Predicting Amps in an RC Electric Power Setup

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Amps are calculated by dividing the Watts by the volts. So if we are setting up a new RC airframe with an electric power system that may not be the manufacturers recommended setup, how can we predict the Amps that our available setup will draw so that we are not dangerously overloading, and overheating, our motor and speed controller?

Since I am often pushing the edges of the envelope when powering my 3D airframes, I have devised a way to predict both Amps and Watts using some basic formulas. By plugging in variables to this formula – like propeller diameter and pitch, the number of battery cells, and the Kv rating of my motor – I can generate an accurate Amp range that eliminates the guesswork and danger from trying a new power combo for the first time.

I begin by using the information I know already. As an example, let's use my 4 cell battery on my 820Kv motor. I know that my motor can safely handle the 4 cell battery because the manufacturer tells me this information. I also know the 820Kv rating for the same reason. The questions that I now want to answer are: what propeller size is safe to use, and what speed controller should I used to make sure I can manage the Amps the system will draw?

I know that a decent, fully charged 4S battery will deliver over 14.8v to my power system because each cell can deliver between a minimum of 3.70 volts when safely discharged, and a maximum average of 4.16 volts per cell when safely charged. But to attempt to predict the amount of Amps the system will draw without a meter, the prop size and volts are the two most important factors, along with the Kv of the motor, and this is why.

Using my 820Kv motor as an example, I know that an 820Kv motor will turn 820 RPMs per volt.

A 4S battery will deliver between 3.70 and 4.16 volts per cell, approximately.

At 80 percent efficiency (a standard for outrunner setups), a fully charged 4S battery will turn an 820Kv motor approximately 11,000 RPMs.

The formula for calculating the amount of Watts required to turn a propeller of a specific size is:

(Prop Constant) x (prop pitch in feet) x (RPMs to the 3^{rd} power) x (prop diameter in feet to the 4^{th} power)

If we are using an electric APC prop, then the prop constant for this formula is about 1.03.

In this formula, a 12x6 prop will mean that the diameter variable will be 1, and the pitch variable will be 0.5.

If we plug in all the numbers, a 12x6 APC will generate approximately 670 Watts on 16.64 volts.

If we now divide 670 Watts by volts, you can get an estimate of the Amps the 12x6 will draw on this motor – approximately somewhere between 40 and 45 Amps using 16.64 and 14.80 volts respectively.

By using the lowest possible volt rating, I can assure myself that I am calculating the highest amount of Amps possible. If I divide 670 Watts by 14.8 volts (3.7 volts per cell) I can determine that 45 Amps could be the highest current reading.

For a 13x6.5e APC, the current could be between 59 and 67 Amps.

On a 13x5 prop, it could be between 46 and 52 Amps.

It may be a good idea, if you are not using the recommended setup, to follow this procedure so that you are not unpleasantly surprised when you do verify this with your meter… always verify with a meter when not using the recommended setup.