BLHeli_S 4-in-1 ESC User Manual

1. Product Features:

--Adopted EFM8BB21F16 chip, 50MHz performance frequency

-Designed for superior performance in multirotors, and uses hardware generated motor pwm for smooth throttle response and silent operation.

-Smaller size, lighter weight, more convenient to install

-The code supports regular 1-2ms pulse width input, as well as Oneshot125 (125-250us), Oneshot42 (41.7-83.3us) and Multshot (5-25us). The input signal is automatically detected by the ESC upon power up.

-All codes use damped light mode. Damped light does regenerative braking, causing very fast motor retardation, and inherently also does active freewheeling.

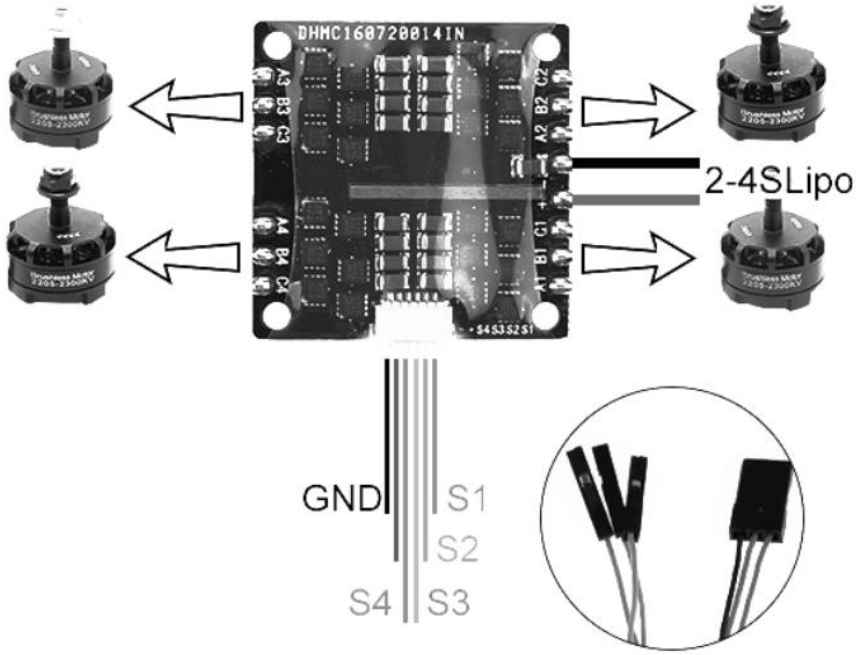
-The code supports features to prevent sync loss.

There are tuneable parameters that can make the code run well even in the most demanding situations, although default settings will work excellently in normal operating environments.

-The code also supports a beacon functionality, where the ESC will start beeping after a given time of zero throttle. This can be very useful for finding lost crafts.

2. User Guide

1). Wire Diagram



2).Beeps - Normal operation:

Power up:

Once

Throttle signal detected (arming sequence start):

Once

Zero throttle detected (arming sequence end):

Once

After this, the motor will run.

3). **Beeps - Throttle calibration:**

Power up:

Once

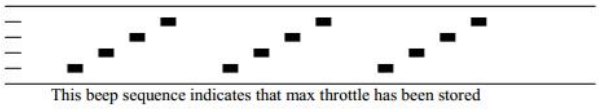
Throttle signal detected (arming sequence start):

Once

When throttle is above midstick (measuring max throttle):

While measuring

If throttle is above midstick for 3 seconds:



Once

This beep sequence indicates that max throttle has been stored

When throttle is below midstick (measuring min throttle):

While measuring

If throttle is below midstick for 3 seconds:

Once

This beep sequence indicates that min throttle has been stored

At this point throttle calibration values are stored. You may remove power from the ESC, or just continue running your ESC.

Please take off propeller during ESC throttle calibration!!

3. Programming parameters and instructions

	Function	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Startup Power**	0.031	0.047	0.063	0.094	0.125	0.188	0.25	0.38	0.50	0.75	1.00	1.25	1.5
2	Temperature Protection	Off	On											
3	Low RPM Power Protect	Off	On											
4	Motor Direction	Normal	Reversed	Bidirectional	Bidirectional Rev									
5	Demag Compensation	Off	Low	High										
6	Motor Timing	Low	MediumLow	Medium	MediumHigh	High								
7	Brake On Stop	Off	On											

** Startup power differs with different ESC. Usually, bigger ESC has bigger startup power.
Dark grey cell is the default set.
If error occurs during saving/re set process due to some reason, e.g power disconnected, low voltage etc, default settings will be re loaded.

1).Startup power

Can be set to relative values from 0.031 to 1.5. This is the maximum power that is allowed during startup. Actual applied power depends on throttle input, and can be lower, but the minimum level is a quarter of the maximum level.
Startup power also affects bidirectional operation, as the parameter is used to limit the power applied during direction reversal.

2).Tempreture protection

The ESC measures temperature within the MCU and limits motor power if the temperature is too high. Motor power is limited in four steps:
- If the temperature is above 1400C, motor power is limited to 75%.
- If the temperature is above 1450C, motor power is limited to 50%.
- If the temperature is above 1500C, motor power is limited to 25%.
- If the temperature is above 1550C, motor power is limited to 0%.

3).Low RPM power protect

Power limiting for low RPMs can be enabled or disabled. Disabling it can be necessary in order to achieve full power on some low kV motors running on a low supply voltage. However, disabling it increases the risk of sync loss, with the possibility of toasting motor or ESC.

4).Motor direction

Rotation direction can be set to fwd/rev/bidirectional fwd/bidirectional rev.
In bidirectional mode, center throttle is zero and above is fwd rotation and below is reverse rotation. When bidirectional operation is selected, programming by TX is disabled.

5). **Demag compensation**

Demag compensation is a feature to protect from motor stalls caused by long winding demagnetization time after commutation. The typical symptom is motor stop or stutter upon quick throttle increase, particularly when running at a low rpm. As mentioned above, setting high commutation timing normally helps, but at the cost of efficiency.

Demag compensation is an alternative way of combating the issue. First of all, it detects when a demag situation occurs.

- In this situation, there is no info on motor timing, and commutation proceeds blindly with a predicted timing.
- In addition to this, motor power is cut off some time before the next commutation.

A metric is calculated that indicates how severe the demag situation is. The more severe the situation, the more power is cut off.

When demag compensation is set to off, power is never cut.

When setting it to low or high, power is cut. For a high setting, power is cut more aggressively.

Generally, a higher value of the compensation parameter gives better protection.

If demag compensation is set too high, maximum power can be somewhat reduced.

6). Motor timing

Commutation timing can be set to low/mediumlow/medium/mediumhigh/high, that correspond to 00/7.50/150/22.50/300 timing advance.

Typically a medium setting will work fine, but if the motor stutters it can be beneficial to change timing. Some motors with high inductance can have a very long commutation demagnetization time. This can result in motor stop or stutter upon quick throttle increase, particularly when running at a low rpm. Setting timing to high will allow more time for demagnetization, and often helps.

7**).Brake on stop:**

Brake on stop can be enabled or disabled. When enabled, brake will be applied when throttle is zero. For nonzero throttle, this setting has no effect.

8). Others

-Beep strength:

Sets the strength of beeps under normal operation.

-Beacon strength:

Sets the strength of beeps when beeping beacon beeps. The ESC will start beeping beacon beeps if the throttle signal has been zero for a given time. Note that setting a high beacon strength can cause hot motors or ESCs!

-Beacon delay:

Beacon delay sets the delay before beacon beeping starts.

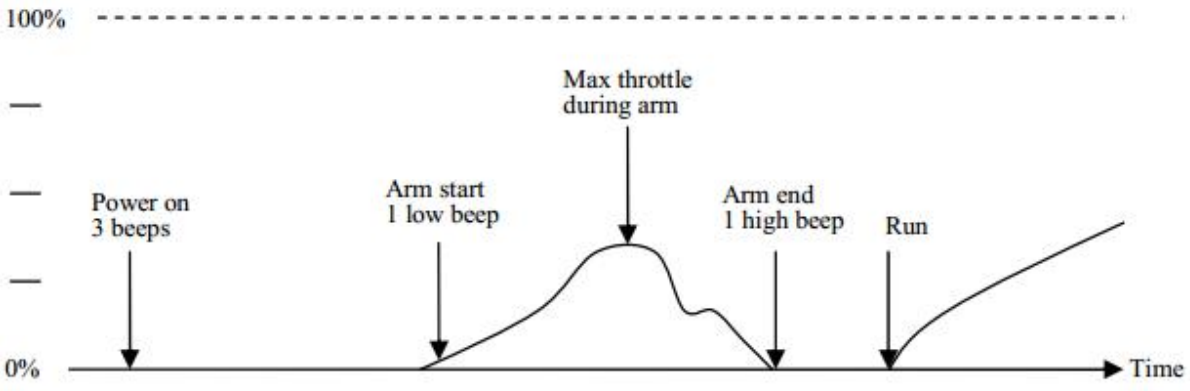
-Programming by TX:

If disabled, throttle calibration is disabled.

-**LED control:**

LEDs can be controlled on ESCs that support it. Up to 4 LEDs can be turned on or off.

-Arming sequence:



The figure below shows an example of throttle value versus time.
At power on, the ESC beeps 3 beeps.
When throttle signal is detected, it beeps one low tone beep. This signals the start of the arming sequence. Then, when or if throttle is zero, it beeps one high tone beep. This signals the end of the arming sequence.
Also, if 100% throttle is detected during the arming sequence, the ESC starts throttle calibration.
If the esc is armed and sees zero throttle for a given time, it beeps beacon beeps, which are about a beep per three seconds.

-Input signal:
Available throttle calibration range is from 1000us to 2000us, and the difference between minimum and maximum throttle must be more than 140us (70us in bidirectional mode). If a calibration is done where the difference is less than 140us (70us), the maximum will be shifted so that the difference is 140us (70us).
Oneshot125 mode works just the same as regular 1-2ms mode, the only difference is that all timing is divided by 8. And the same for Oneshot42, where all timing is further divided by 3. Multishot also works similarly, except the input signal range is 5-25us.
The input signal is always sampled with the MCU clock, at 24MHz or 48MHz.