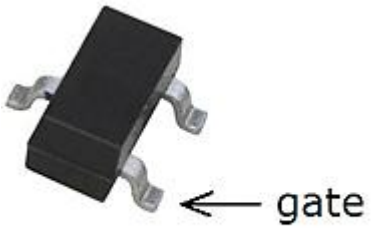
BRUSHLESS SETUP - GENERAL BUILD INFO

CONNECTING THE ESC SIGNAL WIRES TO THE FC

The least complicated way is to simply solder the signal wire from each esc to the gate of each respective FET on the FC. No other modifications to the FC are required using this method. However, it requires reasonable soldering skills to solder a wire to the FET gate, and have a reliable connection, and without damaging other nearby components.



Another (possibly more common) method is to solder a resistor say 1K value (1000 ohms) across each motor pad + and -. In other words, one end of the resistor is connected to the motor - pad and the other end is connected to the motor + pad. Then the signal for the esc is taken from the motor - pad. The motor caps also need to be removed, they are the tiny light brown/tan coloured components and are also connected by copper traces to the motor - and + pads. There is one for each motor. They can be removed with a standard soldering iron by applying a small amount of solder to the iron, and then heating the whole body of the capacitor, and then moving the iron to each end of the cap, and it will soon come off the board and stick to the iron.

Don't forget to set the output signal polarity in the firmware, each method requires a different output signal polarity, because the signal is inverted when it passes through the FET.

POWERING THE FC

There are a few ways to do this. The flight controller has an onboard regulator, but it is limited to how much input voltage it can take without getting too hot. Usually 5V is safe for the boards (but not all boards have been tested as far as I know), but one area of concern when using 5V is the LED's which may or may not be damaged by too much voltage, depending on how the LED's are connected on each board.

1. Use a voltage regulator (buck converter) from ebay or Banggood, I often use one with a variable output voltage set by a mini trimpot and set the output to 4V. It weighs around 1.6gm and works well. I am using this on several quads with no issues. To find one do a search for mini power module or mini step down or buck converter or use similar search terms. The disadvantage with this method is that you need to run a timer or low voltage buzzer so you don't completely flatten and damage your battery. Here is a pic:

2. Use one cell from your 2S or 3S quad battery. If you buy a mating balance connector, you can wire the negative and the first cell + to the FC to power it. This way the FC LED's will flash on low battery voltage.

3. Use an esc with inbuilt BEC, or a standalone mini 5V BEC. Run the 5V from the BEC to the battery terminals of the FC. I have done this successfully with H8 mini green and CG023 boards, but I have

only the 2 LED's on top running, and this lightens the load on the FC's voltage regulator. Use this method at your own risk. Also you will need a timer or low voltage buzzer to know when your flying time is up.

BLHELI

See in the screenshot of these esc's, all the settings are default except Startup Power. If a setting is not default, you get the little house symbol beside the slider. I would leave the Startup Power at 0.50 (or even less for 1105 and 1306 motors) and all else at default. If you are going to use PWM to drive the esc's, the “Enable PWM Input” must be turned ON. Programming by TX needs to be unticked also, otherwise sometimes the esc's can enter programming mode when you don't want them to.

Its a good idea to check each esc by connecting to BLHeli, hit Connect and then Read Setup, and make sure each esc has the exact same settings, and also the exact same firmware, and exact same firmware revision number. You can do it manually, or you can, if you want, do it this way: Read the first esc. If you are happy with the settings, (don't forget to untick the tx programming box), you can then click on ESC Setup/Save Setup to Ini File and save those settings in a file, give the file a name like XM20 1a or whatever so you can find it in the next step. Then Disconnect from that esc, and Connect to the next esc, go to ESC Setup/Read Setup From Ini File, find the file you just saved, and write those settings to the esc. After writing a setup, click on Read Setup to confirm the settings actually made it into the esc. Then click on Disconnect. Do that for the remaining 2 esc's too. That way, all 4 esc's will have identical settings.

PID SETTINGS

Here is a possible starting point for a 140-160mm quad. For a 120mm quad halve the D values. If its too doughy/very slow response, try the 2nd set below and go from there. (These are some approximate values from similar size quads I have.) Note there is no way your quad will fly properly on these exact settings, the chances of that are incredibly small. It's just a suggested starting point (I put here to save people from starting with values that are way too high).

```
float pidkp[PIDNUMBER] = { 4.0e-2 , 4.0e-2 , 2.0e-1 };
float pidki[PIDNUMBER] = { 2.0e-1 , 2.0e-1 , 1.0e-1 };
float pidkd[PIDNUMBER] = { 4.0e-1 , 4.0e-1 , 2.0e-1 };

float pidkp[PIDNUMBER] = { 6.0e-2 , 6.0e-2 , 3.0e-1 };
float pidki[PIDNUMBER] = { 3.0e-1 , 3.0e-1 , 2.0e-1 };
float pidkd[PIDNUMBER] = { 6.0e-1 , 6.0e-1 , 3.0e-1 };
```

If you end up going round in circles trying to tune it, and can't seem to find some good settings, try some different props. Props that are a low load for the motors (low pitch or small diameter for the motor) are often difficult to tune right IME.

1104, 1105, 1304, 1306, 1407 MOTORS FOR SMALL QUADS

1104, 1105 and 1304 all use the same prop mounting system with 2 allen screws bolting the prop on. This is a strong system in that it is difficult to ever bend a motor shaft. At the moment, the prop selection is not as large as for other motors and is usually limited to 3“ or a bit over. They are all in the same weight bracket around 5.5 to 7.5gm with no hardware. The 1306 and 1407 motors are much heavier being around 14.5gm and use a conventional prop mounting system, so there is a good choice of props for these.

Myrcmart sells the RCX H1105 4000kv and 5000kv motors (as well as spare bearings and shafts), Banggood sell an Eachine BG1104 4000kv as well as the DYS 1104 motors in 5400kv, 6500kv and 7000kv versions. RotorX have 1105 4000kv and 1105B 6500kv versions. There are also Emax and Racerstar entering the small quad motor market. I find it difficult to recommend one motor over any other, the ones I have (Eachine, RCX, RotorX and DYS) all perform very well.

When choosing the kv rating of a motor for your frame, the kv rating will largely determine the amount of thrust (and top speed) for a given battery 2S or 3S, and also the runtime for a given battery. The higher kv ratings will give more power at the expense of shorter runtime and less efficiency. All of these motors fly well on 2S, and fast on 3S. Have fun :)

Just a word of caution with motor mounting screws for these small motors - don't use screws that are any longer than 2mm more than the frame thickness, as there is a good chance that the internal windings will be permanently damaged if you do. If you have a 3mm frame, then 5mm screws are what you want (max). Phillips head M2 screws are lighter than Allen head screws and are cheap and plentiful on ebay. If you are not sure what length screws come with your motors when you order them (or you know they will be the wrong length), its a good idea to order some correct length screws at the same time to avoid disappointment when you start the build.

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