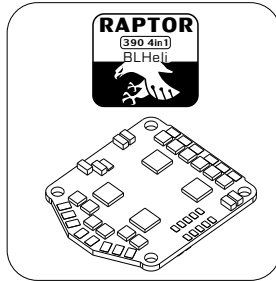




感谢您购买本产品！本产品功率强大，错误的使用可能导致人身伤害和设备损坏，强烈建议您在使用设备前仔细阅读本说明书并保存，严格遵守规定的操作程序。我们不承担因使用本产品或擅自对产品进行改造所引起的一切责任，包括但不限于对附带损失或间接损失的赔偿责任。我们有权在不通知的情况下变更产品的设计、外观、性能及使用要求。

01 主要特性

- 电调采用功能强大C8051F390 MCU, 8位C8051核心, 工作频率高达50MHz;
- 四合一集成电调, 安装更快, 更方便; 专用的三合一驱动IC, 反应更快; 电调最高支持40万转速;
- 只需使用极短信号线连接飞控, 最大程度降低信号传输所产生的干扰, 使飞行更稳定;
- 使用BLHeli开源程序; 默认Damped light模式, 效率更高, 显著提升油门响应速度。油门从大到小变化时, 电机减速响应更加迅速, 多旋翼稳定性和灵活性得到显著加强, 特别适合穿越机使用;
- 多种参数可设置, 使得电调能够在最暴力的配置下运行, 即使默认设置也能在正常配置下出色的运行;
- 电调上电自动检测油门信号, 支持普通油门模式1-2ms的脉宽输入, oneshot125(125-250us), oneshot42(41.7-83.3us)和 multishot(5-25us)。



02 产品规格

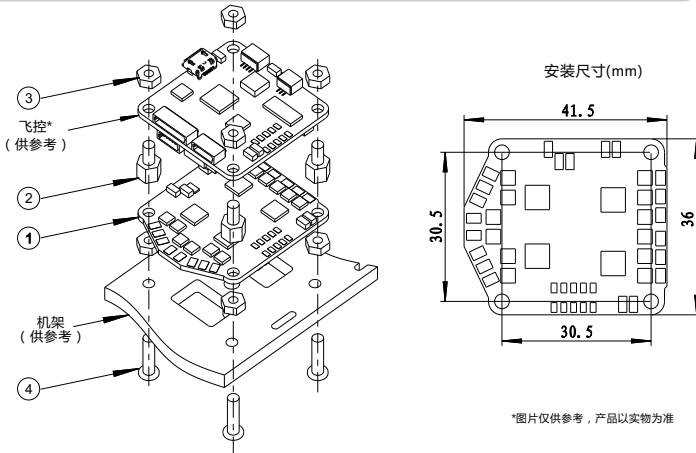
型号	持续电流	瞬时电流 (10S)	BEC	锂电池节数	重量	尺寸(供参考)	典型应用(供参考)
Raptor390 4in1-20A	20A	30A	No	2-4S	9.5g	41.5x36x5mm	130-330多旋翼
Raptor390 4in1-30A	30A	40A	No	2-4S	9.5g	41.5x36x5mm	170-450多旋翼

03 元件清单/安装尺寸

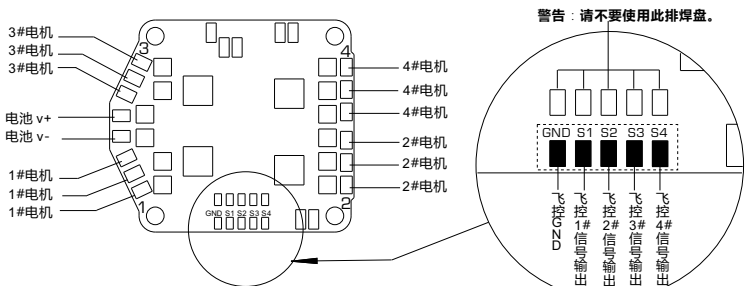
序号	描述	数量
1	猛禽390四合一电调	1
2	尼龙支撑柱 M3*5+6	4
3	尼龙螺母 M3	8
4	尼龙螺钉 M3*12	4

*兼容市面通用F3飞控, 推荐使用 Flycolor Raptor390 Tower F3飞控。

电调额外提供了:
一根5Pin线束(5个Jr端子), 用于与飞控的连接;
一根14AWG电源输入线束(XT60端子)。



04 电调连线示意图



- 所有焊接要求良好的焊接技术, 任何时候都需要避免因焊接而造成元件或线材之间短路;
- 为避免短路和漏电, 请确保连接处绝缘良好;
- 接电之前务必再次检查极性是否正确;

05 编程参数值

表中的参数是可以通过飞控连接BLHeli地面站编程 (BLHeliSuite)

功能	1	2	3	4	5	6	7	8	9	10	11	12	13
1- 转速闭环比例增益	0.13	0.17	0.25	0.38	0.50	0.75	1.00	1.5	2.0	3.0	4.0	6.0	8.0
2- 转速闭环积分增益	0.13	0.17	0.25	0.38	0.50	0.75	1.00	1.5	2.0	3.0	4.0	6.0	8.0
3- 转速闭环模式	高	中	低	关	/	/	/	/	/	/	/	/	/
4- 多轴增益	0.75	0.88	1.00	1.12	1.25	/	/	/	/	/	/	/	/
5- 启动功率**	0.031	0.047	0.063	0.094	0.125	0.188	0.25	0.38	0.50	0.75	1.00	1.25	1.50
6- 进角	低	中低	中	中高	高	/	/	/	/	/	/	/	/
7- PWM 频率	高	低	DampedLight	/	/	/	/	/	/	/	/	/	/
8- PWM加速控制***	关	3	7	15	31	/	/	/	/	/	/	/	/
9- Demag补偿	低	中	高	/	/	/	/	/	/	/	/	/	/
10- 转向	正常	反向	双向	/	/	/	/	/	/	/	/	/	/
11- 输入PWM极性	正	负	/	/	/	/	/	/	/	/	/	/	/

表中圈出标识为默认值

* BLHeli 14.4开始默认值为Damped light(支持此功能的电调); 较早版本默认值仍然为“高”。

**默认的启动功率是根据ESC变化的。一般情况下下的ESC默认启动功率比较低。

***BLHeli 14.4以及之前的版本, 选项为: 7/15/31/63

1. 转速闭环比例增益(Closed loop P gain): 通过比例增益来控制电机。
2. 转速闭环积分增益(Closed loop I gain): 通过积分增益来控制电机。
3. 转速闭环模式(Closed loop mode): 设定控制回路工作的速度范围, 以一对极电机为例:
 - 高: 油门值从0%到100%, 转速从0到200,000 RPM;
 - 中: 油门值从0%到100%, 转速从0到100,000 RPM;
 - 低: 油门值从0%到100%, 转速从0到50,000 RPM;
 - 关: 当闭环模式设置为关闭时, 转速闭环被禁用。
4. 多轴增益(Multi gain): 该功能把PWM输入信号按照比例给电机提供能量(PPM输入信号无效)。注意低增益会限制电机的最大功率。
5. 启动功率(Startup power): 启动时总是用直接启动的方法, 它使用每次启动时检测的反电动势来运行电机。在这种模式下, 功率是由使用的油门提供的, 但限制在一个最大的值。这个最大值由启动功率参数来控制。
要注意的是, 设置启动功率太高会造成ESC或电机过载!
6. 进角(Commutation timing): 低进角约0°、中低进角8°、中进角15°、中高进角23°、高进角30°。通常设置中进角适用于大部分电机, 但如果电机运转不顺畅时, 可以尝试改变进角。
7. PWM 频率(PWM frequency):
 - 高: 高PWM频率在20kHz;
 - 低: 低PWM频率在8kHz;
 - Damped light: (现象为刹车) 该功能可以加快电机的减速, 该模式使用的是高PWM频率, 只有一些MOSFET满足足够的ESC支持Damped light模式。
8. PWM加速控制(Pwm dither): 此功能控制PWM加速时每次的加速值。这种方法能使电机的加速变得流畅。特别适合于Damped light模式下时使用。PWM加速控制不适用于转速闭环模式。
9. Demag补偿(Demag compensation): Demag补偿是防止电机由于换向引起停转的一个功能, 典型的现象是在快速增加油门时电机停转或卡顿, 尤其在低转速运行时。如前面所述, 设置高进角可以帮助改善, 但有可能降低效率。一般情况下, Demag补偿参数的值越高, 保护越好。如果补偿值设置得太高, 最大功率将有所降低。
10. 转向(Rotation direction): 可用于设置电机反向旋转。
11. 输入PWM极性(Input pwm polarity): 能够适用于反极性的PWM输入情况。当使用PPM的输入时必须设置为正。

以下参数只能从BLHeli地面站编程 (BLHeliSuite):

- PPM输入油门的最小值和最大值 (PPM Min Throttle/PPM Max Throttle) (也可以通过油门校准改变)。
- PPM双向操作油门中间值(PPM Center Throttle)。
- 鸣叫音强度/鸣叫音间隔/鸣叫音开始时间(最小油门时) (Beep strength/Beacon strength/Beacon delay)。
- TX编程(Programming by TX): 如果禁用的TX不能用来改变参数的值 (默认是启用的)。
- 温度保护保护(Thermal protection): 可以启用或禁用。当温度高于150°C时, 电机功率降低到75%; 高于145°C, 电机功率降低到50%; 高于150°C时, 电机功率降低到25%; 高于155°C时, 电机功率降低到0%。
- PWM输入(PWM input): 可以启用或禁用 (默认是禁用)。如果禁用, 只有1-2ms PPM和oneshot125(125-250us) 被视为有效输入信号。
- 低转速功率保护(Low RPM Power Protect): 可以启用或禁用 (默认是启用的)。如果有需要可以禁用它的。如果需要在低电压运行的一些低KV电机的全功率, 然而禁用它增加烧电机或ESC的风险。
- 停机制动(Brake on stop): 从14.5版本开始, 可以启用或禁用 (默认是禁用的)。当设置启用时, 通电状态, 油门在零点位置电机将会有拖刹, 阻止电机转动。如果油门没有零点, 此项设置无效。

06 注意事项

- 首次使用无刷电调或更换遥控设备后需要进行油门行程校准;
- 使用BLHeli开源程序, 当电机出现异常或者要求达到更高转速时, 可尝试更改进角参数;
- 可通过飞控连接BLHeli调参软件(BLHeliSuite)升级最新版本BLHeli开源程序;
- 如需更多信息, 请联系飞盈佳乐售后或者技术支持。



Thank you for purchasing our product. Any Improper operation may cause personal injury damage to the product and related equipments. This high power system for RC model can be dangerous ,we strongly recommend reading the user manual carefully and completely. We will not assume any responsibility for any losses caused by unauthorized modifications to our product. We have the right to change the design, appearance, performance and usage requirements of the product without notice.

01 Main features

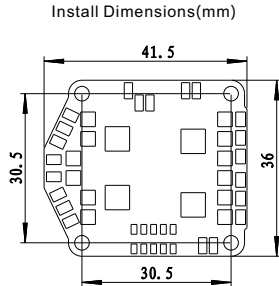
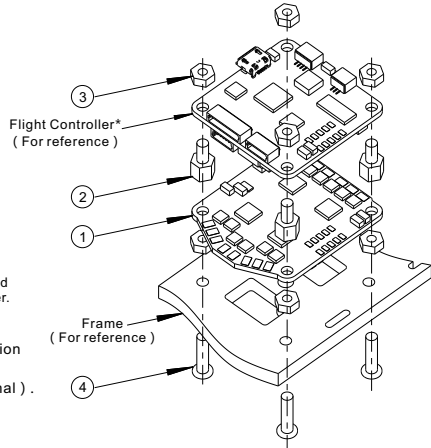
- Using C8051F390 MCU ,pipelined 8-bit C8051 core with 50 MHz maximum operating frequency.
- 4in1 ESC makes the installation faster and more convenient ; Using dedicated 3in1 drivers, faster response. ESC maximum speed is limited to 400k eRPM.
- Only need to use very short signal cable to connect flight controller. The interference caused by the signal transmission is reduced to the maximum extent, and the flight is more stable.
- Use BLHeli open-source firmware; Using "Damped light" mode , it improves the throttle response, when reducing the throttle amount, the Motors slow down rapidly. It strengthens the stability and flexibility of multi-rotors, quite suitable for QAVs.
- 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.
- 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.

02 Specification

Model	Con. Current	Burst Current (10S)	BEC	LiPo cells	Weight	Size (For reference)	Typical Application (For reference)
Raptor390 4in1-20A	20A	30A	No	2-4S	9.5g	41.5x36x5mm	130-330 Multi
Raptor390 4in1-30A	30A	40A	No	2-4S	9.5g	41.5x36x5mm	170-450 Multi

03 Part list / Install Dimensions

Item	Description	Qty.
1	Raptor390 4in1 ESC	1
2	Nylon spacer M3*5+6	4
3	Nylon Nut M3	8
4	Nylon screw M3*12	4

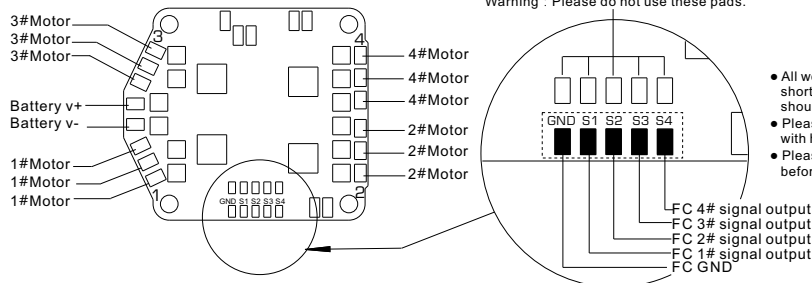


*All pictures are for reference only

* Compatible with the general F3 FC. Recommend the Flycolor Raptor390 Tower F3 Flight Controller.

ESC additional provide :
One 5-Pin cable (5 JR terminals) for connection with Flight Controller;
One 14AWG power input cable (XT60 terminal) .

04 Wiring diagram of ESC



Warning : Please do not use these pads.



- All welding requires good welding technology, short circuit between the element or the wire should be avoided at any time.
- Please ensure all solder joints are insulated with heat shrink where necessary.
- Please double-check the polarity is correct before power up.

05 ESC Programming parameter

Programming parameters below in table that can be accessed from the configuration software (BLHeliSuite) via connect the flight controller :

Function	1	2	3	4	5	6	7	8	9	10	11	12	13
1 - Closed loop P gain	0.13	0.17	0.25	0.38	0.50	0.75	1.00	1.5	2.0	3.0	4.0	6.0	8.0
2 - Closed loop I gain	0.13	0.17	0.25	0.38	0.50	0.75	1.00	1.5	2.0	3.0	4.0	6.0	8.0
3 - Closed loop mode	HiRange	MidRange	LowRange	Off	/	/	/	/	/	/	/	/	/
4 - Multi gain	0.75	0.88	1.00	1.12	1.25	/	/	/	/	/	/	/	/
5 - 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	1.50
6 - Commutation timing	Low	Med-Low	Medium	Med-High	High	/	/	/	/	/	/	/	/
7 - Pwm frequency	High	Low	DampedLight	/	/	/	/	/	/	/	/	/	/
8 - Pwm dither***	Off	3	7	15	31	/	/	/	/	/	/	/	/
9 - Demag compensation	Off	Low	High	/	/	/	/	/	/	/	/	/	/
10 - Rotation direction	Normal	Reversed	Bidirectional	/	/	/	/	/	/	/	/	/	/
11 - Input pwm polarity	Positive	Negative	/	/	/	/	/	/	/	/	/	/	/

Default values are marked in dark gray.

*Only enabled for some ESCs. From code rev 14.4, damped light is default on the ESCs that support it. For prior code revisions, high is default.

** Default startup power varies by ESC. Generally the default power is lower for larger ESCs.

***For code revs 14.4 and before, dither range was 7/15/31/63.

- Closed loop P gain sets the proportional gain for the rpm control loop. This setting controls the gain from speed error to motor power.
- Closed loop I gain sets the integral gain for the rpm control loop. This setting controls the gain from integrated speed error (summed over time) to motor power.
- Closed loop mode sets the range of speeds that the control loop can operate on.
 - For the high range, throttle values from 0% to 100% linearly correspond to rpm targets from 0 to 200000 electrical rpm
 - For the middle range, throttle values from 0% to 100% linearly correspond to rpm targets from 0 to 100000 electrical rpm
 - For the low range, throttle values from 0% to 100% linearly correspond to rpm targets from 0 to 50000 electrical rpm
 - When closed loop mode is set to off, the control loop is disabled.
- Multi gain scales the power applied to the motor for a given input. Note that this is only for PWM input, for PPM input it has no effect. Beware that a low multi gain will also limit the maximum power to the motor.
- Startup 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 parameter. Beware that setting startup power too high can cause excessive loading on ESC or motor!
- Commutation timing can be adjusted in three steps. Low is about 0°, mediumlow 8°, medium 15°, mediumhigh 23° and high 30°. Typically a medium setting will work fine, but if the motor stutters it can be beneficial to change timing.
- Pwm frequency:
 - High: High pwm frequency is around 20kHz.
 - Low: Low pwm frequency is around 8kHz.
 - Damped light : This mode adds loss to the motor for faster retardation. Damped light mode always uses high pwm frequency. This mode is only supported on some ESCs (where fet switching is sufficiently fast).
- Pwm dither is a parameter that adds some variation to the motor pwm off cycle length. This can reduce problems (like throttle steps or vibration) in rpm regions where the pwm frequency is equal to harmonics of the motor commutation frequency, and it can reduce the step to full throttle. It is primarily beneficial when running damped light mode. Dither is not applied in closed loop mode.
- 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 described earlier, setting high commutation timing normally helps, but at the cost of efficiency. Generally, a higher value of the compensation parameter gives better protection. If demag compensation is set too high, maximum power can be somewhat reduced.
- The rotation direction setting can be used to reverse motor rotation.
- The input pwm polarity setting can be used to inverse the throttle behaviour. This is intended to be used with receivers that provide negative pwm. When using PPM input it must be set to positive.

Programming parameters that can only be accessed from configuration software (BLHeliSuite):

- Throttle minimum and maximum values for PPM input (will also be changed by doing a throttle calibration).
- Throttle center value for bidirectional operation with PPM.
- Beep strength, beacon strength and beacon delay.
- Programming by TX. If disabled, the TX can not be used to change parameter values (default is enabled).
- Thermal protection can be enabled or disabled (default is enabled).
Temperature is above 140°C, motor power is limited to 75%;Above 145°C, motor power is limited to 50%;Above 150°C, motor power is limited to 25%. Above 155°C, motor power is limited to 0%.
- PWM input can be enabled or disabled (default is disabled). If disabled, only 1-2ms PPM and 125-250us OneShot125 are accepted as valid input signals.
- Power limiting for low RPMs can be enabled or disabled (default is enabled). 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 toasting motor or ESC.
- Brake on stop can be enabled or disabled (from rev14.5 ,default is disabled),When enabled, brake will be applied when throttle is zero. For nonzero throttle, this setting has no effect.

06 Attention

- User need to calibrate the throttle range when starting to use a new ESC or another transmitter.
- BLHeli open-source firmware, when some abnormality occurs in ESC driving the motor or need the motor to reach a higher RPM, user can try to change the timing.
- User also can connect the flight control to the computer to update the firmware or change the setup via configuration software (BLHeliSuite).
- Please contact Flycolor sales or technical support for more information.