Build notes and electric conversion for the Seagull Extra 300S 1.6m span

(with techniques useful for similar models)

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This 1.6 m span balsa, ply and film model is designed for an IC engine. However such models are usually easy to convert to electric power so I decided to give it a try.

Motor

The suggested 10 cm^3 to 12 cm^3 (0.61 in^3 to 0.75 in^3) 2-stroke engine would produce about 2 HP. This is 1500 W in electric units, calling for a motor of about 5065 size. I opted for the 4Max one with a kV speed of 360 turning an 18 x10 two-blade or 16 x 10 scale three-blade. On a 6S battery of about 24 V and the maximum current of 58 A this gives up to 1450 W. Including the hub, the motor weighs 500 g compared with about 800 g for an engine. This compensates somewhat for the weight of the battery – 674 g - over a full fuel tank.

Servos

The control surfaces are not large and there are two servos for the elevators. A neat gauge was suggested in July 2020's RCM&E for making sure the rise and fall is the same for each half. I opted for Corona DS-538MG servos which give 7 kg cm pull. They have metal gears and are coreless so will be fast. I put each servo on a separate channel so they will not overload the receiver. The servo holes in the wing and fuselage mountings needed a small amount of enlarging, about 1mm on length and breadth.

Batteries

To get adequate ('too much') power out of the motor I decided to go for a 6S battery. I chose Zippy compact 4.5 Ah batteries which, with the lower current, should give about ten minutes of flight time if not constantly flat out. There is of course a separate eneloop 4.8 V receiver battery.

Fuselage

This was the only part that needed modification. The original canopy was held on by tabs at the front and two screws at the rear. For IC this only needs to be removed once each session to put the receiver battery in. For electric flying it must be removed for each flight. I cut the canopy into two pieces. The rear remains in place and the front is easily removable. After cutting I put a 4 mm balsa filler in the ends of the two pieces. I put on two coats of Eze-Kote then painted to match the film, mixed from light and dark blue acrylics.

Whole canopy area


Canopy rear part after being cut

The canopy parts are now held in place by screws, location pads, slots and magnets.

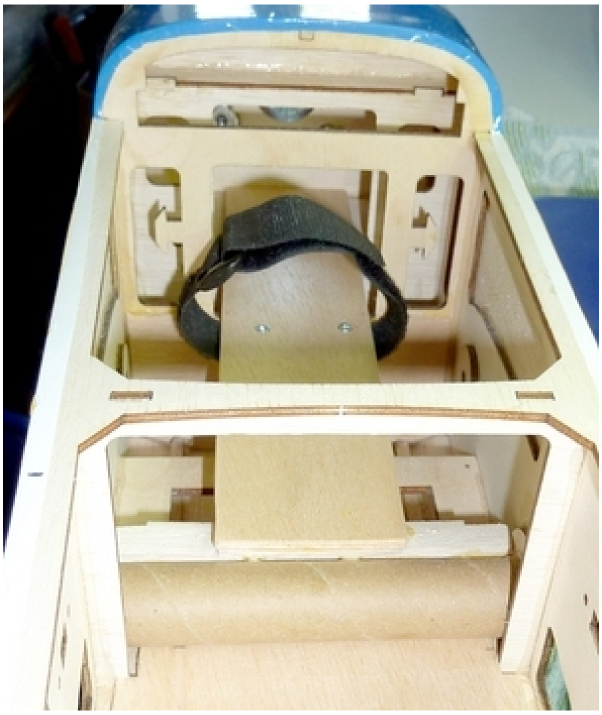

Canopy front part after cutting


Both parts in place

I decided to secure the rear part of the canopy with screws. This meant making a front cross-piece out of liteply, with an M4 insert, as shown below. I used the original screws and inserts at the back.

The front canopy piece is easily removable for battery changes. I glued location pads onto the front canopy that lock into the structure. It is held by pairs of magnets 7 mm diameter and 6 mm long. You can see the front magnet in the picture above, glued into a piece of ply that I glued in. The rear magnet is in the front of the rear canopy. I was pleased with the result.

Battery plate



I ground away the bottom of the front former, using a Dremel and grinding wheel, to make it level with the second and then added a balsa block to support the rear of the plate. The plate was made out of 3 mm liteply and coated with Eze-Kote to ensure that the velcro would stick well. I also fitted a battery strap as this is an aerobatic model and the battery is heavy.

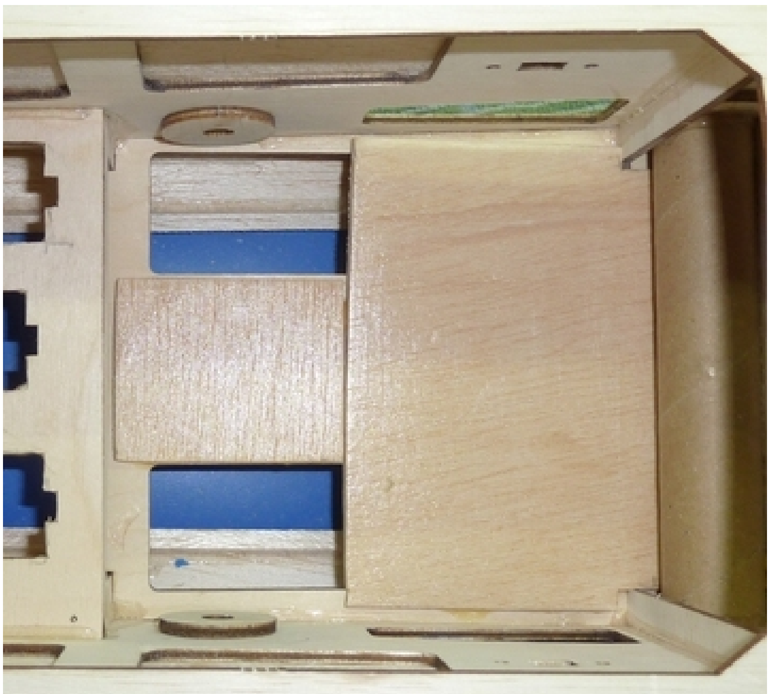
One consequence of fitting the battery plate was that the wing front retaining bolts had limited space. There were two options. The first was to leave the full length bolts in place permanently, fitting them before gluing the battery plate in. The second was to shorten the bolts so they could be removed after dismantling. After measuring the amount of length needed I cut the bolts to 22 mm below the head and cleaned up the cut ends with a pencil sharpener. In the end I shortened all four bolts. Why spend a long time screwing the rear ones in for no reason? Once again these were the obsolete ¼” UNC threads rather than M6. I suppose it’s too soon to expect to be fully metric. After all it’s only 230 years since its invention and 50 since the UK went metric.

Wings

I wasn’t very impressed by the supplied horns. The ailerons had coreless fast servos so I wanted a really solid connection. Here is the final arrangement. For once I didn’t use alloy servo arms.

Receiver plate

I like to have a solid plate for the receiver, sealed with Eze-Kote. This ensures that the velcro sticks well. The extra piece is for the receiver battery. There is a battery strap to secure the battery as well as velcro.



Motor mount

The cowl is very long to allow for the length of the IC engine. The motor needed an extension from the firewall of about 45 mm. I decided to make a motor mounting plate out of 2 mm aluminium and use 60mm M4 screws and 25 and 20 mm nylon spacers, with a washer at each end, to screw into the motor firewall captive nuts. This plate proved to be the most difficult part of the whole job.

One difficult part was to find the centre lines for the motor. Horizontal centring was easily done by measurement but the position in the vertical plane was more difficult. The engine mounts were not intended to hold the engine upright but at a small angle. I held the spinner against the cowl, hand-held in position with the trims lined up As nearly as I could judge, the centre line was lined up with the lower edge of the blue side trim.

After throwing away my first effort I hit on this scheme:
I:

- marked the centre lines on the bulkhead
- taped a square of paper onto the bulkhead and marked the centre lines on that
- pushed a scriber through the paper into the M4 holes
- used the paper to make a card template with markings and holes
- screwed the template into position with the screws and spacers to check accuracy
- transferred the shape and markings onto 2 mm aluminium sheet
- made centre punch marks at drilling points
- positioned the motor cross mount on the cross lines and centre punched
- punched the centre of the central hole
- drilled the holes and cut around the shape
- Cleaned up the edges and the face

This gave a perfect fit for the spinner against the cowl. Here is the motor mount and motor in place. The motor screws have lock nuts and the firewall screws are secured with medium strength locking liquid.

Cowl

The underside of the fibreglass cowl had to be cut to allow cooling air to leave easily, using the 3 to 1 rule for ideal outlet to intake area. Some escapes though the side gaps, but I made a 70 mm square hole by drilling the corners and using a fine hacksaw blade to join up. I painted the cut edges with blue paint after smoothing with a blade and sandpaper. I added a balsa cross brace to stiffen the cut area. This also allowed a screw to be added to fix the cowl to the former.

I wasn't happy with the screw fixings for the cowl. I used two screws in line fore and aft on the top centre line. For the rear one I had to glue a ply pad inside so the screw could bite. I used a hidden wood screw through the underside bracing into the firewall. This left a small gap down each side for further cooling air. I had to glue a 9 mm ply pad onto the firewall for the rear top screw.

Electronic speed controller

I used a FrSky Neuron 60. At first it would not run at more than a tickover at full throttle. I tried the usual calibration routines without success. One involved using the BLHeli Suite and the USB toolstick that FrSky supplies with some Neuron ESCs. I set the throttle range to 1000 to 2000.

On a forum I then found out that the 60 can be over-protective.
Again in toolstick mode I did the following:
Set 'Low RPM Power Protect' to OFF
Set 'Ramp-up Power' to 150%
Then it ran like the clappers.

I tried two props, both of which were smaller than that specified by 4-Max (18 x 10 on 6S).
First was a 17 x 10
This gave me 64.6 A and 1551 W. Too much.
I then fitted a 16 x 10
This gave 55.6 A and 1343 W.
I reckoned that was optimal with maximum current below the 58 A specified for the motor.
I settled on that.
The calculated power from maximum battery voltage was 56 A x 25.2 V = 1411 W

Flying surfaces: hinges and horns

The hinges were the only change I made to the wings, tailplane and fin. The supplied hinges were the capillary type cloth ones, that are glued in with thin CA. I prefer plastic flat hinges with steel pins. My technique is to enlarge the slots with a hinge tool then cut recesses to take the cylindrical part of the hinge. I then put in some drops of Super 'phatic and work them in with a cocktail stick. I do that two or three times, wipe out the glue in the recesses, then insert the hinge. The trickiest part is to fit the hinges all at once into the second part of the join before the glue starts to harden. I think four hinges is a practical maximum for me and I ensure that the slots allow the hinges to slide in easily. All surfaces dropped under their own weight without the horns in place. The supplied steel horns were rather clumsy so, as shown above, I used more substantial, neat aluminium ones.

Wheels

I decided not to fit the spats. On average, spats last about five flights then have to be prised off. The ones on this model are not very securely held, relying on the friction from the wheel bolt rather than two screws as is more usual. Apart from that the main wheels seemed fine.

The tailwheel is poor, or to be more exact the fixing of it. Two screws hold it down on the rear of the fuselage. However the screw size is not specified in the manual and the only two left that are long enough have large heads. This is alright for the front screw but the rear one jammed badly and then took a lot of removing. The screws go through a layer of balsa to some harder wood beneath. I cut the balsa away and glued in some birch ply to improve the fixing. In the end I used a 2 x 9 self-tapper for the rear screw with an M2 washer.

Spinner

The supplied 70 mm plastic spinner was acceptable except for the colour. The colour scheme for the model is blue but the spinner is bright red. It had to be sprayed. Fortunately electric motors don't need a starter so the paint will not be rubbed off. The plastic material felt greasy and the blue acrylic that I mixed didn't stick. I had to sand it off and spray it white with car rattle-can paint.

I might change it for the three-bladed prop and alloy spinner if the power is adequate. Or I might try a non-scale small solid aluminium spinner. This will increase cooling air flow.

Balancing

To my surprise the battery position needed to be quite well back. A heavier battery might have required balancing weight, which is anathema to we leccy heads.

Here it is ready to fly. It's a handsome machine but the pilot is a bit small (later). You can see how awful a bright red spinner would have looked.

Weights

Total weight without batteries 3.2 kg (exactly as specified by Seagull)
Flight battery 675 g
Receiver battery 112 g
Total flying weight 3.98 kg
The wing area is 42.8 dm^2
This makes the area loading 93 g dm^{-2}

Power to weight ratio is as follows:
1400 W / 3.98 kg = 350 W/kg
That should be hot!

Pilot

The pilot is 75 mm across the shoulders. This make him about 9:1 scale. The model is 1.6 m where the full size Extra is 8 m. That gives a scale of 5:1. No wonder the pilot looks too small.

Here's what the real one (left) looks like compared with the model.

Criticisms

(Details previously described)

Horns
Spat fixing
Tailwheel
Spinner colour
Pilot size

Suppliers

Seagull Extra model		Kings Lynn Models
Servos (5)	Corona DS-538MG servos	Hobby King Europe
Battery	Zippy compact 6S 4.5 Ah	Hobby King UK
Motor	4-Max 5065 360 kV 58 A	4-Max Nijhuis
Wood		SLEC
Propellor	Two blade 16 x 10	Hobby King
(Propeller	Three blade 15 x 10	4-Max Nijhuis) perhaps
(Spinner	Three blade	eBay okey100c)
ESC	FrSky Neuron 60	T9HobbySport
Wire	12 awg black and red silicone	eBay component-shop
T-nuts		eBay