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TECH CORNER

Brushless Motor and ESC Assembly

Before you start building your car go through this Tech Corner, it can save you from ultimate failure.

MOTORS, BUSHINGS AND GEAR MESH

- Ensure mounting screws are not too long. M2 x 3mm long is plenty of length to mount a motor. Any contact with the windings of the stator will damage the motor and can be fatal for the ESC.

Interestingly, often hurting the input side of the electronics where over-voltage protection components live. Even if your setup runs fine to begin with, pressure on the windings from a long screw may cause the insulation to break down soon after you begin, hundreds of laps later when you think all is well.

- The KC Racing motors are equipped with a snap ring on pinion side of the shaft. The snap ring is used to lock the shaft axial position. Ensure there is adequate clearance between the snap ring and the motor mounting bracket. (Motor mounting brackets sold by KC Racing are designed to have proper clearance for the snap ring). Inadequate clearance of the snap ring to the motor mounting bracket will result in drag on the motor. This drag will affect performance and cause 'shuttering' or 'cogging' of the motor. When shuttering occurs amperage requirements on the output side of the ESC increases dramatically. This amperage results in overheating of the motor windings, wires from the ESC to the motor and the ESC, failure will occur.

- Among all the interesting specifications of brushless motors please take note of the S rating as well as the Kv. Often the motors are listed as being 1-2S or 2-3S etc. In their native world (drones, not slot cars) this refers to the number of cells in the battery pack. Those cells are usually 3.6 volts each.

Hurt motors hurt the ESC. So, consider that a 2-3S rated motor is a specification that is rated for 7.2-11.1 volts. And here we are all running 12-16.5 volts (looking at you drag racers.....). So understandably we are in a risky trade, and much is compromised.

- You can sometimes see when a stator winding has overheated just like a cooked armature in a brushed motor where one stack might be a darker color. If you have a meter and know how to check resistance, you may be able to identify a shorted winding (lower resistance than the other two) or a blown winding (open circuit compared to the other two). In any case, all three readings being very close, if not the same, is a good indication that the motor is electrically OK. The motor should not be connected to the ESC to test the windings with a meter. Before you blame the motor of failing CHECK the winding resistance!

- Gear mesh. Make it super free! Although these motors have lots of power, startup resistance can be a big deal. A damaged tooth on a spur or crown gear can ruin the party. Balloons popped and beer spilt.

- Axle bushings need to be clean and oiled. If you soldered the bushings into the chassis, make sure you clean them with Acetone and a Q-Tip on the inside before you install the rear axle.

- Wiring from the motor to the ESC. These wires are small gauge wires and if they rub against the bell of the motor or the track surface, they will wear through the insulation fast shorting the motor. Secure the wiring on the chassis with clearance of ALL moving parts.

- Wiring in general. Do not leave exposed bare wire. Keep the jacket trim to the least amount necessary to make your connection. Bare wire and chassis bite bars are a problem waiting to occur. Shrink tube the exposed wire to prevent short circuits.



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- Keep acid flux away from the motor. The use of Loctite #271 to attach the pinion to the motor shaft is an excellent way to keep the acid away from the motor. If you are building a chassis, NO NOT put the motor in the mount when using acid flux to solder a mounting bracket to the chassis. No matter how careful you are in keeping the acid off the motor and motor screws the fumes from the flux will attack the motor.
- Wiring the ESC to the motor. See the wiring instructions on the Tech Tip page of the KC Racing website.

The ESC

- Isolate/insulate mounting of the ESC into your chassis to ensure no wiring connections touch any metal parts of the chassis. The WestRock ESC is single sided to make this easier (components all on one face leaving a flat face for mounting). Double sided tape is OK but be mindful of future need to remove again. This is a delicate piece of electronics!
- Consider wrapping or 'skinning' the mounting face with something that can be more easily removed than double sided tape. Using mylar tape on the face of the board then double sided. It offers a safe protective layer to the board and components.
- Never use acid flux on electronics. The acid and acid fumes will attack the copper on the boards and legs of the components on the board.
- Soldering - less is better. Tin the parts first and heat them to attach. You are not welding, and filler material just increases the chance of bridging the board or components.
- Soldering Tip and Heat – The soldering iron used to assemble the chassis is likely a high temperature chisel tip. The connections are small, the ESC is small. A small, pointed tip and lower temperature heat is appropriate. Excessive heat can potentially dislodge other components.
- Soldering the connections. Don't be too proud to ask for help. If you don't count yourself a soldering master, then please ask someone to make those connections for you. There is no way to safeguard the product from misadventure with a soldering iron.
- HINT, if you want future use to be simpler, then add a thicker header wire to the solder pads first and make your connections to those headers (so a few millimeters away from the actual ESC board).

IN SUMMARY HERE ARE THE BIGGEST FAULTS and they can be avoided....

- Do not fit motors with screws that are long enough to touch the stator windings.
- Check for adequate motor snap ring clearance.
- Do not allow solder connections to bridge to any other nearby components.
- Avoid excessive heat when soldering. If you are struggling to get the job done ask for help!



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INITIAL TEST

Using a 9-volt battery test the tire rotation. Positive on right braid, Negative on left braid. If the rotation is backwards, switch the sides of the two outer wires that go from the motor to the ESC. If you choose to use a power supply, turn down the voltage! A brushless motor run unloaded at full power will cause problems. You will experience shuttering or pulsing of the motor and the wires from the ESC will get hot and if operated unloaded long enough at higher voltages you will let the smoke out.

Is your gear mesh set right. Okay time to go to the track.

TRACK TIME

The first few times you start the car on the track slowly advance your controller throttle observing the car movement. The ESC takes about 3 volts to wake up. Slowly keep pulling. If the car stutters and doesn't move, you have a problem! **STOP THE CAR!** Do not go any farther until you troubleshoot the issue, or you will heat things up and let the smoke out of the ESC, and/or wiring from the ESC to motor or motor stator. Go back through this Tech Tip and recheck each item not once but twice.

Some controllers have been known to be a problem. Ask another racer to try their controller if it is another brand or model and see if that is the cause. Use a track rental controller if necessary.

If you haven't found the problem at this point you can go to the KCRacing.net website and follow the link to the BLDC Support questionnaire on the Tech page.

If everything looks good let's try some laps. Run the car. Take a couple of laps. STOP! Check the temperature of the ESC and the motor. Are they hot? If so, STOP! Your drivetrain is too tight and needs to be adjusted. The brushless drivetrain needs to be loose and free. If your ESC and motor are cool or just warm, take another 3 or 4 laps and check the temperature of the ESC and motor again. Do this process three or four times to ensure you have the drivetrain set properly.

If you have reached this point and have no issues, go ahead, and run the car for 15 to 20 laps straight and check one more time the temperatures. All good? Welcome to the Brushless Revolution and enjoy!