

Troubleshooting

It happens, you were careful, counted all your winds, made sure your magnets were all lined up, did your best to press the shaft in straight, yet your motor runs poorly if at all. Find your symptom on the cart and follow the steps for remedy. If your problem is not listed (very rare) then submit it to us with the remedy and we'll add it. You can seek more immediate help on the Power Systems forum on eZone (www.rcgroups.com).

Issue	Cause	Remedy
<p>My motor runs erratically if at all</p>	<p>Oh boy, this is such a broad problem that we'll have to approach it in steps. First and foremost we need to look for electrical shorts.</p> <p>1. Shorts: A short is the short name for a short circuit. There are many different areas that could short but the most common is that the top of your stator (the windings that is) are physically rubbing the inside of the can. Thus several turns are being shorted (to the motor it looks like an imbalance of turns).</p> <p>2. Bad termination: You did not connect the wires as directed, or your solder connection is poor.</p> <p>3. Magnets: If your magnets are out of sequence then the back EMF waveform will</p>	<p>1. Pull the bell off, and use some method of gently flattening the top turns. Some builders now make it a habit of putting their completed stators between two boards in a vice and giving them a squeeze before assembling the stator to the bearing holder.</p> <p>Others have used other methods involving crafting a spacer to fit between the plastic disk and the bearing or bushing to give a bit more clearance. In the future try to pull your windings tight as you wind.</p> <p>2. For a wye termination you have to connect all the starts or all the ends. Any other combination will not work. As for delta, double-check the wires (use tri colored wiring for your first one). Now, inspect all of your wires. Be sure you removed all of the insulation before tinning. Make sure all connections are tight, and solder the ends together before you twist them. Use heat shrink to insulate the connections.</p> <p>3. Double-check the magnet polarities around the bell using one</p>

	<p>confuse the ESC and your motor will not run.</p> <p>4. Friction: Determine if you feel any physical resistance (rubbing, unusual friction, scraping sound).</p> <p>5. ESC: Some esc's require advancement, some not, some soft start, some none.</p>	<p>of your spares. Verify attract-repel-attract-repel...it happens. Also verify as close to perfect alignment (i.e.: equal spacing) of your magnets.</p> <p>4. Bell misalignment is the obvious culprit. You may have to reinsert the shaft. Double-check the concentricity of your rotor by chucking it up in a drill. If you see wobble there, then you have to reinsert it...if not, then the shaft is fine. With the rotor still chucked, spin it up and observe the inside of the can. Did you make sure not to install any magnets over the nibs? If they are, they will stick out too far and rub. Use an Xacto blade to pop them loose and re affix them per the instructions. If they look fine, then you can try to file the stator teeth down (never file neodymium magnets). Go back to #1 above and check for the winds rubbing the rotor.</p> <p>5. Play with those settings 1 at a time. Next confirm that you are not going into LVC (use a fresh pack), and that you are not exceeding the max draw of the ESC.</p>
<p>2. My motor runs...YEA!!!, but starts to act erratic past half throttle ☹</p>	<p>1. Magnets: Are too weak.</p> <p>2. Wiring: Intermittent connections or shorts.</p>	<p>1. If you heat your magnets above 80C they will start to demagnetize. If you are trying to use the stock ring magnet you are on your own ;)</p> <p>2. Vibration or some other force is causing your wiring to rub intermittently, or else you have a weak solder joint (AKA cold solder joint). Some builders use tooth floss to wrap their windings to keep them from creeping. Others use red glpt a coating designed for the purpose.</p>

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Jay Couture (AKA Jay C): Provided all the photos in this revision rewriting the majority of the text from the first revision. He has coded the performance database and provided several motors and measurements to help people pick a wind that will work for them. Furthermore he has coded a motor simulation form and rotor calculator form with a dynamic magnet template creator.

Steve Metcalf (AKA ScubaSteve): Had an idea to buy the DVDROM parts and distribute them to all of us would-be experimenters at very affordable prices and extremely high quality. Steve provided some of the text in the intro on the GBL banner image. Steve continues to try to expand the sub hobby by getting new stator configurations, supplying high quality custom parts, and providing a single source for all things concerning these motors in the form of mini articles and tutorials like this one.

Phil Smith(AKA HappyHarry): Wrote the entire first version of the tutorial including all photos and text.

Eric Tolladay (AKA Tolladay): Has used his expertise to enhance the cut away photo to show the different components more clearly.

Ron van Sommeren: A catalyst for the entire spectrum of DIY brushless motors including CDROM rewinds and LRK motors. If you have a question (no matter how many times it's been asked) Ron will always answer or know where to find one.

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Richard (AKA Rysium): Richard is an engineer, experimenter, and aspiring 3D pilot. He designed all of the custom parts, provided volumes of experiments for motor designs including magnet thickness, Delta over Wye, air gap width, and more.

Martyn McKinney: Provided the original Excel spreadsheet and guidance for the motor Simulator form.

Appendix A Miscellaneous Information

Glossary

I_o = no load current usually measured at WOT without an propeller

K_v = RPM per V or RPM/V

R_m = resistance of 1 phase of windings

bell = yoke = can = flux ring + end cap

delta = triangle

double = two stators stacked

flux ring = back iron ... required to complete the magnetic flux circuit

pole = magnetic pole containing 1 or more magnets of similar magnet polarity

stator arm = stator tooth

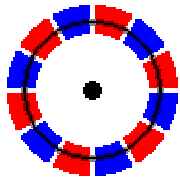
triple = three stators stacked

whopper = a postfix used after double, triple, etc...

wind = turn = 1 complete loop around the stator arm

wye = star

Magnet templates



22.7mm 5mm mags



22.27mm 5mm mags

We now have a dynamic form that will create a magnet template based on the rotor, stator, and magnet measurements you provide.

Appendix B

(<http://www.rcgroups.com/forums/showthread.php?t=249940>)

Delta or wye

I personally chose Wye because less windings are needed for the same amount of torque (versus a delta wind) ... at least that's what we have been telling ourselves. Well, to try and put it to rest (yeah right) here are some links I've found via google.

1. This one links to a discussion board. To quote them

Quote:

The difference between the star and delta connections is the voltage required at a given frequency to produce the rotating field is the square root of 3 greater for the star connection compared to the delta connection.

To keep the same field when the frequency changes the volts/hz ratio needs to be kept constant.

For the low speed case, a voltage applied to the star connection would produce torque at lower speeds/frequencies. The voltage divided by 1.73 applied to the delta connection would provide the same torque.

Raising the frequency to increase the speed would lower the volts/hz ratio and weaken the motor. When the motor is unable to produce the torque required at a given frequency, the motor can be changed to the delta connection which would be equivalent to raising the voltage by a factor of 1.73. This would produce torques at higher frequencies/speed until the point is reached where the field is weakened by the increase in frequency for a given voltage.

As stated by sreid, delta is not used in 3-phase bldc motors because of circulating currents. The voltage waveforms are rich in harmonics and in particular the 3rd harmonic causes a large circulating current at this frequency. This not only causes higher copper loss, but it also gives rise to a large torque ripple whilst contributing nothing to average torque.

2. This one from MicroMo says:

Quote:

Brushless DC-Servomotors

In the 4490 ... B series, the windings are delta-connected. This results in higher motor currents together with lower voltages. These motors are particularly suitable for high-speed applications.

Conversely, the prominent feature of the new 4490 ... BS is its high torque. The partwindings are star-connected. The motor currents are therefore lower, while the voltage is higher.

3. This one is the same thing but from Design News. Apparently (and I didn't catch this the first time) MicroMo and Faulhaber are the same company.

Quote:

The B series have delta-connected windings, reportedly resulting in higher motor currents with lower voltages. The BS series features star-connected windings and high torque; the motor currents are lower, and the voltage is higher, according to the company.

So, here's how I analyze it,

1. If you want more torque and use 3s then go for a wye wind. It will be slower but turn a bigger prop.

Advantages: Lower current = less wear on battery (lipos in particular) and esc

Can support higher voltages of 3 and 4s packs

Lower number of winds = easier to wind

No circulating currents

Are used by majority of commercial motor manufacturers both inside and outside the hobby

2. If you need more speed can source the current and use 2s, 7 or 6 cell packs go delta.

Advantages: More speed at lower voltages

Jay