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TURBULATOR

Newsletter
of the Rio Rancho Radio Control Flying Club

AMA Club #2770

WATERMAN FIELD ELEVATION 5840 FEET 35° 17.2'N 106° 44.8'W

PRESIDENTS CORNER

"Da Prez Sez"

Winter is here with much cooler weather in the mornings, but with above average temps and some nice calm days flying for the most part has been pretty good. Christmas party Friday is the beginning of our events for the winter months. All of this should make the cooler months go buy a little faster. See you all at the part

Coming Events

1. Christmas Party this Friday, 1st floor of the Sleep Center starting @ 6pm
2. Next Meeting 8 Jan 2018 @ Wallen Club House
3. Next indoor Event at the Star 15 Jan 2018, 0900-Noon

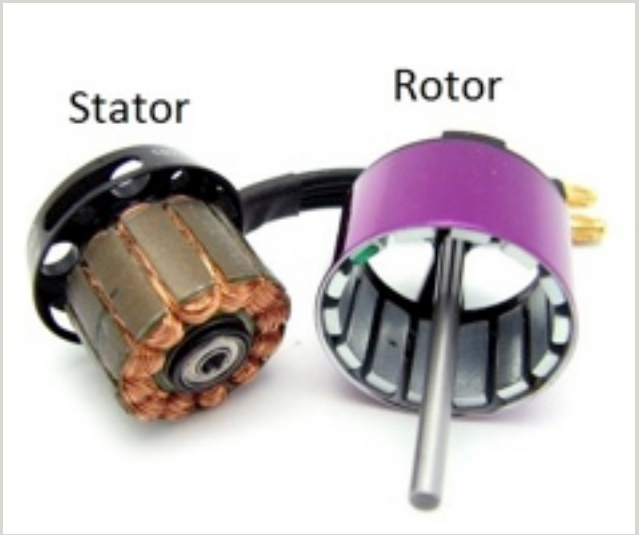
Brushless motors what the #'s mean

The motors of your aircraft is what your propellers are connected to which cause them to spin around and generate thrust to enable your aircraft to fly. In the case of fixed wing aircraft, the motors generate a forward thrust to push your plan forwards through the air. In the case of multirotors, the motors generate upwards thrust which keep your drone such as a quadcopter flying.

Without going into too many technical details this guide will cover the basics of what you need to know in order to know all the things you need to know about when using brushless motors.

Simply put, a brushless motor contains a bunch of electromagnets (coils) which are connected together in specific pairs. The motor controller (commonly known as the electronic speed controller or ESC) is the device that controls the motor by activating and deactivating specific sections of electromagnets in the motor at very specific times to cause the rotor of the motor to spin due to the magnetic force. These electo-magnets are connected into three main sections which is why all brushless motors have 3 wires coming out of them.

Brushless motor components



A brushless motor consists of two main sections :

Rotor - the part that rotates and has the magnets mounted in a radial pattern

Stator - the part that does not rotate, and has electromagnets

Inrunner and Outrunner motors

There are two categories of brushless motors however with multirotors and most fixed wing aircraft you will only encounter outrunner motors are pictured above. The difference between the two is that outrunners have the rotor on the outer area of the motor, and inrunner motors have the rotating part on the inside while the outer shell remained stationary. Inrunner motors are often used with R/C cars as they can spin much faster than outrunner motors. However outrunner motors are able to produce more torque which allows them to drive larger propellers used on aircraft and multorotors.

What do the numbers mean?

As you shop around for some brushless motors you will notice that there is often a trend in motor naming with a series of 4 numbers and might wonder what those numbers mean. It's simple enough; most motors have a few letters followed by 4 number. the letters hold no significance (usualy a model or series name, such as MT series motors, or Q series for

quadcopter), whereas the numbers tell you the essential measurements of the motor.

Generally, the first two numbers indicate the diameter of the entire can of the motor OR the diameter of the stator (the inner part of the motor) only. Please see the picture at the below for clarification.

Similarly, the second pair of numbers can indicate either the height of the entire motor, or only the height of the stator. In this case of the MT2204 motors that unmanned tech, these numbers indicate the stator diameter and height, and so we have an 22mm stator diameter, and a 4mm stator height.

The size of the motor can give you an idea about what size drone you will use with the motor. Typical FPV racing miniquads will use 1806 or 2204 motors, whereas larger quadcopters that are designed to carry a gopro camera will typically be around the 2212 size.

kV Rating

$$rpm = Kv \times voltage.$$

The Kv rating of a motor. When a motor is supplied with a voltage, it spins. As the voltage increases, so does the rate of the spin; logical. This rate of spin is quantified using revolutions per minute i.e. rpm, and this Kv rating gives you the rpm a motor will spin at full throttle, given a certain voltage. This value is also assuming that the copter is unloaded. The Kv rating gives you the rpm of the motor in the following way:

Note: The ideal number of rpm of a motor for you is dependent on what type of copter you're looking for. For example, if you're looking for a high performance, acrobatic copter, a high rpm motor is the one for you, meaning of course a high Kv rating. This is intuitive because these acrobatic copters are generally of the smaller variety, meaning a smaller motor, leading to smaller propellers. When you have these smaller propellers, the motors need to produce more rpm in order to produce the necessary thrust. However, this means that these motors use up more power than others, and so are less efficient.

On the other hand, if you would like your copter to use the least amount of power as possible, and so last longer and be more stable, then motors with lower rpm are ideal. An example for when these types of motors would be useful is in taking aerial photos. Again, this is partly due to the fact that the type of copters used for this these tasks are bigger in order to carry the necessary equipment, meaning larger propellers, which will create more thrust when rotated. They therefore require fewer rpm.

Magnet Configuration

The configuration number tells you how many electromagnets there are on the stator, and the number of permanent magnets there are on the rotor. The number before the letter N shows the number of electromagnets there are in the stator. The number before the P shows how many permanent magnets there are in the rotor. Most outrunner brushless motors follow the 12N14P configuration. There are some specialist low KV multirotor motors which have a higher number of electromagnets and permanent magnets which allow the motor to create more torque more efficiently, however due to the added number of magnets these motors are more expensive.

Propeller of an average sized Quadcopter. Its Specifications are 104.5 inch and it is attached to a 1000 kV motor. This is the top view.*

Some other terminology

When investigating and looking into which motors to buy, there are a few terms that are useful to know and recognise. This text takes you through some of these with brief explanations.

Efficiency

The next important feature for anyone considering motors is efficiency. It is intuitive why high efficiency is desired in any motor as they can run for longer, and higher efficiency results in less heat produced. If this is the case, the motors can be pushed harder at any given moment, or over a long period of time.

The most basic and general equation for calculating efficiency is the following:

The power in is calculated using the formula V × I where V is voltage and I is current. Intuitively, the power out of the motor is the power put into it, minus the energy that is necessarily lost i.e. power out = power in– power lost. There are two main ways that a motor can lose efficiency; copper loss and iron loss.

Copper Loss. Copper loss is the loss of energy through heat. To calculate this value, we need to incorporate the electrical resistance of the motor, which is referred to as the winding resistance and denoted by Rw. This quantity is measured in Ohms and once we have this value, we can go on to easily calculate the copper loss with

$$copper\ loss = I^2 \times R_w.$$

This is measured in Watts.

Iron Loss. Iron loss is a little less intuitive but nonetheless important. This quantity explains the power lost due to the fluctuating magnetic fields in the motor. To calculate this term, we need to know the amount of current the motor needs to run when it is unloaded, denoted by I0. With this term, we calculate the iron loss as follows

$$Iron\ loss = V \times I_0.$$

Conclusion. Combining these two losses together, we obtain the total power lost, and so we can now calculate the efficiency of a motor. This is given by

$$efficiency = \frac{VI - (I^2 R_w + V I_0)}{VI}.$$

MEETING MINUTES

Minutes from the November 2017 Club Meeting

Called the meeting to order at 7:00pm with 16 members present.

Minutes: Published in Turbulator: Accepted as published

Treasurer's Report: Accepted as presented

Membership report: 41 Current. 28 Members paid for 2018.

Field Report: Its cold and windy at the field

Safety: None Noted

Completion of unfinished business:

Christmas party Raffle prizes;

a. E-Flite Taylorcraft 450 ARF
b. E-Flite UMX Radian
c. Dromida Quad Copter/controller
d. Pair of Air Duel Drones

The membership decided on a $5/person fee to offset costs.

There was a discussion to have K'lynns cater for $10/plate as proposed by Steve Shaffer other option is Rudy's and members bring side dishes. Membership vote for Rudy's 14 to 2.

Don will email for rsvp and ask side dish. Pay $5 at the door or to Treasurer at the field.

Party starts @ 6pm ends 9pm

There was also a discussion for the nomination for club officer positions. The nominations are open until the meeting at the Christmas Party. All current members are eligible to hold club office. If you would like to hold club office please step up and nominate yourself. Current Officers were nominated to hold their current offices and are listed below.

President Ken French
Vice President Reggie
Treasurers Bill Ryan
Secretary Don

The meeting adjourned 745pm

Turbulator:
Editor Don McClelland
We are always looking for articles, pictures and your input!

For comments, or suggestions Please Email Don at macmoke1@gmail.com

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Next Club Meeting
December 8th 6:00pm at the Pongal Events Center