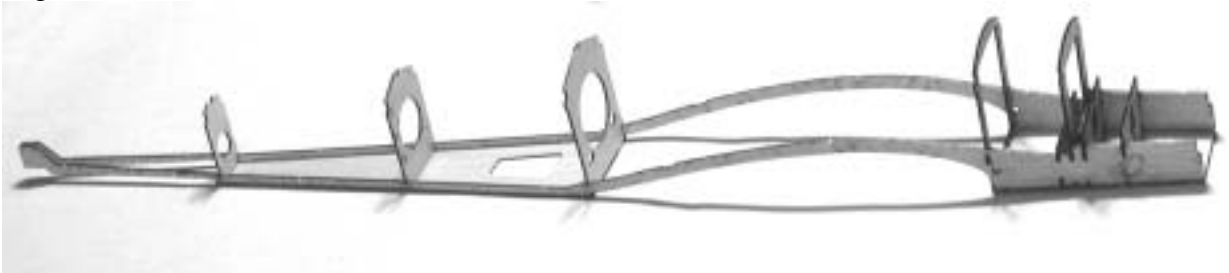
- ❑ Glue the 3/32" balsa blind nut support to B4 so that the holes are centered. Press the blind nut into place.



- ❑ Position bulkheads B2-B6 in the 1/16" front bottom fuselage. **The blind nut and support are on the front of B4 facing forward. You will insert the landing gear bolt from the wing opening.** Glue with thin CA.



- ❑ Position the two bottom side stringers. Glue in place. Carefully align the very backs and glue together with thin CA.

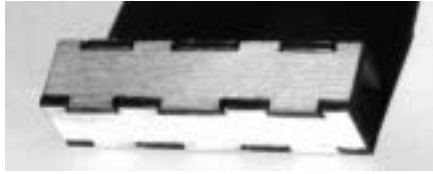


- ❑ Position and glue the top two stringers. Glue the servo mount supports between the top and bottom stringers.



- ❑ Position and glue B1.

- ❑ Glue the motor mount parts together ensuring they are square and tight. Position the motor mount into B2 and B3 so that it is flush with the back of B3. Glue with thick CA.



- ❑ Position the 1/32" balsa fuselage sides. They will line up with the bulkhead tabs and with the bottom of the last part of the rear stringers. The sides will extend slightly above the upper stringers. Glue with thin CA. **NOTE: Do not glue the left side to the top stringer between B6 and B7. You will later glue canopy hinges there.**



- ❑ Position the servo mount in the fuselage and glue with thick CA.



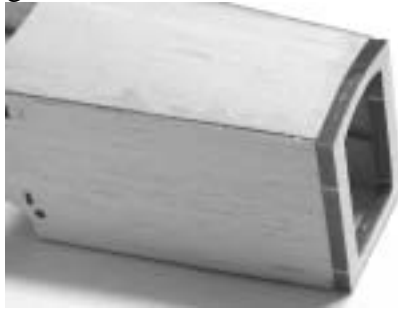
- ❑ Cut two 1/32" music wire pushrods to 15" and bend a Z bend in one end of each. Slide the pushrods through the rear bulkheads B7-B9. B7 has two 3/32" holes for the pushrods. B8 and B9 have 1/32" holes for the pushrods. Bring the pushrods out the fuselage sides through the provided slots.
- ❑ Position the 1/8" square balsa stringer on the top of bulkheads B7-B9. Glue with thin CA.
- ❑ Glue the two 1/32" balsa rear fuselage tops in place. They should be lined up with the front of the 1/8" square.



- ❑ Glue the 1/32" balsa front fuselage in place.



- ❑ Glue the two 3/32" cowl together. Sand the front of the fuselage so that the cowl pieces fit flush then glue the cowl to the fuselage.



- ❑ Sand down the cowl to give it a nice rounded look.

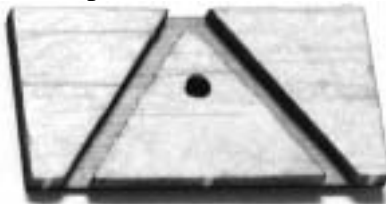


- ❑ Position and glue the two 1/8" wing holddown dowels in holes in the fuselage in front of and behind the wing saddle. If you plan to cover the fuselage instead of paint it, you may want to insert the dowels after you cover.

### ***Landing Gear Assembly***

The landing gear is constructed by sandwiching the 3/32" landing gear wire between 1/32" plywood structures.

- ❑ Lay one 1/32"x 1.6" x .8" plywood rectangle on the worktable.
- ❑ Position the three 3/32" balsa parts on the 1/32" ply as shown. They will be lined up with the edges of the ply. The gap between the parts should be the width of the landing gear wire.



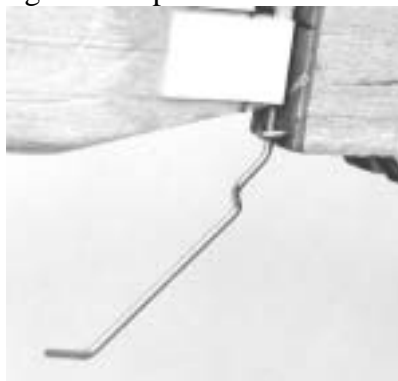
- ❑ Find the middle of the 3/32" landing gear wire and bend such that it fits in the gear mount you just glued. Measure in 3/4" from each end of the gear wire and bend as shown.



- ❑ Glue the other 1/32" ply rectangle over the gear assembly to contain the wire.
- ❑ The gear assembly will slide up into the bottom of the fuselage and is contained with a 4-40 bolt accessed from the wing opening.
- ❑ Slide the wheels on the gear wire. Retain the wheels with a small piece of 1/8" heatshrink that is glued to the wire with thick CA. Roughen the wire first. Be very careful to not glue the wheels.

### ***Fuselage Final Assembly***

- ❑ Sand the fuselage to make it smooth and to round the corners.
- ❑ If you intend to paint the fuselage separate from the tail, now is a good time to do it.
- ❑ Glue the vertical stabilizer in place. The notch in the front of the vertical stabilizer rests on the 1/8" square stringer that was glued to the rear bulkheads.
- ❑ Carefully position the horizontal stabilizer/elevator. Mark where it meets the fuselage. Remove the horizontal stabilizer and remove the covering from where the fuselage will be meeting the stabilizer. Reposition the stabilizer and glue in place.
- ❑ You will now make a small wire loop that will be attached to the fuselage and contain the tail wheel wire so that it forms something of a hinge. Cut a 1" piece of the 1/32" pushrod wire and fold it in half to form a U-shape. Make sure there is a gap large enough for the tail wheel wire to fit in the loop. Drill a 1/32" hole in the base of the back edge of the fuselage. Insert the loop into the hole so that it sticks out 1/16" and the hole in the loop is aligned vertically. Glue with CA. Feed the wire on the rudder through the loop as shown.



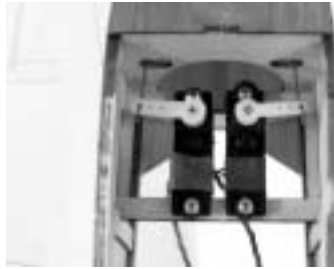
- ❑ Hinge the rudder to the vertical stabilizer with packing tape.
- ❑ Glue the two 1/16" laser cut plywood tail wheel halves together
- ❑ Wrap the strip of foam rubber around the tail wheel and cut the foam rubber 1/16" shorter than the circumference of the tail wheel. Glue the two ends of the foam rubber together with CA. Mount the foam rubber ring around the tail wheel and glue in place with CA.



- Slide the wheel onto the tail wheel wire.
- Slide the 1/16" laser cut plywood hub onto the tail wheel wire and glue in place with CA. Use caution to not glue the tail wheel to the wire.

### ***Elevator and Rudder Servo***

- Install the rudder and elevator servos upside down in the servo tray.
- Install single arm control horns to the servos after first attaching the pushrods through the outer hole of the control horn.

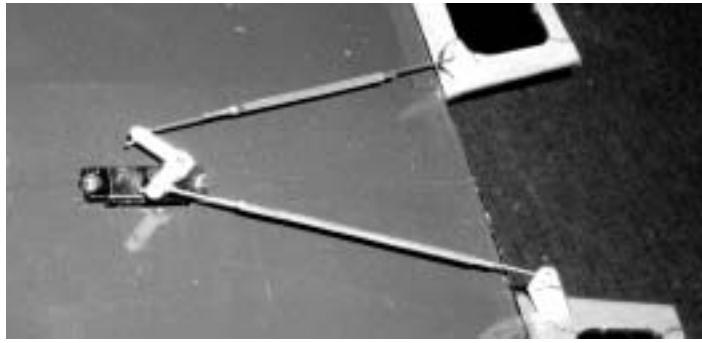


- Cut two pieces of heat shrink tubing  $\frac{3}{4}$ " long.
- Slide a piece of heat shrink over the back of the rudder and elevator pushrod.
- Cut two pieces of 1/32" music wire 2" long. Measure in  $\frac{1}{4}$ " and make a 90 degree bend.
- Take one of the music wires and insert the short end in the rudder control horn.
- Slide the other end of the wire into the heat shrink and heat the heat shrink. You will adjust the position of the L bend wire so that the rudder points straight back. Use a drop of thin CA to prevent the pushrods from slipping in the heat shrink. Note that the long pushrod wire is on the other side of the control horn, which captures the control horn.
- Do the same for the elevator control horn.



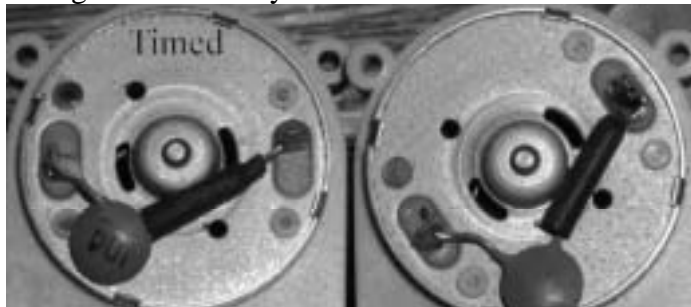
### ***Aileron Servo***

- Install the aileron servo through the bottom of the wing.
- Use a servo control horn with four arms. Cut off two adjacent arms leaving you two arms 90 degrees from each other. Install the control horn so that the arms face forward, 45 degrees from center. This is to give you differential aileron control to counteract adverse yaw.
- Cut four pieces of 1/32" music wire 3.25" long. Bend a Z bend in one end of each wire.
- Install two of the wires in the outer holes of the aileron control horns and the other two wires in the outer holes of the servo control horns.
- Cut two pieces of heat shrink tubing 2" long. With the heat shrink, join the pushrods.
- Adjust the pushrod lengths so that the ailerons are level with the wing. Use a drop of thin CA to prevent the pushrods from slipping in the heat shrink.



## Final Assembly

- ❑ The stock motor is neutrally timed. You can get more power out of it by timing it. I have a pair of bent nose pliers that have the tips ground to more of a point. On the endplate of the motor, there are two holes. I place the pliers in the holes and rotate the plate clockwise as shown in the photo. Note the position of the red dot in reference to the tab that holds the endplate on. (The dark dot in this black and white photo.) You may need to unsolder the capacitors on your motor to be able to rotate the plate far enough. Make sure you solder them back on!



Timed Motor

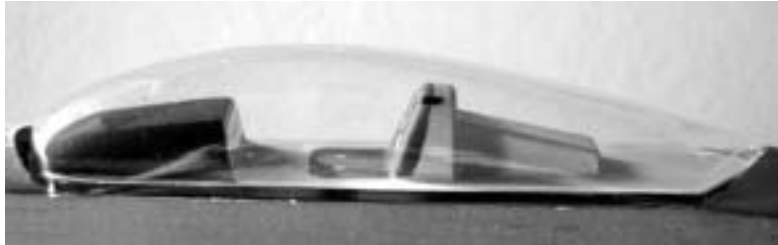
Stock Motor

- ❑ It is a good idea to break your motor in. There are different schools of thought on how to do this but, essentially, you are trying to get the carbon brushes to seat. An easy way to do this is to run the motor for an hour on one cell with no propeller installed.
- ❑ Mount the receiver inside the center part of the wing with Velcro. The Velcro should run from the spar to under the servos.
- ❑ Solder or plug the ESC to the motor and run the ESC and wires through the front fuselage.
- ❑ Carefully press the motor onto the motor mount. The Switchback was designed around the GWS EPS300 motor. If you are using the GWS EPS 370, you will need to cut down the plastic to fit inside the fuselage. The motor comes with 4 tiny screws. I have no idea what they are for but you can use one to fasten the motor to the motor mount. Using the access hole in the bottom of the fuselage drill a small pilot hole through the plastic gearbox and into the motor mount. Screw the tiny screw in. It does not need to be tight.

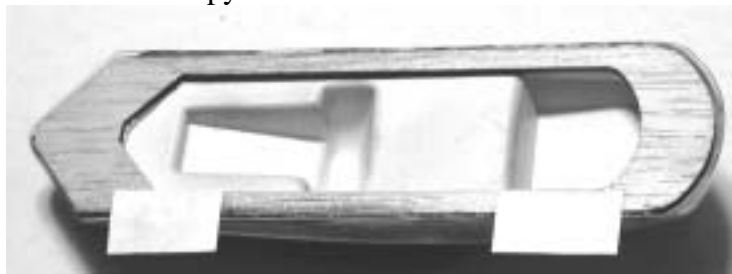


- ❑ Slide the 3/32" balsa canopy base into the canopy insert. Glue it in place with 5-minute epoxy. Do not use CA. It will crack the plastic.

- ❑ Trim the insert to the bottom of the canopy base. It is easy to split the plastic so work slowly and make your first cut at least 1/4" out. Paint the insert if you prefer.
- ❑ Push the base and insert into the clear canopy. You will need to push it in as far as possible to get a good fit with the fuselage. Glue it with 5-minute epoxy. Trim the canopy to the bottom of the base.



- ❑ Cut two 1" long strips of Tyvek to be used as canopy hinges (the white paper-like material in the bagged parts). Glue one canopy hinge 1/4" from the front of the canopy and the other 1/4" from the back. The hinges are glued to the left side of the canopy lengthwise with half of the hinge extending past the side of the canopy. Glue them with thin CA.



- ❑ Slide the hinges between the fuselage side and the fuselage stringer. Glue with thin CA. Also, finish gluing the stringer to the fuselage side.



- ❑ In the parts bag, you'll find a 1/4" x 1/4" x 3/4" balsa stick with a metal tack pressed into it, and a small Neodymium magnet. Remove the tack from the balsa stick and position the stick so that it is centered with the right servo mount support and 5/32" below the top of the upper fuselage stringer. Glue with thin CA.



- ❑ Align the Neodymium magnet with the center of the balsa stick and glue to the bottom side of the canopy assembly.



- ❑ Press the tack partially into the 1/4" stick so that the magnet will be aligned with the tack. Apply a drop of thin CA where the tack meets the stick. Be certain to not get CA between the tack and the magnet. Close the canopy and press it down until it is flush with the fuselage. The tack will now have been pushed into the stick the correct height.



- ❑ Attach the wing to the fuselage. Use 6 rubber bands crossing under the wing to form an X.

## ***Flying***

Attach a battery to the Velcro strip on the wing inside the fuselage. Check that none of the control surfaces are binding and that everything, including the battery, is secure.

Before you fly the Switchback, check that the control surfaces move the correct directions. Always check the directions while you are behind the airplane. I highly recommend that you check the control surfaces before EVERY takeoff.

For your first few flights, set the center of gravity (CG) just behind to 1/4" behind the wing spar. With the battery installed, place a finger on each side of the fuselage just behind the spar and lift the Switchback. It should balance there. If not, adjust the battery forward or backwards till the CG is correct.

Adjust your radio trim so that the elevator, rudder, and the ailerons are level. The throws should be as follows:

	Low Rates	High Rates
Ailerons	3/8"	5/8"
Elevator	5/8"	3/4"
Rudder	1 1/4"	1 3/4"

25% exp on Ailerons, 15% on elevator

For your first flight, be patient and wait for a calm day. Choose a large field where you have a smooth surface to use as a runway. Set the plane down pointing away from you. I would say to point it into the wind but it's a calm day, right? If everything goes well, applying full power will result in a short rollout and a rapid climb. Initiate turns slowly till you get used to the way the Switchback flies. Remember that this is a responsive airplane so feed control inputs carefully.

After you become comfortable with the plane, you may want to increase the control throws by moving the pushrods to the center holes of the control surfaces. This will make a big difference so be ready. If your transmitter has it, I recommend adding some expo to your aileron and elevator throws. You can also move the CG back for more radical maneuvers but move it back in small steps.