BLHELI_S

01 Introduction

Thank you for purchasing Sunrise BLHELI_S product! Brushless power systems can be very dangerous. Any improper use may cause personal injury and damage to the product and related devices. We strongly recommend reading through this user manual before use. Because we have no control over the use, installation, or maintenance of this product, no liability may be assumed for any damage or losses resulting from the use of the product. We do not assume responsibility for any losses caused by unauthorized modifications to our product.

02 Warnings

- Read through the manuals of all power devices and aircraft and ensure the power configuration is rational before using this unit, as incorrect configuration may cause the ESC to overload and be damaged.
- Ensure all wires and connections must be well insulated before connecting the ESC to related devices, as short circuit will damage your ESC. And ensure all devices are well connected, (please use a soldering iron with enough power to solder all input/output wires and connectors if necessary,) as poor connection may cause your aircraft to lose control or other unpredictable issues such as damage to the device.
- Do not use this unit in the extremely hot weather or continue to use it when it gets really hot (around 105 /221). Because high temperature will cause the ESC to work abnormally or even damage it.
- Users must always disconnect the batteries after use as the current on the ESC is consuming continuously if it`s connected to the batteries (even if the ESC is turned off). The battery will completely be discharged and may result in damage to the battery or ESC when it is connected for a long period of time. This will not be covered under warranty.

03 Features

- Chips on EFM8BB21F16,50MHZ Greatest
- BLHeli_S is designed for superior performance in multirotors, and uses hardware generated motor pwm for smooth throttle response and silent operation.
- Small size combined with light weight for easy installation.
- The code supports regular 1-2ms pulse width input, as well as Oneshot125 (125-250us), Oneshot42 (41.7-83.3us) and Multishot (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.

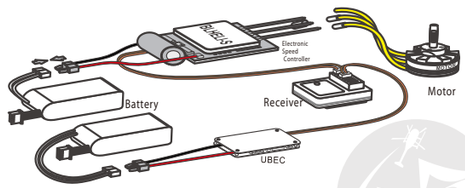
04 Specifications

Model	Cont. Current	Peak Current (10sec)	BEC	LiPo	Weight	Size
BLHeli_S 20A	20A	25A	No	2-4S	7.9g	27 x 12 x 5.5 mm
BLHeli_S 25A	25A	30A	No	2-4S	8.5g	28 x 13 x 5.5 mm
BLHeli_S 30A	30A	35A	No	2-4S	9.1g	28 x 13 x 5.5 mm

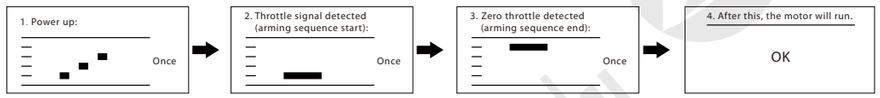
● Not all items listed here.

05 User Guide

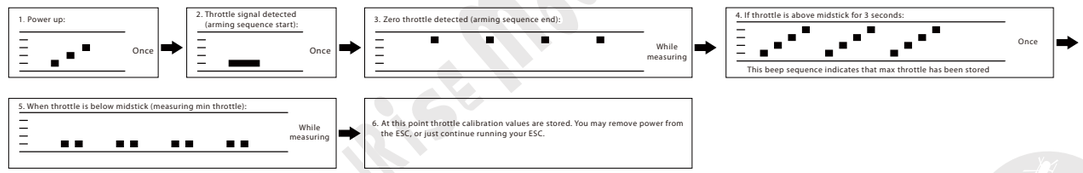
1 Motor Wiring



2 Normal Start-up Process



3 Throttle Range Calibration



This is an extremely powerful brushless motor system. We strongly recommend removing your propellers for your own safety and the safety of those around you before performing calibration and programming functions with this system.

06 ESC Programming

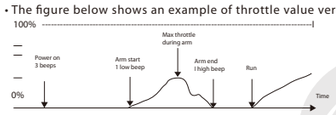
	Function	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Startup Power**	0.031	0.047	0.063	0.094	0.125	0.188	0.25	0.38	0.50	0.75	1.00	1.25	1.5
2	Temperature Protection	Off	On											
3	Low RPM Power Protect	Off	On											
4	Motor Direction	Normal	Reversed	Bidirectional	Bidirectional Rev									
5	Demag Compensation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

(Those "gray background and black text" options are the factory default settings.)
**: Default startup power varies by ESC. Generally the default power is lower for larger ESCs.
If for some reason there is an error in the eeprom/flash write operation (e.g. due to loss of power or low voltage), defaults will be loaded.

1. Startup Power: it is always done with the direct startup method, which runs the motor using back emf detection from the very start.
   In this mode power is given by the throttle used, but limited to a maximum level. This maximum level can be controlled with the startup power parameters. Beware that setting startup power too high can cause excessive loading on ESC or motor.
2. Temperature Protection:Thermal protection can be enabled or disabled.
   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.

The following is additional instruction for BLHeli_S Suite programing:

- 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.
- Beep strength, beacon strength and beacon delay.
- Sets the strength of beeps under normal operation.
- 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 sets the delay before beacon beeping starts.
- If disabled, throttle calibration is disabled.
- These settings set the throttle range of the ESC. Center throttle is only used for bidirectional operation. The values given for these settings are for a normal 1000us to 2000us input signal, and for the other input signals, the values must be scaled.
- 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.
- LEDs can be controlled on ESCs that support it. Up to 4 LEDs can be turned on or off.
- 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.

- 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.
- If the motor has attempted to start but not succeeded for a few seconds, it will stop attempting and wait for throttle to be zeroed before attempting again.
- Damped light mode is implemented by doing regenerative braking, and inherently active freewheeling is also implemented.Then losses due to braking are counteracted by the reduced losses of active freewheeling.
- The motor PWM frequency is always 24kHz. The resolution is 2048 steps for MCUs running at 48MHz on ESCs that have automatic deadtime control. On ESCs that have fixed deadtime, the PWM resolution is 1024 steps. For MCUs running at 24MHz, the PWM resolutions are half.
- For ESCs with a 24MHz MCU, maximum speed is limited to 350k eRPM, at which point power to the motor is limited. For ESCs with an MCU running at 48MHz, this number is 500k eRPM.

07 Others

BLHeli official website： https://github.com/bitdump/BLHeli
BLHeliSuit download： https://www.mediafire.com/folder/dx6kfaasyo24l/BLHeliSuite
This BLHeli_S ESC Firmware： BB1(G-L-30 BLHeli_S Rev:16.2),BB2(G-L-30 BLHeli_S Rev:16.2).