

01 Disclaimer



Thank you for purchasing this HOBBYWING product! Please read this declaration carefully before use, once you start to use, we will assume that you have read and agreed with all the content. Brushless power systems can be very dangerous and any improper use may cause personal injury and damage to the product and related devices, so please strictly follow the instruction during installation and 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. Besides, we have the right to modify our product design, appearance, features and usage requirements without notification. We, HOBBYWING, are only responsible for our product cost and nothing else as result of using our product. Regarding the possible semantic difference between two different versions of declaration, for users in mainland China, please take the Chinese version as standard; for users in other regions, please take the English version as standard.

02 Warnings

- Read through the manuals of all power devices and aircraft and ensure the power configuration is rational before using this unit, as improper power configuration will overload the motor and damage the unit.
- When installing this unit, relevant operations like soldering, connecting will be needed, so please ensure all wires and connections are well insulated before connecting the unit to related devices, as short circuit will damage the unit. When soldering relevant wires of the unit, please use a soldering iron with sufficient power to do the job, as poor connection may cause your aircraft to lose control or other unpredictable issues like damage to the device.
- Always keep your aircraft away from unsafe elements like obstacles, crowd, high-voltage power lines. Please fly your aircraft in the working environment as regulated in this manual. Although there are some protections, improper use may still cause permanent damage to the product.
- Always disconnect and remove batteries after use, as the ESC may drive the motor to rotate and cause unpredictable danger if it's still connected to the battery. Long-time contact will cause the battery to completely discharge and result in damage to the battery or/and the ESC. This will not be covered under warranty.
- The open source ESC can only be flashed with the corresponding firmware (not any other firmware) when flashing or upgrading firmware, otherwise it may cause the ESC to stop working or even damage the chip inside.
- This user manual is based on the operation manual for BLHeli_32 ARM rev32.x and only for reference. For more detailed information, please refer to the original BLHeli manual. Due to firmware update or other reasons, the descriptions for functions may differ, so please always take the official BLHeli manual as standard.
- Please note that this product is only applicable to the multi-rotors with the diagonal wheelbase doesn't exceed 300mm, because using it beyond the specification may cause damage to the ESC or other issues. In that case, users need to take full responsibility for the consequences.

03 Features

- High performance 32-bit microprocessor with the running frequency of up to 48MHz for excellent performance.
- BLHeli_32 firmware is the third generation BLHeli, following base BLHeli and BLHeli-S.
- 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 tunable 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 supports regular 1-2ms pulse width input, as well as Oneshot125 (125-250us), Oneshot42 (41.7-83.3us) and Multishot (5-25us).
- Dshot signaling is supported at any rate up to at least Dshot1200. The input signal is automatically detected by the ESC upon power up.
- 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.
- On board 5V BEC , powering different accessories such as FC and Receiver .(XRotor Micro 40A BLHeli_32 4in1 DShot1200 (20x20) doesn't have this function).

04 Specifications

Model	Cont. Current	Peak Current	BEC	LiPo Cells	Weight	Size	Mounting Hole
XRotor Micro 60A BLHeli_32 4in1 DShot1200	60A	80A	5V@0.6A	3-6S	15g	52x42x6.6mm	30.5x30.5mm
XRotor Micro 40A BLHeli_32 4in1 DShot1200 (20x20)	40A	60A	No	3-6S	12g	40x33x5mm	20x20mm M3

05 User Guide

1 Definitions for Different Ports

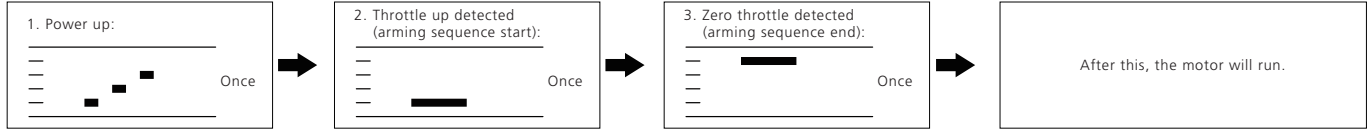
Note: Users only need to connect the throttle control wire, 5V power wire and ground wire of the ESC to the corresponding ports (on peripheral devices like receiver) when a single ESC needs to be programmed.

- NC:** none output.
- BAT:** Battery Volt monitoring port with the battery voltage is to connect to the Battery Volt monitoring port on flight controller.
- CRT:** Amp monitoring port with the amperage of 11.75mw/A is to connect to the Amp monitoring port on flight controller.
- GND:** Ground wire.
- 5V:** 5V Power output port . (For FC , Camera , 5V LED light and etc .)
- S1-4:** Throttle Signal Input Ports. Port S1 is for ESC M1, S2 is for M2, S3 is for M3, and S4 is for M4.
- POWER INPUT:** Power input soldering point , “-” for connecting the power wire - , “+” for connecting the power wire + .

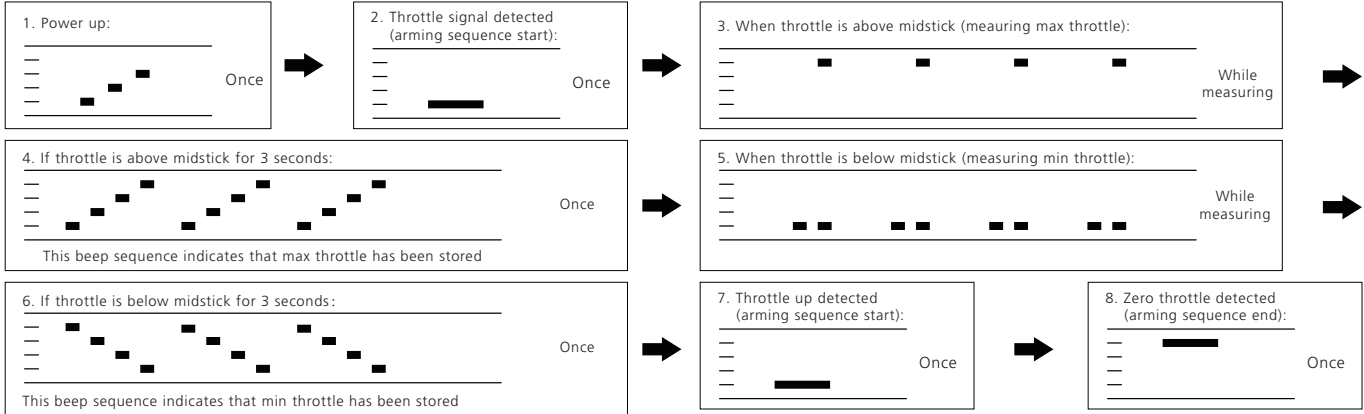
Note: Users only need to connect the throttle control wire and ground wire of the ESC to the corresponding ports (on peripheral devices like receiver) when a single ESC needs to be programmed.

- TELEMETRY:** 4ini Telemetry data port.
- VCC:** Battery Volt monitoring port with the battery voltage is to connect to the Battery Volt monitoring port on flight controller.
- CRT:** Amp monitoring port with the amperage of 11.75mw/A is to connect to the Amp monitoring port on flight controller.
- GND:** Ground wire.
- S1-4:** Throttle Signal Input Ports. Port S1 is for ESC M1, S2 is for M2, S3 is for M3, and S4 is for M4.
- POWER INPUT:** power input soldering point , “-” for connecting the power wire - , “+” for connecting the power wire + .

2 Normal Start-up Process



3 ESC/ Radio Calibration



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

Attention!

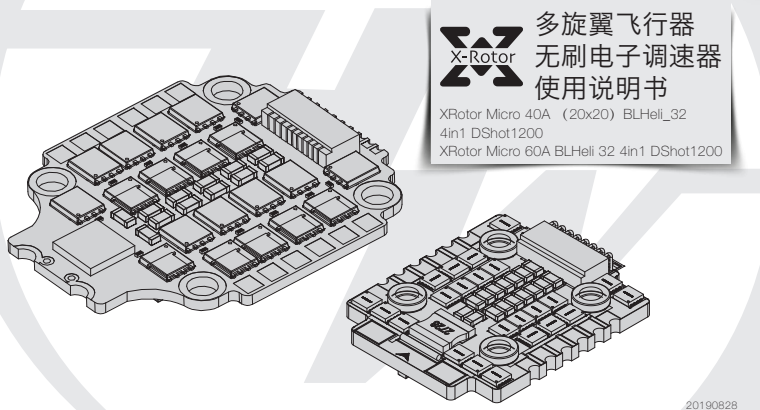
- This is an extremely powerful brushless motor system. We strongly recommend removing your propellers for your own safety and the safety of those around you before performing calibration and programming functions with this system.
- Available throttle calibration range is from 1000us to 2000us, and 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. Multshot also works similarly, except the input signal range is 5-25us.
- Dshot is supported at any rate, up to at least Dshot1200. When the input signal is Dshot, throttle calibration is disabled, and the throttle calibration values are ignored.
- Input signal rates up to at least 32kHz are supported. But please note that higher input signal rates put a heavier load on the MCU, and will reduce the maximum ERPM that the ESC can handle.

06 Programming parameters

- Rampup Power:**
Rampup power can be set to relative values from 3% to 150%. This is the maximum power that is allowed when ramping up at low RPMs and during start-up. For low RPMs, the maximum power to the motor is limited, in order to facilitate detection of low BEMF voltages. Rampup power also affects bidirectional operation, as the parameter is used to limit the power applied during direction reversal. During startup, the actual applied power depends on throttle input, and can be lower than the maximum level set by the rampup power parameter, but the minimum level is a quarter of the maximum level.
- Temperature Protection:**
Temperature protection can be enabled or disabled. And the temperature threshold can be programmed. The programmable threshold is primarily meant as a support for hardware manufacturers to use, as different hardware can have different tolerances on the max temperatures of the various components used.
- Low RPM Power Protection:**
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.
- Low Voltage Protection:**
Low voltage protection can be set between 2.5V and 4.0V per LiPo cell. Or it can be disabled. When enabled, it will limit power applied to the motor if the battery voltage drops below the programmed threshold. This feature is primarily intended for fixed wing crafts.
- Current Protection:**
Current protection can be enabled to limit current. If enabled, then current will be limited to maximum the programmed value. The reaction time of the current limiting is quite fast, so current will also be limited during accelerations.
The value given for current protection, is per ESC. So if setting limit to e.g. 40A for each of the ESCs in a quad (using BLHeliSuite32), then the total current limit for the four ESCs will be 160A.
- Motor Direction:**
Motor direction can be set to fwd / rev / bidirectional / bidirectional rev.
In bidirectional mode, center throttle is zero and above is fwd rotation and below is reverse rotation. When bidirectional operation is selected, throttle calibration is disabled.
- 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 for some motors.
- Motor Timing:**
Motor timing can be set between approximately 10 and approximately 310 in approximately 10 increments (actual accurate values here are 15/16ths of a degree). Typically a medium setting will work fine, but if the motor stutters it can be beneficial to increase 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 higher will allow more time for demagnetization, and often helps. This parameter can also be set to auto. In this case the code monitors demagnetization time, and keeps timing as low as possible without having issues with demag. On well behaved motors, timing can be low in the entire power range, and thereby max power can be reduced. On not so well behaved motors, timing is increased as needed, and thereby improves margins against sync loss.
- Maximum Acceleration:**
Maximum acceleration can be set between 0.1%/ms and 25.5%/ms. It can also be set to maximum, in which case acceleration is not limited. Limiting acceleration is primarily intended as a backup parameter that can be used in cases where too hard acceleration gives desyncs.
When setting to e.g. 10%/ms, it means that the power applied to the motor is not allowed to increase by more than 10% per millisecond.
- Throttle Cal Enable:**
If disabled, throttle calibration is disabled.
- Minimum Throttle, Maximum Throttle and Center Throttle:**
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.
For Dshot input signal, these settings have no effect.
- Brake On Stop:**
Brake on stop can be set between 1% and 100%, or disabled. When not disabled, the given brake force will be applied when throttle is zero. For nonzero throttle, this setting has no effect. This feature is primarily intended for fixed wing crafts with folding props.
On some ESCs this setting is not linearly programmable, it will just be enabled (at 100% force for any setting 1%-100%) or disabled (this applies to ESCs that have “EN/PWM” style fet drivers).
- LED Control:**
LEDs can be controlled on ESCs that support it. Up to 4 LEDs can be turned on or off.
- 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.
- PWM frequency:**
Motor PWM frequency can be programmed between 16kHz and 48kHz. Higher PWM frequency can run motors smoother. Programmable frequency also allows for moving of small but potentially disturbing bumps in the throttle response. All ESCs have these bumps, with BLHeli_32 they can be moved in the RPM range, to a place where the system has low sensitivity to them.

07 Others

- Thermal Protection**
The ESC measures temperature within the MCU and limits motor power if the temperature is too high. Motor power is limited over a range:
-If the temperature is above the threshold, motor power begins to be limited.
-If the temperature is above the threshold plus approximately 150 C , motor power is limited to 25%.
Motor power is not limited below 25%.
- Stall Protection**
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.
- Beacon---Beeps**
If the ESC is armed and sees zero throttle for a given time, it beeps beacon beeps, which are approximately one beep per three seconds.
- Not activated ESC---Beeps**
All ESCs shall be activated during manufacturing. If for some reason this is not done, the ESC will beep like this upon power up, before the normal operation beep sequence starts: “B, B, B...” (the time interval shortens gradually)”. If for some reason activation has failed and the ESC is not regarded as a valid BLHeli_32 unit, the ESC will beep like this upon power up, before the normal operation beep sequence starts: “BBB, BBB, BBB...”(the tone of the “BBB” changes from high to low)”. In this case the ESC will only accept 1-2ms pwm input signal.
- Other Relevant Information**
BLHeli official website: <https://github.com/bitdump/BLHeli>
BLHeli32 official documentation download website: https://github.com/bitdump/BLHeli/tree/master/BLHeli_32%20ARM
Firmware: Hobbywing_XRotor_BLHeli32...



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02 产品注意事项

- 使用本产品前，请认真查看各动力设备以及飞行器的使用说明书，确保动力搭配合理，避免因错误的动力搭配导致电机超载，最终损坏电调。
- 安装本产品时，由于需要进行焊接，连接等操作，所以请务必确保所有电线和连接部件绝缘良好，短路将会毁坏本产品。对本产品的相关线材进行焊接操作时，为保证焊接牢靠，请使用足够功率的焊接设备进行焊接。若连接不良，您可能不能正常控制飞行器，或出现设备损坏等其他不可预知的情况。
- 使用本产品时请远离不安全因素，如障碍物，人群，高压线等。请严格按照本手册中规定的工作环境置（如电压，电流，温度等参数）使用，虽然本产品有相关保护措施，但极限的使用还是有可能会对本产品造成永久性的损坏。
- 使用完毕后，切记将电源切断。如使用电池未断开，电调有可能会误驱动电机转动，造成不可预知的危险，若长时间连接电池，电池最终会被完全放电，进而导致电池或电调出现故障。
- 开源电调自行刷写或升级固件时，只可刷写该电调对应的固件，不可刷写其他固件，否则有可能造成无法使用的情况，严重时会造成损坏电调芯片。
- 本说明书依据BLHeli官方说明书编写而来，仅作参考使用，更多更详细的说明请参考BLHeli官方原文档，随着BLHeli固件更新等原因，可能会出现功能或描述不同的情况，一切请以BLHeli的官方文档为准。
- 注意本品只适用用轴距不超过330mm的多旋翼使用，超规格使用有可能会造成诸如电调损坏等其他问题，由此带来的后果，将由用户自行承担。

03 产品特点

- 采用高性能32位ARM微处理器，运行频率高达48MHz；
- BLHeli_32固件是在BLHeli（代码）及BLHeli-S（代码）基础上编写的第三代BLHeli（代码）。
- 使用Damped light模式。Damped light不仅能再生制动从而使电机迅速减速，还能同步整流。
- 该版本代码支持各种功能从而防止出现（电机）失步问题，尽管其默认设置在通常运行环境下即能工作良好，但它仍支持多项参数可调节从而使代码即使在最严苛的情况下也能运行良好。
- 电调可支持普通PWM油门模式，OneShot125油门模式，OneShot42油门模式以及MultShot油门模式；
- 电调可支持DShot150/300/600/1200数字油门模式；
- 具有导航提示功能，若零油门信号持续一段时间，电调即会发出导航提示音，有效帮助找到丢失的飞行器。
- 内置5V BEC，可为飞控，接收机等设备供电。（XRotor Micro 40A BLHeli_32 4in1 DShot1200（20x20）无此功能）

04 产品规格

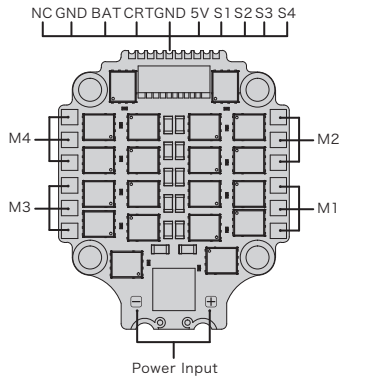
型 号	持续电流	瞬间电流	BEC	支持锂电节数	重 量	尺 寸	安装孔尺寸
XRotor Micro 60A BLHeli_32 4in1 DShot1200	60A	80A	5V@0.6A	3-6节	15g	52x42x6.6mm	30.5x30.5mm
XRotor Micro 40A BLHeli_32 4in1 DShot1200 (20x20)	40A	60A	无	3-6节	12g	40x33x5mm	20x20mm 孔径M3

05 使用向导

1 接口定义

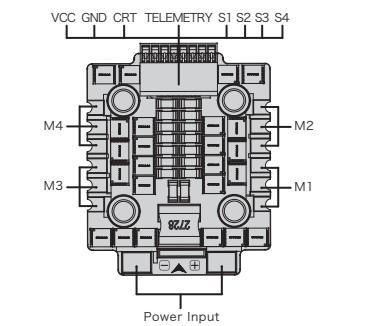
注意：需要对单个电调进行定时时，只连接对应电调的油门线与地线即可。

- NC**：没有被定义的接口，无任何输出输入。
- BAT**：电池电压检测信号输出接口，接飞控电池电压检测口，输出规格为电池电压。
- CRT**：电流检测信号输出接口，接飞控电流检测口，输出规格为：11.75mv/A；
- GND**：地线即电源负极；
- 5V**：5V稳压供电输出接口；
- S1-4**：油门信号输入接口，S1对应M1号电调，S2对应M2号电调，S3对应M3号电调，S4对应M4号电调；
- POWER INPUT**：电源线焊盘，“-”对应电源线负极，“+”对应电源线正极。

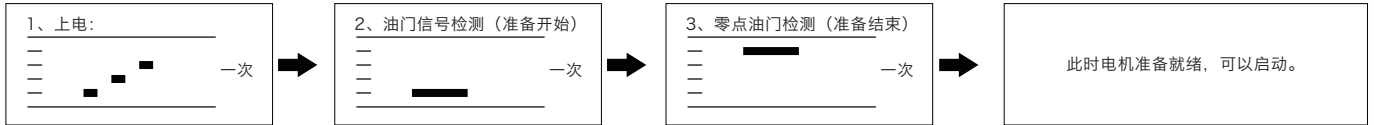


注意：需要对单个电调进行定时时，只连接对应电调的油门线与地线即可。

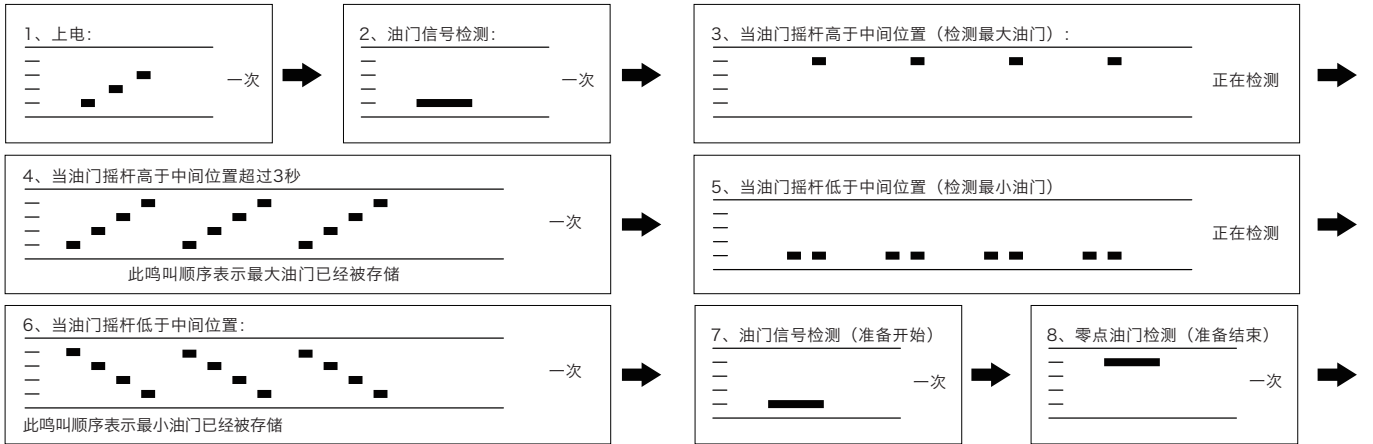
- TELEMETRY**：四合一电调TELEMETRY数据口。
- VCC**：电池电压检测信号输出接口，接飞控电池电压检测口，输出规格为电池电压。
- CRT**：电流检测信号输出接口，接飞控电流检测口，输出规格为：11.75mv/A；
- GND**：地线即电源负极；
- S1-4**：油门信号输入接口，S1对应M1号电调，S2对应M2号电调，S3对应M3号电调，S4对应M4号电调；
- POWER INPUT**：电源线焊盘，“-”对应电源线负极，“+”对应电源线正极。



2 正常的开机过程



3 油门行程校准操作方法



此时，油门校准值都储存了。用户可断开电源或继续运行电调。

- 注意：**
- 进行油门行程校准时请将螺旋桨卸下，以免发生意外！
 - 可用油门校准行程范围在1000~2000 μ s之间，最小与最大油门之间的差异必须大于140 μ s（双向模式下为70 μ s）。若一次校准结束但最小与最大油门间差距小于140 μ s（或双向模式下70 μ s），则最大油门位置会移动来确保最小最大油门间差异为140 μ s（双向模式下70 μ s）。
 - Oneshot125模式与一般1-2ms模式工作情况相同，唯一的差异就是所有进角都除以8。Oneshot42模式也一样，只是所有进角再除以3。Multshot模式也类似，除了输入信号范围为5-25 μ s。
 - Dshot支持任何速率，高达至少Dshot1200。当输入信号为Dshot时，油门校准功能禁用，油门校准值被忽略。
 - 支持高达至少32kHz的输入信号速率，但请注意，高输入信号速率将会加大MCU（主控芯片）负载，从而降低电调可应对的最大电气转速。

06 可编程参数项目及其说明

可调节参数设置项：

- 加速功率（Rampup Power）：**
加速功率可设置为3%~150%范围内（任意）相对值，它是低转速加速时或启动过程中所允许的最大功率。低转速情况下，为了便于低反电动势电压检测，（从电调）输出到电机的最大功率是受限的。加速功率也影响双向运行/操作，因为该参数是用来限制方向转换过程中（所应用的）功率的。启动过程中，实际应用功率取决于油门输入（大小），它可低于加速功率参数设定的最高水平，但最低水平（要）有最高水平的四分之一。
- 温度保护（Temperature Protection）：**
温度保护可开启或禁用且温度阈值可调节。可调节阈值主要是作为一个支持专供硬件制作商使用，因为不同硬件对所使用的各零部件的最大温度有不同的偏差/公差。
- 低转速功率保护（Low RPM Power Protection）：**
低转速功率限制（保护）可开启或禁用。在低供电电压下运行低KV电机时，为了获得全额功率有必要禁用此功能。但是，禁用会增加失步风险且有可能导致电机或电调烧毁。
- 低压保护（Low Voltage Protection）：**
低压保护可在2.5V~4.0V（每节电）范围内调节电池电压或直接禁用。该保护开启时，若电池电压低于设定阈值，则它会限制（电调）输送到电机的功率。该功能主要应用于固定翼飞行器。
- 电流保护（Current Protection）：**
可开启电流保护用来限制电流。开启时，电流会限制在设定的最大值。电流限制发生得非常快，所以加速过程中电流也会受限制。电流保护的值是根据电调计算得出，所以例如设置四旋翼上（使用BLHeliSuite32固件的）每个电调的电流限制值为40A，那么对四个电调的总电流限制值就是160A。
- 电机转向（Motor Direction）：**
电机旋转方向可设置为正转、反转、双向，双向反转。双向模式下，中心油门为零油门，中心油门以上为正向旋转，中心油门以下为反向旋转。选定双向运行/操作后，油门校准功能失效/禁用。
- 退磁补偿（Demag Compensation）：**
退磁补偿旨在防止换向/整流后因线圈退磁时间过长而导致电机停转现象的发生。突然加大油门（尤其是低转速运行）时，退磁时间过长一般会引发电机停转或卡顿。如上所述，高换向进角设置通常能帮助改善情况但也会影响（驱动）效率。退磁补偿是应对该问题的一种选择性方案。首先，退磁情况发生时，它会检测。在这样的情况下，不知道电机进角度数，换向/整流根据一个预估进角值摸索着进行。此外，电机功率会在下一次换向/整流前被切断。一个表明退磁严重程度的度量标准会被计算出。退磁程度越严重，则被切断的功率越多。退磁补偿设置为“关闭”时，则（任何时候）功率都不会被切断。设置为低或高时，功率都会被切断。差异在于，设置为“高”时，功率会被骤然切断。一般来说，高补偿参数可提供更好的保护。对有些电机来说，退磁补偿值设置得太高，最大功率也会一定程度地受削减。
- 电机进角（Motor Timing）：**
电机进角可在大约1°~31°（参照后面的备注说明，即0.9375度~29.0625度）范围内以大约1°（这里的实际准确值是0.9375度）的步长来进行调节。一般来说，中间（水平）设置即可工作良好，但若出现电机卡顿问题，可通过调大进角来进行改善。有些高电感电机会有很长的换向/整流退磁时间，这样就会导致电机在突然加大油门（尤其是低速运行）时出现停转或卡顿。高（水平）进角设置允许更长的退磁时间，所以（对前面的问题）通常能起帮助作用。该参数项也可设置为“自动”。在这样的情况下，代码监测退磁时间及保证进角尽可能低同时又不出现退磁方面问题。在性能良好的电机上，进角在整个功率范围都可设置为低水平，这样最大功率也会被削减。在性能不佳的电机上，可按需调大进角，这样可以改善（时间）余量以防（电机）失步。
- 最大加速（Maximum Acceleration）：**
最大加速可在0.1%/ms~25.5%/ms范围内进行调节，它也可设置到最大值，这样的情况下，加速就不受限制。限制加速主要是作为一个辅助参数（在遇到过硬加速导致失步/不同步情况时）来使用。例如，当“最大加速”设置到10%/ms时，那意味着应用到电机上的功率增加加速度不允许超过每毫秒10%。
- 油门校准开启（Throttle Cal Enable）：**
若禁用，油门校准功能则失效/禁用。
- 最小油门，最大油门及中位油门（Minimum throttle, maximum throttle and center throttle）：**
这些设置设定电调油门行程，且中位油门只用于双向运行/操作。这些设置对应的值为一般的1000~2000 μ s输入信号。对其他输入信号来说，这些值一定要依比例决定。对Dshot输入信号来说，这些设置都不起作用。
- 停转制动（Brake On Stop）：**
停转制动可在1%~100%范围内进行调节或直接禁用。非禁用情况下，零油门时，会按规定的刹车力度制动。非零油门时，该项设置无任何效果。该功能主要是应用于带折叠桨的固定翼飞行器。在某些电调上，不能进行线性设置该项功能，只能直接开启（无论设置在1%~100%范围内任何值，都会以100%的力度来制动）或禁用（这应用于带“EN/PWM”类型FET驱动程序的电调）。
- LED指示灯控制（LED Control）：**
该项设置可控制支持该功能的电调上的LED指示灯，（实际可）控制多达4颗LED指示灯亮起或熄灭。
- 提示音强度（Beep Strength）：**
该项用来设置正常运行情况下提示音强度。
- 灯塔导航提示音强度（Beacon Strength）：**
该项用来设置导航提示音强度。若零油门信号持续一段时间，电调即会发出导航提示音。注意！导航提示音强度设置较高的话会导致电机或电调发热。
- 灯塔导航提示延时（Beacon Delay）：**
导航（提示）延时用来设置导航提示音开始前延时的长短。
- PWM频率（PWM frequency）：**
电机PWM频率可在16kHz~48kHz范围内进行调节。高PWM频率可使电机运行更平滑，可调节频率也考虑到移动油门响应（过程）中较小但可能恼人的“颠簸”。所有电调都存在这些“颠簸”问题，使用BLHeli_32固件，可在转速范围内移动这些“颠簸”到系统对其没那么敏感的位置。

07 其他说明

- 温度保护：**
电调检测MCU（主控芯片）内温度，若温度过高，则会限制电机功率。电机功率限制在一个范围内：若温度超过阈值，则电机功率开始受限制。若温度超过阈值且大约在150℃时，电机功率会限制为25%。
- 停转保护：**
若电机因外力导致停转，电机会尝试重启转速，几秒内，电机尝试重启都仍未成功的话，它将停止尝试直至油门归零。
- 寻机提示：**
若电调已准备好且检测到零油门有一段时间，则它会发出导航鸣响提示，提示音大约每3秒鸣响一次。
- 未激活提示：**
所有电调都应在制造过程中被激活。若因为某些原因没有被激活，那么电调会在上电后，正常运作/操作一连串鸣响开始前发出“哔，哔，哔...”（逐渐加快）的提示音。若因为某些原因，激活失败，电调不被认定为有效的BLHeli_32设备，那么电调会在上电后，正常运作/操作一连串鸣响开始前发出“哔哔哔，哔哔哔，哔哔哔...”（三声降序）的提示音，这样的情况下，电调只接收1~2ms PWM输入信号。
- 其他：**
BLHeli官方网站：<https://github.com/bitdump/BLHeli>
BLHeli32官方文档下载地址：https://github.com/bitdump/BLHeli/tree/master/BLHeli_32%20ARM
固件：Hobbywing_XRotor_BLHeli32…