Thanks for purchasing *Fulcrum* brushless speed controllers manufactured by HIFEI Technology Co., Ltd. *Fulcrum* series ESC are specifically developed to whom the high voltage and high power are concerning about. Please read the instruction carefully before running.

Safety

⚠ The brushless ESC is used for R/C electric powered model airplane and helicopters, which are not toys. ONLY adults can run it correctly according to this instructions, young children must run it with guardianship of adults.

⚠ Please keep the propeller away from your body and others, all the time when the battery is connected.

⚠ It is suggested that you remove the propeller when you are working on the airplane with the battery connected.

⚠ It is suggested that you remover the pinion when you are working on a helicopter with the battery connected.

⚠ Please observe all local laws regarding the flying of remote control airplane. Never fly over others or near crowds.

⚠ Before beginning flying, turn on the transmitter BEFORE powering on the receiver. When finish the running, power off the receiver BEFORE turning off the transmitter.

⚠ Never disconnect the battery pack while the brushless motor is running, as this could cause damage to the speed controller and/or motor. And such damage would not covered under manufacturer's WARRANTY.

⚠ High Voltage! Never touch any terminal as soon as power ON.

Features

• 32-bit Microprocessor with up to 80MHz frequency.
• 40-120V support
• Max Power 30KW
• Active FreeWheeling optional
• Motor PWM frequency 8-32K Hz
• Throttle resolution up to 1uS
• Throttle signal refresh rate up to 1K Hz
• Built-In Anti-Spark circuit* (detail for fig.7)
• Integrated RPM sensor to simplify the wiring for external Governor
• Optimized the Governor Algorithm to ensure the head speed more stable
• Built-In data Logger (logging parameters: battery voltage/current/throttle output/ temperature/motor RPM)
• Solid CNC housing

Specifications

ESC	Voltage	Max Power	BEC	Size (mm)	Weight
Fulcrum III SHV	40-120V	30KW	Yes	226x173x53	1.8Kg

Install your ESC

Please make sure the washers and screw of battery and motor have been fixed tight enough (see Fig 3). When connect power wires to battery, it is IMPORTANT to correctly connect positive to positive, and negative to negative. Swap any two motor wires' connecting can change the rotation direction.
In order to prevent any signal disturbance generated by ESC hardware, please install the ESC far away from receiver.
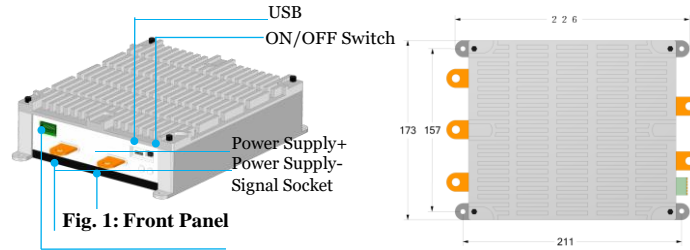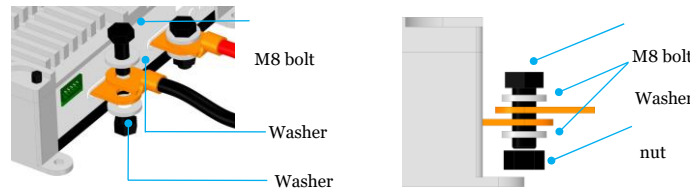

Fig. 1: Front Panel

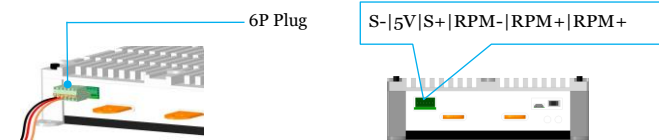

Fig. 3: Cable connection

Fig. 4: Signal wiring diagram

⚠ **WARNING : High Voltage!!! Never touch the any one terminal as while as ESC power on.**

Step ①: Keep the Switch at the OFF position

Step ②: Connect ESC to brushless motor (see: Fig.3)

Step ③: Connect the signal wires and plug into the 6P signal socket (see: Fig. 4)

Step ④: Connect negative(-) and positive(+) of ESC to the battery pack (see: Fig. 3)

Step ⑤: Move the Switch to ON , the green LED light (see: Fig.7)

After above operations there are two beeps ♪♪ emit from the motor, it is ready to run

Calibrate throttle of TX

Note: In the following 3 situations, it is required to calibrate the throttle range of transmitter.

-When it is the first time to use a new speed controller.
-When change a new TX or RX, or a set of new radio system.

Transmitter

1st: Connect ESC to motor, plug receiver lead of ESC to throttle channel of RX.

2nd: Push joystick of transmitter to max throttle position, power on TX.

Push joystick to max throttle position

3rd: Power on receiver, connect ESC to battery. Motor emits three beeps in drop tones.
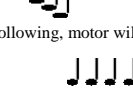
4th: In the following, motor will emit four long beeps in flat tones.

After any one beep of the four long beeps, pull joystick to zero immediately

Pull joystick to zero throttle position

5th: Then motor emits two beeps in up tones. Calibrating is completed, it's ready to go.

Note: Fulcrum ESC can not run in reverse. If throttle range were calibrated from reverse to neutral, the calibrating range will be invalid.

Program ESC by PC

Hifei USB Linker is an adapter to link Fulcrum ESC to PC, then it can easily fully program ESC, upgrade ESC firmware, and read logging data of Fulcrum ESC through Hifei software. Hifei software can be downloaded from www.hifei.com.

Install Hifei software

Download the setup software of 'Hifei V6.0X' from website (**Support column**) and finish the installation according to the popped-up window guide.
When installation is finished, Hifei V6.0X' software icon is auto saved on computer desktop.

HiFei USB Linker

Fig. 5: Program setting the ESC

⚠ **WARNING: Use COMMON USB Cable will damage the ESC**

Step①: Correctly connect ESC's receiver lead to terminal of USB Linker (brown wire to negative, red to positive, orange to signal)
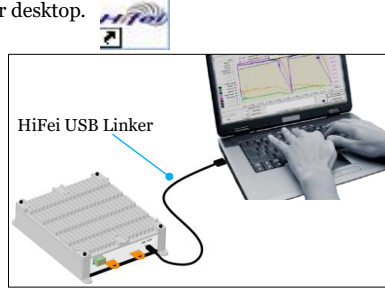Step②:Plug in the USB side of USB Linker to one of computer's USB ports
Step④:Connect ESC to battery;
Step⑤:Switch 'ON';
Step⑥:Run software Hifei V6.0X

Parameters features

Fulcrum III SHV ESC come with default factory settings which are recommended for most applications. The programming options are provided for obtain optimum performance in different setup.

Low voltage cutoff

Option 1: Auto	Option 2: 4s Lipo(default)
Option 3: 5s Lipo	Option 4: 6s Lipo
Option 5: 7s Lipo	Option 6: 8s Lipo
Option 7: 9s Lipo	Option 8: 10s Lipo
Option 9: 11s Lipo	Option10: 12s Lipo
Option 11: 13s Lipo	Option12: 14s Lipo
Option 13: 15s Lipo	Option14: 16s Lipo
Option 15: 17s Lipo	Option16: 18s Lipo
Option 17: 19s Lipo	Option18: 20s Lipo

Note: Recommended to set LVC at exact Lipos series number for better protect Lipo packs from over-discharging. ONLY WHEN battery packs are fully charged, 'Auto' can detect Lipo cells number correctly and it is suggested under this condition.

Lipo cell Cutoff Voltage

Option 1: 2.5v	Option 2: 2.6v
Option 3: 2.7v	Option 4: 2.8v
Option 5: 2.9v	**Option 6: 3.0v (default)**
Option 7: 3.1v	Option 8: 3.2v
Option 9: 3.3v	

Current Limiting

Option 1: very sensitivity	Low over-current threshold, will shut down rapidly
Option 2: standard (default)	Moderate over-current threshold, will shut down after a slight delay. Recommended for inrunner motors.
Option 3: Insensitivity	High over-current threshold, will shut down after a slight delay,. Recommended for outrunner motors. Only experienced modelers should use this option.
Option 4: disabled	Current limiting detection disabled. Only experienced modelers should use this option.

Note: Default setting is recommended. If you change the setting, damage to the controller as a result of over current will be not covered by the manufacturer's warranty.

Brake

Option 1: Disabled (default)	Brake disabled is mainly used for helicopters.
Option 2: Soft brake	Soft brake provides 50% of full braking power. General aircraft use, with fixed or folding prop
Option 3: Hard brake	Hard brake is 70% braking power. Direct drive applications where more braking power is required. Hard brake should only be used below 12V.

Timing Advance

Option 1: Low (0°~15°)	Recommended for lower pole count motors. Gives more power and slightly less efficient.
Option 2: middle (5 °~ 20 °)	Recommended for most motors .Gives a good balance of power and efficiency.
Option 3: High (15° ~ 30 °)	Recommended for most of higher pole count motors
Option4:Auto (default)	Recommended for most of all brushless motors.

Option 5: 0°; Option 6: 2°; Option 7: 4°; Option 8: 6°; Option 9: 8°; Option 10: 10°; Option 11: 12°; Option 12: 14°; Option 13: 16°; Option 14: 18°; Option 15: 20°; Option 16: 22°; Option 17: 24°; Option 18: 26°; Option 19: 28°; Option 20: 30°

Note: 0° and 30° timings are for special motors. ONLY when motor manufacturer requests the special timings, they can be used.

Cutoff types

Option 1 : Hard cutoff	When battery voltage reaches cut-off voltage the motor will shutdown immediately. Motor can be restarted by closing the throttle to the lowest position and then move the throttle as normal.
Option 2: Soft cutoff (default)	When battery voltage reaches cut-off voltage, the ESC will slowly reduce motor power to zero , you will notice a decrease in power and it is time to land, the throttle maintains its full linear.

Start types

Option 1:Soft start	Recommended for helicopters
Option 2: Standard start (default)	Recommended for most of the fixed or folding prop airplanes, and some helicopters.
Option 3: Fast start	Recommended for fastest startup.

PWM switching rate

Option 1: 8 KHz (default)	Recommended for most brushless motors
Option 2: 10KHz	Recommended for low inductance motors
Option 3: 12KHz	
Option 4: 16 KHz	Recommended for very low inductance motors
Option 5: 20 KHz	
Option 6: 24 KHz	
Option 7: 28 KHz	
Option 8: 32 KHz	

Fly Modes

Option 1: Fix Endpoint (default)	Recommended for fixed wing aircraft and EDF
Option 2: External Governor	ESC turn over the throttle signal to external FBL controllers such as VBar, Skookum,MB,BeastX etc
Option 3: Governor	ESC Internal Governor

Active FreeWheeling

Option 1: (default)	OFF
Option 2:	ON (helicopter mode)

Active FreeWheeling comes in when, instead of running at partial throttle through the FET body diodes, as one FET switches off, the "freewheeling" diode switches on to allow the "freewheeling" current to flow through it instead of it's body diode. Since the resistance of the FET is much much lower than its body diode, so much less heat is dissipated. ESC's that are equipped with active freewheeling are able to operate over a wider range of throttle percentages due to the more optimized PWM algorithm that is used. This means that you can run lower head speeds without having to re-gear or worry about your ESC blowing up! *We strongly recommend you to option Active Free-wheeling 'On' as you option the Governor Mode (helicopter mode)*

Governor

The Governor mode acts as an RPM control. Throttle stick position determines the RPM that the motor runs and the controller will attempt to hold that RPM regardless of load changes and battery voltage decreasing . Thanks to Active Freewheeling ,the motor RPM control could be available as long as the throttle level exceed 30%. In Governor Mode, the' brake' MUST always disable, 'Soft Cutoff ' and 'Soft Start' MUST be optioned.
Note: we strong recommend to open the Active Freewheeling when Governor is option

Spool Up Rate indicates the startup spool up rate, the default setting is Level 3, higher level numbers
means to approach the head speed faster.

Governor Gain The default setting is grade 9, the higher grade number means the higher gain.

Head Speed Change Rate The default setting is standard, this setting indicates the change rate between 2 different head speed switching (for example, throttle curve switch up from Normal to Idle1 or Idle1 to Idle2 ,vice versa).
The "Head Speed Change Rate" value also determines the speed at which the head recovers.

AR Recover Time is Autorotation Recover Time, it also can be understood as the recover time from Autorotation (TH=0) to Normal mode. The default setting is 'Disable', it indicates the AR is inactived.

10 to 60 Secs can be optioned to determine the recover time that Autorotation is actived, for example if you program the AR Recover Time to 30 secs, the AR will be available WITHIN 30 secs, in this period the motor can be ramped up to a preset head speed instead of soft startup, but more than this time (>30 seconds) will lead to the motor engaged with soft startup.

Throttle Calculator is a calculator to help you calculation the throttle curve according to your desired HS, Gear rate and motor poles. Please see the following screenshot:

Logger Configuration

Cycle Record

1) Not Reverse indicates when data logger memory space is filled up, it will stop logging.
2) Reverse indicates when data logger memory space is filled up, it continue logging data indefinitely by overlapping the former data and do a cycle. *Default setting is Not Reverse.*

Sampling rate

means the times that data logger samples per second. *Default setting is 3ps. *
* Higher sampling rate will fill up the memory space quickly and thus reduce the logging time when in 'not reverse' record type.*

| Sampling Rate	Max logging Time	Mini running Time
Once/ second	Approx. 68.1 minutes	> 60 seconds
Twice/second	Approx. 34.05 minutes	> 30 seconds
3 times/second	Approx. 22.7 minutes	> 20 seconds
4 times/second	Approx. 13.62 minutes	> 10 seconds
10 times/second	Approx. 6.81 minutes	> 5 seconds
15 times/second	Approx. 3.405 minutes	> 3 seconds
30 times/second	Approx. 2.27 minutes	> 2 seconds

Minimum running Time means the minimum time that ESC is requested to run. The time MUST be longer than reference in above form. Too short running will cause ESC logs little data that cannot be displayed in PC windows.

Show the Record

Show the Record will read the logged data of latest fly by ESC.
- Firstly, it is requested to input the **Gear Rate** and motor **magnetic Poles** at the bottom.
- Click on **Upload the Record** at right bottom.
- Click on **Yes**, then it begins to upload data and finish uploading in a short time.
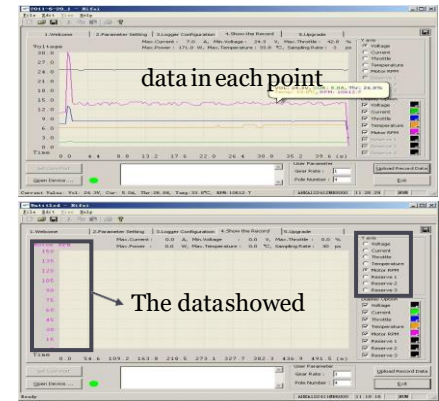
To magnify a range of data for more clearly view. left click mouse on beginning point, and click again to the end point, the period of data will be magnified. Right click mouse once will recover to original display.
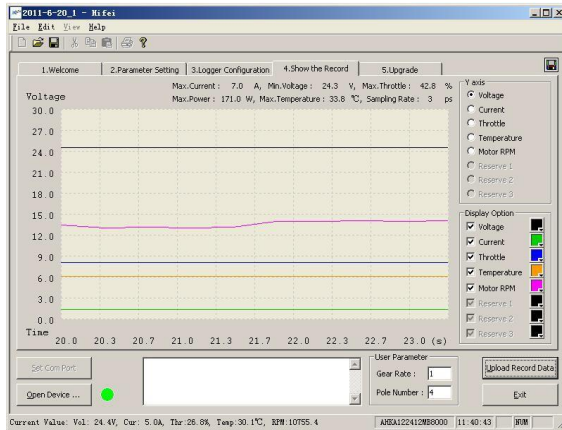
Firmware Upgrade

The Fulcrum III SHV ESC's firmware can be upgraded if there is a new firmware for the ESC be released.
Before upgrade the ESC, there are 3 wires of 6P plug have to be shorten as Fig. 6, and connect the Fulcrum ESC to computer with HiFei USB Linker.

Each ESC has specific firmware and be different. You **MUST** *not make mistake to upgrade ESC with a wrong firmware, otherwise possibly result from ESC be damaged.*
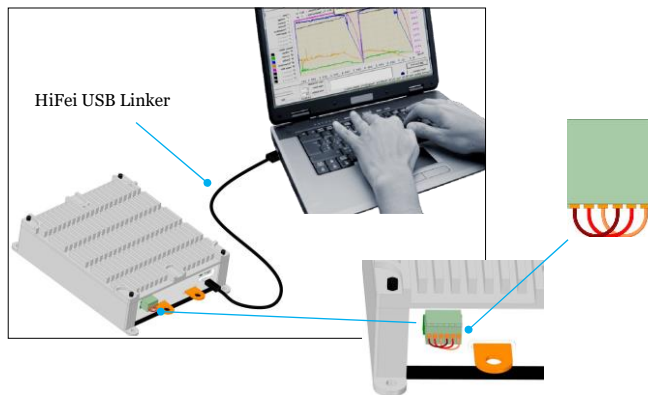

HiFei USB Linker

Fig. 6: Wiring Diagram of Firmware Upgrade

RPM Sensor

Fulcrum III SHV has a built-in RPM sensor to provide the rpm signal to the third party devices such as Vbar/mini Vbar / Skookum/BeastX Plus, and the RPM signal specification as following:

RPM Signal Voltage: 3.3v
RPM Signal Duty Cycle : 50%
Internal Resistance: 510 Ohm

Anti-Spark Circuit
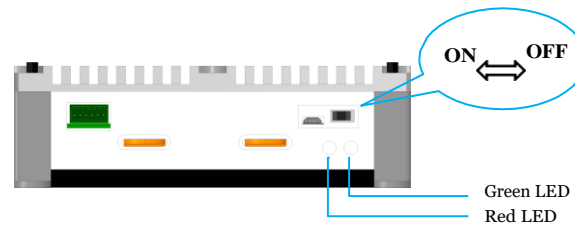

ON ⟷ OFF

Green LED
Red LED

Fig. 7 : Anti-Spark operation procedure

Fulcrum III SHV has a built-in Anti-Spark Circuit, anytime before you connect the power cable, Please make sure to keep the ON/OFF switch at OFF position, after the power cable connected, move the ON/OFF switch to ON position (the green LED light) to power on the ESC.

HiFei WIFI Dongle (Sold Separately)

Reset
Antenna
Mini USB
Reserve

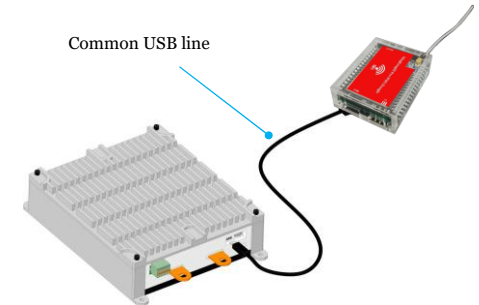### Connect the WiFi dongle with Fulcrum III SHV ESC

Common USB line

Fig. 7: connection with WiFi Dongle

Note:
1) **Keep the length of USB cable no more than 500mm**
2) **Compatible to any kind of smart mobile phone, PAD or PC   with iOS/Android/Windows Operation System**
3) **Support all kind of browsers such as: Chrome, IE, Safia,Firefox,etc.**

• Connecting the cable to ESC and WiFi dongle (Figure 6)

• Power on the ESC (the red LED of dongle will light a while and then black out) , waiting more than 20 seconds till the green led on dongle start to blink.

• Option **HiFei-KIII** in the WLAN list of your smart device

• Open your browser and input the default IP address & password as following:

  IP address 192.168.1.16:2015

  Password   12345678

• Entered into the Home Page
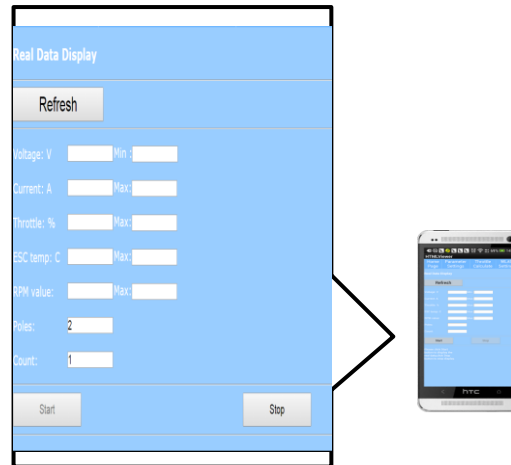
Home Page

Parameter Settings
Real Data Display
Throttle Calculate
WLAN Settings
Copyright © HiFei Technology

KingKong III PRO

Real-time Data Telemetry

Real Data Display

Refresh

Voltage: V   Min :
Current: A   Max:
Throttle: %   Max:
ESC temp: C   Max:
RPM value: Max:
Poles: 2
Count: 1

Start   Stop

WLAN Setting

Home Page   Parameter Settings

WLAN Settings

AP Name:
PassWord:
IP Address:

Update   UpLoad

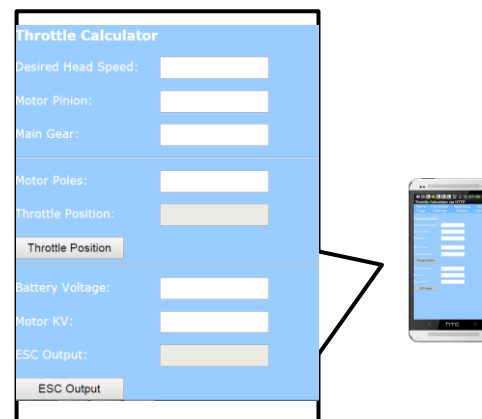If modified the AP name, please research the new AP name setting by press the button on WIFI module.

Note: After Updated the The AP name and IP Address, Please press Reset button in 1 second and release, the red LED will blink in 5 seconds and go to steady light, after that ,you have to re-power up the WiFi dongle to make the change available.

Parameters Setting

Home Page   Real Data Display

Parameter Settings

Low Voltage Cutoff:	Auto
LVC / Per cell:	2.5 V
Current Limiting:	sensitivity
Brake Type:	no brake
Timing:	Low
Cutoff Type:	Hard Cutoff
Startup Type:	Soft Start
PWM Rate:	8 KHz
Active FreeWheeling:	Disable
Governor Mode:	Fixed Endpoints

Helicopter Mode

Spool Up Rate:	Level 1
Governor Gain:	Grade 1
HS Change Rate:	Very Slow
R Recover Time:	Disable

Update   Back to Default   UpLoad

Note: the updated parameters will be available only after the ESC is re-powered up.

Throttle Calculator

Throttle Calculator

Desired Head Speed:
Motor Pinion:
Main Gear:

Motor Poles:
Throttle Position:

Throttle Position

Battery Voltage:
Motor KV:
ESC Output:

ESC Output

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