

How to Convert a Glow Powered Airplane to Brushless Electric

Twin Cities Radio Controllers
March 9, 2010



What resources are available?

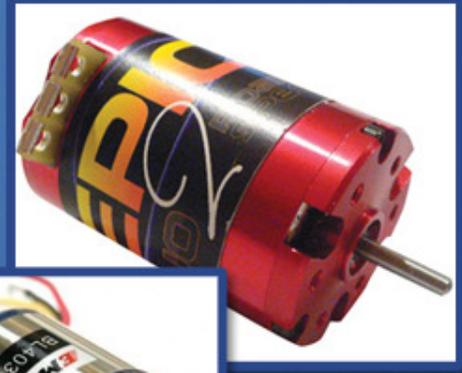
- With all of the resources out there, where do you begin?
 - RCGroups - <http://www.rcgroups.com/glow-to-electric-conversions-247/>
 - RCUniverse - http://www.rcuniverse.com/forum/forumid_132/tt.htm



Agenda

There are numerous vendors that advertise power systems designed to replace a generic glow powered engine (E-flite, Nitroplanes, etc.)

This presentation is designed to provide you with the tools to select a power system based on weight, flying style, and aircraft type. Hopefully this will also save you money.



Getting Started

- The correct power system should be based on what airplane you have and your flying style.
 - 50-70 watts per pound; Minimum level of power for decent performance, good for lightly loaded slow flyer and park flyer models
 - 70-90 watts per pound; Trainer and slow flying scale models
 - 90-110 watts per pound; Sport aerobatic and fast flying scale models
 - 110-130 watts per pound; Advanced aerobatic and high-speed models
 - 130-150 watts per pound; Lightly loaded 3D models and ducted fans
 - 150-200+ watts per pound; Unlimited performance 3D models



Finding power



- Let's use the example of the Great Planes Ultrasport 40 Plus kit
 - <http://www3.towerhobbies.com/cgi-bin/wti0001p?&I=LXCZR8&P=0>
 - The Specs say:
 - 5.3-5.7 lbs



Finding Power

- Based on the flying style of Sport/Sport Aerobatics, I think we should shoot for about 125 watts/pound.
- When we convert to E-Power, the weight will most likely increase a bit. I would add about 40% to the weight of the engine.
- A typical .46 engine weighs about 16 oz, so if we add 40% then we will add about 6 oz to the weight of the plane.



Finding Power

- At 125 watts per pound and 5.9 lbs, we need about 740 Watts.
- So... where do we go from here?



Finding a motor

- We need to find the right motor for our application.
- A good place to start would be to determine the weight of the motor we will need.
 - A good rule of thumb for Brushless Outrunners is a motor putting out about 3 watts per gram of mass.



Finding our motor

- At 3 watts per gram of mass, we should choose a motor weighing at least 245 grams.
 - If you start looking for motors in this size range, you will see that most of them have a Kv of 400-750 Rpm/volt
 - I like the Turnigy SK line of motors from Hobbyking.com - let's try the 42-60 500



Looking at our motor – 42-60 500

- The specs on the motor are:
 - 290g
 - 500Kv
 - It can handle 4-7 lipo cells
- So how do we determine what battery, ESC, and Prop to use with it?



Determining the rest

- I now look at the type of prop the original glow model would use.
 - Looking at the listing for the plane, it says to use a .40-.52 2-stroke, which means swinging an 11-13" prop.
 - 12 inch props are pretty common and in the middle of the range, so it will give us some room to wiggle and make sure we have the ground clearance on the plane to fit.



Determining the rest

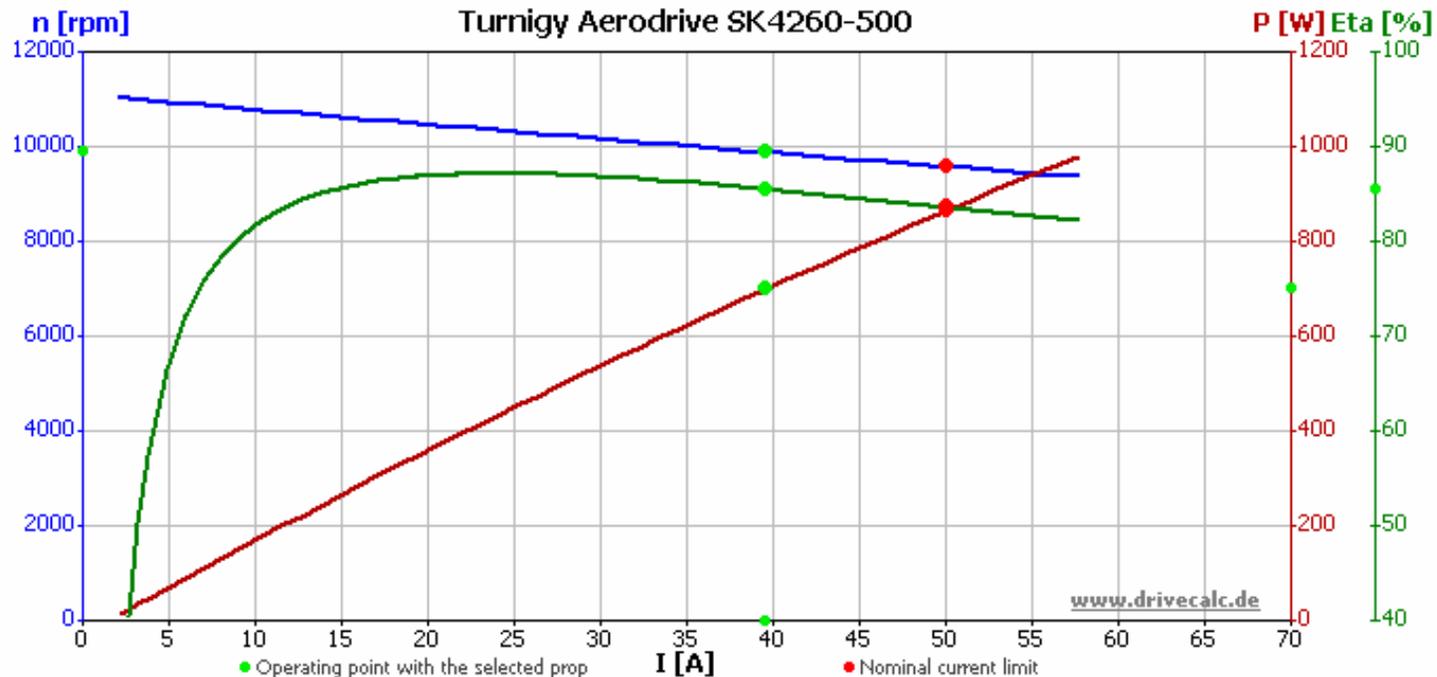
- Given that we want to run our motor much like that of a glow engine, we probably want to run it around the same speed. To do that we want to find a nominal speed to shoot for and adjust our battery voltage to meet that. 12k RPM
 - $12,000/500 \text{ Kv} = 24$. $24/4\text{v-nom} = 6\text{S}$



Determining the rest

- I like to use DriveCalc, which is a free piece of software, much like MotoCalc that gets updated by people around the world.
 - <http://www.drivecalc.de/>
- With this calculator, you can plug in your motor, prop, ESC and Battery and see power curves and generate thrust and cruise velocity.





Power supply: Hold cells 20.65 V ESC

Motor: 1031 Products Custom Bookmarked Measured only Match prop

Weight limit g Current limit A

Eagle Tree Logger, Standmessung mit Pushbetrieb, Timing hard Weight 300 g Kt 1.777 Ncm/A Rd 51.2 mOhm
max 50.0 A ns 535 rpm/V max Eta 87.1%

Gearbox: Hold

Propeller: 236 Fixed Folding Bookmarked Match motor Altitude m Temperature °C

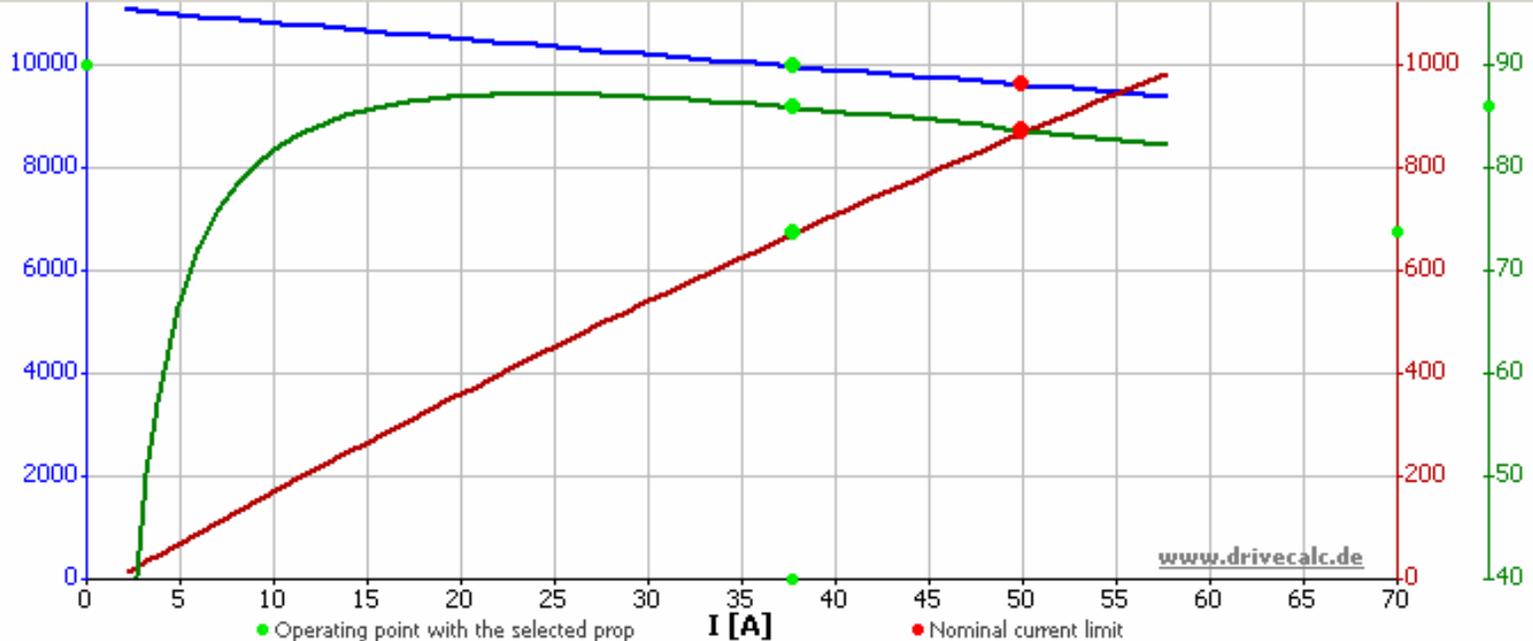
Hold Prop speed **9876 rpm** Current **39.6 A**
 Static thrust **2978 g** Power in **818.5 W**
 Vopt **98 km/h** Power out **700.2 W**
 Thrust efficiency **3.6 g/W** Drive efficiency **85.5%**

Total weight 876 g
WOT flying time 0:04:34



Drive Calculator: DCbase.dcd

File Edit Tools Window Help



Power supply

Zippy H3300-20/30C Hold 6 cells 20.73 V Turnigy Plush 60A ESC
 Weight 516 g Weight 60 g

Motor

1031 Products Custom Bookmarked Measured only Match prop
 Turnigy Aerodrive SK4260-500 Weight limit Current limit A
 Eagle Tree Logger, Standmessung mit Pushbetrieb, Timing hard Weight 300 g Kt 1.777 Ncm/A Rd 51.3 mOhm
 max 50.0 A ns 535 rpm/V max Eta 87.2%

Gearbox

Direct drive Hold

Total weight 876 g
WOT flying time 0:04:48

Propeller

236 Fixed Folding Bookmarked Match motor Altitude m Temperature °C
 13x6 APC Sport Hold Match Prop
 Prop speed **9969 rpm** Current **37.8 A**
 Static thrust **3694 g** Power in **782.5 W**
 Vopt **70 km/h** Power out **671.8 W**
 Thrust efficiency **4.7 g/W** Drive efficiency **85.9%**



Where are we?

- From the two previous slides, you should note the following:
 - The first is the 12x8 APC E, the Second is the 13x6 APC Sport
 - In either case, our thrust is over 6.5 lbs and our speed is over 43 mph

Prop speed	9969 rpm
Static thrust	3694 g
V _{opt}	70 km/h
Thrust efficiency	4.7 g/W

Prop speed	9876 rpm
Static thrust	2978 g
V _{opt}	98 km/h
Thrust efficiency	3.6 g/W



Where are we?

- Note the following two snapshots of the same props 12x8 and 13x6 respectively.
 - Note the current consumption at WOT – both are under 40A and the drive efficiencies are both over 85%.
 - We should be able to get by with a decent 40A ESC.

Current	39.6 A
Power in	818.5 W
Power out	700.2 W
Drive efficiency	85.5%

Current	37.8 A
Power in	782.5 W
Power out	671.8 W
Drive efficiency	85.9%



Where are we?

Total weight 876 g
WOT flying time 0:04:48

- Here is the last important piece of the puzzle, how heavy is it and how long will it fly.
 - With our 3300 mah 20/30C battery, we should be able to rocket around the skies at full throttle for about 5 minutes.
 - Most people choose a battery that will get them 8-10 minutes, but most people won't fly at full throttle most of the time.



So how much will it cost?

- Here is the bill of materials from HobbyKing
 - Turnigy SK 42-60 500 motor - \$29.99
 - Turnigy Plush 40A ESC – 23.10
 - Turnigy 4.0 6cell 4000 mah 20/30C battery (for a little longer runtime) – \$42.90
 - Sum Total – \$95.99



Why would we do this!?

- No need to break-in the motor
- No need to clean up the plane afterward (except to clean off the dead bugs)
- No need to buy glow fuel
- To irritate the anti-electric folks 😊

Please Note: This presentation was not endorsed or sponsored by Hobbyking.

