Scorpion Power System

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Scorpion
User Guide for
Commander V SBEC
Series ESC

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SAFETY

⚠ Scorpion and their re-sellers are not responsible for your use of this product, or any damage or injuries you may cause or sustain as a result of it's usage.

⚠ Understand that an electric motor that is connected to a battery and speed control may start unexpectedly and cause serious injuries. Always treat them with necessary respect. Keep the propeller away from your body and others at all times.

⚠ We suggest that you remove the propeller when you are working on the plane with the battery connected.

⚠ We suggest that you remove the pinion when working on a Helicopter with the battery connected.

⚠ Please observe all local laws regarding the flying of remote control aircraft.

⚠ Never fly over others or near crowds.

Included in the Box

1x Scorpion Commander V SBEC Series ESC   1x IR Receiver

1x IR Program card   1x Instruction Manual

Commander V SBEC Series

The Scorpion Commander V SBEC Series ESC is come with two different versions.

◆ 50V 90Amp   ◆ 50V 130Amp

Please identify which ESC's you are using as it will help you with setup in the manual. Both versions are come with the internal BEC and have an external governor function.

Features of the Commander V Series

1. BEC is rated as 15Amp peak with 5.4 6.2, and 7.4V selectable.

2. Additional red male wire for phase sensor output, has to be used with Scorpion OPTO cable (sold separately) to connect external governor.

3. External governor function as new function "Air 2", when power up, will DI DI DO DO, for all other setup, only have DI DI only.

4. For Air 2, there is NO need to do throttle calibration, however if you are NOT using AIR 2, you must do throttle calibration or else the ESC will not be armed.

5. Additional Commander V Link cable for upgrading ESC firmware (sold separately).

1.0   Connecting your ESC

* for connection diagram, please refer to back of this manual

1.1   Add your battery connector

You must attach a quality battery connector of your choice to the red (positive) and black (negative) power wires. Solder the battery connector to the wires. ENSURE THAT THE POLARITY IS CORRECT (red wire (positive) to battery red wire (positive), black wire (negative) to battery black wire (negative)). Follow the instructions provided with the battery connector.

1.2   Connect Motor to ESC

Recommend using bullet connectors to connect your ESC to your motor as most of the Scorpion motors come with pre-installed bullet connectors that include a female set for your ESC. Solder the corresponding connectors for your motor to the wires coming from the ESC, or solder the motor wires directly to the motor leads. You may find it convenient to temporarily connect the motor leads to the ESC and test for proper rotation before you permanently solder them. Once connected DO NOT allow any exposed wire or connectors to contact each other, insure that proper insulation around each of the three wires is achieved, Heat shrink is the best material for this job. Failure to do so will cause the ESC malfunction and void your warranty.

1.3   Connect to your receiver

Connect the receiver lead (the three colored small wires with a black plastic connector on the end) to the throttle channel on your receiver and conect the power lead to a spare chanel on your receiver, it's recommended to install a back up battery for your onboard radio system as a back up to the BEC.

Connect a receiver battery pack to the receiver, always turn on the receiver from the backup battery and power down the receiver with the backup battery. Therefore, you can check if the BEC is working properly or not, after, you can disconnect the main power to the ESC.

1.4   Mounting the ESC

Mount the ESC with the Heatsink side of the controller facing outward. We recommend using Velcro to attach the ESC to the airframe for easy removal. Double sided tape is also acceptable. If zip ties are used, do not place them over any of the components on the ESC. Instead, zip tie around the metal heat sink, leaving some slack to allow for movement.

2.0　Using your Scorpion ESC

2.1 Ensure that Initial setup (4.0) has been done before using your ESC.

2.2 Ensure that the ESC is connected to the proper channel on your receiver.

2.3 Turn your transmitter ON and set the throttle stick to zero throttle.

2.4 Connect the main power battery to the ESC.

2.5 The ESC will beep the motor 2 tones or 4 tones (depends on which mode) to indicate that it is armed.

⚠️ Place the IR receiver away from the motor with a distance to avoid any interference with the IR receiver.

⚠️ To arm the ESC ready for use, you must disconnect the battery, then move the throttle stick to zero and reconnect to power-up. The ESC with full throttle for ten seconds will back to factory default setting. All previous setting will be lost.

⚠️ Always power your radio transmitter before powering up the receiver and/or the ESC. Some receivers with failsafe features or spektrum receiver units that are not bound on receiver power up are entirely capable of causing the arming sequence to occur and command the ESC to driver the motor. Always keep the aircraft restrained and clear of body parts when the ESC is powered.

⚠️ If your ESC cannot sense any radio signal it will beep the motor and flash orange on the LED continuously.

3.0　Scorpion Commander features

All Scorpion ESC programming features are available though the use of the ESC programming card included with your ESC. So there is NO NEED to purchase any other cables or cards to allow you to program your ESC properly.

Scorpion ESC's come with default factory settings which are recommended for most applications. Programming options can be changed at the discretion of the user. See section 6.0 for programming instructions.

Safe Power up	To arm the controller, the throttle must be held in the "Brake/Zero" position (all the way down). If throttle is not at zero at startup, the ESC will not provide any power to the motor regardless of where the throttle stick is positioned when first powered up.
Loss of signal (fail safe)	The Scorpion ESC will stop the motor as a safety feature when the throttle signal is lost or corrupt for 3 seconds. If a signal is regained the user will have instant control again.
LED*	The LED is used for programming /startup confirmation of your Scorpion ESC. Once armed the LED can be set to give an indication of low battery conditions, you may extend the LED wire by adding an extention wire.

Low Voltage Cutoff	You can choose for your ESC to stop or reduce power when the input battery voltage drops to a preset/programmed cutoff voltage.
Current Limiting	Amp output limit, the output is rated at 10% over the rated Amp. At approximately 10% over the rated Amps it will automatically limit the output to the motor, as long as the motor is not rated too much over the ESC spec limits, this safety mechanism will prevent a over load to the ESC but if you install a motor for example rated at 100 Amps on a ESC that are rated for only 60 Amps, this mechanism will not work properly due to the instant surge of power demand from the motor, it may shutdown too early or simply fry the ESC, the only solution to this is to never use a Motor that has a rating bigger then the ESC, don't even think you can use it if you run the motor at a slower RPM or load, it will not work and void your warranty!!
Thermal Protection	At 95°C, the ESC will slowdown the power output to the motor by 50% (the on board LED will flash red), to re-initiate full throttle you need to move the throttle stick to idle position and then the ESC will resume normal output once you throttle up again. If your ESC is over 60°C on startup it will not arm red LED will flash and a DI DI DI sound will be played.
Brake	Stops rotation of the motor when the throttle signal is moved to the lowest position.
Throttle	Airplane and Heli modes come pre-programmed and can be selected by the user.
Electronic timing	Manual settings that may improve the efficiency of the system for some motors are available. The standard Scorpion setting is to automatically detect and adjust for the motor it is driving.

4.0　Initial setup

You MUST perform throttle range setup before the first use of the ESC, except if you are using AIR MODE 2, remove propeller/pinion from motor or back off pinion from main gear while performing initial throttle range setup.*

4.1 Turn on transmitter and receiver, then set throttle to maximum position be sure that your throttle curve is set at 0% minimum throttle and 100% at maximum throttle.

4.2 Place the switch on the IR receiver to PPM (see section 5.0) Connect battery to ESC. After few seconds you will hear 2 beeps come from the motor to indicate you are in throttle calibration mode.

4.3 Once you have heard these two beeps move your throttle to minimum position within 10 seconds and hold throttle at minimum position. Then you will hear 4 beeps indicating minimum throttle position is set and confirmed. Your ESC will also arm after you have set the minimum position. You only need to do this once as throttle range will be stored in the memory of the speed controller. You can reset the throttle range by performing steps 4.1 to 4.3 again.

✳️ If using Futaba Radio, please reverse the throttle channel.

⚠️ Please note: once maximum throttle position has been set. (If at this time, you leave the throttle stick at maximum position for over 10 seconds, the ESC will reset itself to Factory default settings).

5.0 Connecting your Scorpion ESC to the programming card

Your Scorpion ESC is programmed using the Infrared (IR) Program card and Receiver included with this ESC. First you must connect your IR Receiver to your ESC. Ensure the brown wire from your ESC is facing outwards.
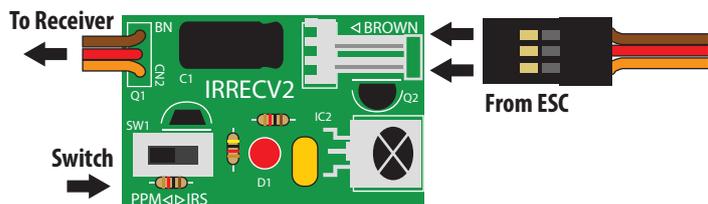
5.1 Once you have plugged in the IR Receiver push the switch across to IRS.

**5.2** Now connect a battery to the ESC. Your Motor will emit 3 beeps and the LED will flash 3 times red.

5.3 Your IR Receiver is now ready to receive a signal from the program card.

⚠ Direct sunlight may interfere the IR receiver, so to program your model we suggest doing it indoors in the shade out of direct sunlight.

⚠ Before flying you will need to place the switch back to PPM mode.

6.0 Using the Programming Card

All parameters of the ESC can be changed via the program card.

ESC Programming Card
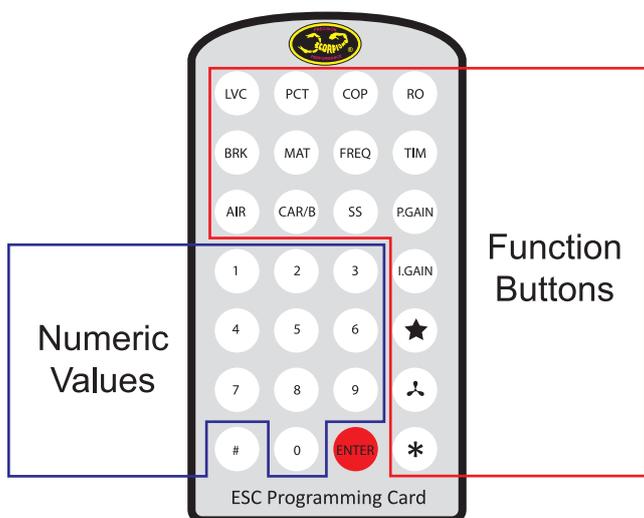
To program any function on the card you must follow the following procedure:

6.1 Press a function button

6.2 Enter a numeric value

6.3 Enter to complete

Example LOW Voltage Cut to enter 36V:

PRESS LVC ▶ 3 ▶ 6 ▶ 0 ▶ ENTER

If successful a DI DOO sound will come from the motor and the LED will Flash RED. An invalid option will not get any confirmation sound from the motor and the LED will not flash.

⚠ Please note that there is a time limit from when you press a function button the numeric values and enter if you go over this time limit no sound of flashes will come from the ESC.

Definition of Function Buttons

Function Button	Numeric value	What it does
Example from Above	360	Sets Low Voltage Cut to 36.0 Volts.
LVC 50V ESC (Low Voltage Cut)	120-480	Low Voltage Cut 120 (12V) to 480 (48V) in 1.0 V increments. *12V
BRK (Brake Setting)	1* 2 3 4 5	*No brake Very soft brake Soft Brake Hard Brake Very Hard Brake
AIR	1* 2	Activate Airplane mode External governor mode
PCT Program Cut Type (LVC type)	1* 2 3	Cut 50% of maximum power No Cut just LED warning Pulse warning
MAT Motor Acceleration Time Delay	1* 2 3 4 5	0.15 second (recommend for AIR 2) 0.3 second 0.45 second 0.7 second 1.3 second
CAR/B Car/Boat Mode	Disable	No Function is Available
COP Current Overload Protection	1* 2	Protection on Protection off (this option will void warranty)
FREQ Drive Frequency	1*	8k Hz
SS (Heli Mode / Soft Start Mode) See section 8.0	1* 2	Heli mode with soft start, Variable throttle adjustable. Heli mode with soft start and governor. (See Governor Section)
RO Motor Rotation Direction	Disable	No Function is Available
TIM Motor Timing	1* 2 3 4 5 6	Auto Timing 5° (recommend for GOV 1) 15° 20° 25° 30°
P.GAIN	1~11 5*	Soft~Hard
I.GAIN	1~8 5*	Insensitive~Sensitive
⚙ Auto Rotation (Bail Out Time)	1* 2 3	15 Seconds 25 Seconds 35 Seconds
✱ BEC voltage setup	1* 2 3	5.4V 6.2V 7.4V
ENTER		Enter value send signal to ESC
OTHER		All other keys are reserved for future programming options

*Factory Default

⚠ To reset all parameters to Factory Default:

PRESS # ▶ 1 ▶ ENTER

7.0   Lights and Sounds

Your ESC will emit different lights and sounds according to the function it is applying below is a table of the following conditions:

No Signal from receiver at startup	LED light will flash orange with constant 2 warning tone. If Using program card, the LED will flash red and emit 3 beep tones then you will enter setup mode.
Loss of signal during operation	LED will flash red with a 2 beep warning tone.
Over temperature during power up (>60°C)	LED will be constant red with 2 beep (DI DO) warning tone. To restart, disconnect power source, wait for cool down then re-connect.
Over heat during operation (>85°C)	Power reduced to half throttle, red LED will flash. To reset throttle must be put into idle position.
Power on low voltage warning	LED will flash red quickly with beep warning tone when voltage is lower than preset cut-off voltage.
Low voltage cut warning	When voltage is lower than preset cut off voltage, red LED will flash rapidly red.
Over Amp Protection	Is only activated at over 50% throttle during over-amp protection, LED will flash red rapidly.
Soft start indication	Orange LED will flash to indicate soft start is activated, it will turn off automatically when soft start has been completed.

8.0 Heli Mode (Soft Start) Function

In Heli Mode 1 (SS [1]), the governor function is disabled.
The following parameters will be changed.

BRK   Brake = [1] No Brake

When the throttle stick is in the minimum position and the Heli Mode 1 is enabled, the motor will accelerate slowly until reaching the throttle position, then the acceleration time will be back to the default setting of MAT (Motor Acceleration Time Delay).

After landing, the soft start function will not be enabled until the throttle stick is moved to the minimum position over bail out setup time is completed.

In Heli Mode 2 (SS [2]), the governor function is enabled and only Option 1 or 2 can be selected in PCT.
The following parameters will be changed.

BRK   Brake = [1] No Brake

P.GAIN   P.GAIN = [5]

I.GAIN   I.GAIN = [5]

Different speeds can be set in Governor function, throttle should have at least 5% difference. The throttle range should be between 30% and 95%.

During landing, the soft start mode will not be enabled until the throttle position is moved to the minimum position over 12 seconds. (See Section 9.0 for more information about Governor Mode)

9.0 Governor Function for helicopters

Scorpion has developed a build-in governor that uses complex mathematics and fast processor speeds to provide one of the most user friendly and advanced governors on the market today.

Please follow the below steps to setup the governor on your ESC.

What it does
A Governor is designed to Govern the speed of your main rotor blades. In basic terms this means that the ESC will try to keep the same rotor blade speed (set by you) regardless of the amount of load on the main blades and load on the motor. To do this the ESC tracks the motors speed and will automatically increase or decrease the power to the motor to maintain constant rpm or headspeed.

What it allows you to do
- Push 3D performance to the limits by giving you more power when you need it while keeping the rotor speed constant at other times.
- Give you consistent flight feel from start to finish; unlike some ESC governors, RPM does not drop as battery voltage drops (as long battery can provide enough power).
- Takes the Guesswork out of setting up Throttle Curves.

Programming the Governor
Before programming the governor you must perform the initial Setup in section 4.0 in this manual first.

Items you will require
Head Speed Tachometer
1.   Insure you have the IR Receiver Plugged in Refer to Section 5.0 of this manual
2.   Remove the motor pinion or back off pinion from main gear
3.   Power ESC
4.   Move Switch of IR Receiver to IRS (program mode see section 5.0)
5.   3 beeps will sound you are now in program mode
6.   Press SS > 2 > Enter. 2 beeps will sound confirming SS 2 mode selected
7.   You can reengage the pinion to the main gear

Radio Setup
1.   Set your throttle hold position in your radio to 0%
2.   In your radio you need to set your throttle curves to the % of throttle you wish to operate your governor at. It is a good idea to use a head speed calculator first to find out an estimated target HS you wish to achieve.
3.   Once you have estimated the amount of throttle needed to achieve your target head speed enter it into a throttle curve so that it is the same % of throttle across the entire range eg I would like 80% throttle for all points across the curve you should have flat line at 80%. You can only select values from 30-95% throttle.
4.   You can have different throttle values for each flight mode and you can flick between them in mid flight in order to change your headspeed in flight.

Startup Procedure (Read all steps before attempting)
1.   Turn on your radio and place throttle hold switch to ON.
2.   Plug your ESC to the main power battery.
3.   Wait for it to arm (2 beeps).
4.   Select the flight mode you wish to fly in.
5.   Insure your blades are at 0 deg pitch (If your blades are not at 0 deg your governor will not set itself properly). **Only on first initial setup**.
6.   Turn throttle hold switch OFF.
7.   Soft start will initiate – Wait for the blades to stabilize speed. (The LED will glow orange during startup and will turn off once the headspeed has been set and stabilized).
8.   Turn-off the motor, waiting for 15 seconds. For the ESC to store the head speed value, then disconnect the power or continue your flight.

Auto Rotation Bail out Feature

For Soft start mode and Heli mode, if you attempt an autorotation once you have switched your throttle hold switch you have a 15, 25 or 35 seconds time window (set in Auto Rotation) where if you feel you cannot make the auto rotation you can switch the throttle hold off and your helicopter will instantly regain throttle to either your stick position in Soft start mode or your set governor throttle %.

Tips For Setting Up The Governor

To Program the ESC to optimize the RPM range, please follow the below instruction:

- Make sure you have a fully charged flight pack.
- Program SS [2] on the Program card (Soft start with Governor Function). Please See Section 6.0 for further help.
- Spool up the helicopter to 50% throttle in fairly rapid movement (either engage the idle switch with a 50-50-50-50-50 curve or move throttle stick without hesitation)
- Stay at zero pitch, and leave the stick there until the LED on the ESC turn off.
- Stop the motor by either lowering the throttle stick or engage throttle hold.
- Wait 15 seconds then turn unplug the flight pack.

The helicopter is now ready for flight where you can program your throttle curves as you wish.Remember that Governor do like flat curves as it has to re-acquire its RPM at each throttle change.A flat curve like 80-80-80-80-80 is required for idle-up where the actual percentage determine your headspeed.

Please note: A motor that surges in hover is indication that above routine was not performance correctly, so you need to re-program the governor setup again.

10.0 I.GAIN & P.GAIN

The I.GAIN is integral gain, higher number will provide higher gain (tighter control).

When I.GAIN is too high, tail will swing (waging) due to rpm compensation is too fast for your heli.

When I.GAIN is too low, rpm will drop more before the governor start to compensate the rpm lost under load.

The P.GAIN is power, higher number will provide higher power.

When P.GAIN is too high, your tail will not hold under load, it will be pushed a way from the torque of the motor/ main blade, reduce P.GAIN will solve it.

When P.GAIN is too low, rpm will not hold well under load, (this depend on how good the tail is able to hold under the influences of the torque).

11.0 Trouble Shooting

- **?** If you hear a pulsed warning tone and/or see a continuous orange flashing LED after powering up the ESC: Check your transmitter. Is it on? If yes.
- **?** Check your throttle is at its minimum position. Your esc will not arm if your throttle is anything other then zero at startup if you have not yet done the initial setup for throttle calibration.
- **?** Check the ESC servo connection? Connection good? If yes.
- **?** Check the motor connection to the ESC, reconnect them if necessary. Check your battery. Full charged? Replace battery if necessary. Try another receiver.
- **?** Disconnect battery and then reconnect battery and start at step 2.0 again.
- **?** Motor does not shut off with throttle hold set throttle hold position to 0%.
- **?** After initiating esc with throttle hold on motor spins slowly when turned off > Set throttle hold to 0%.
- **?** If your motor is spinning in the wrong direction swap any two of the three motor wires. It does not matter that the colors do not match. Unlike the battery wires there is no polarity to the motor.

Abbreviated Terms

ESC = Electronics Speed Controller
LED = Light Emitting Diode
V = Volts
IR = Infra Red
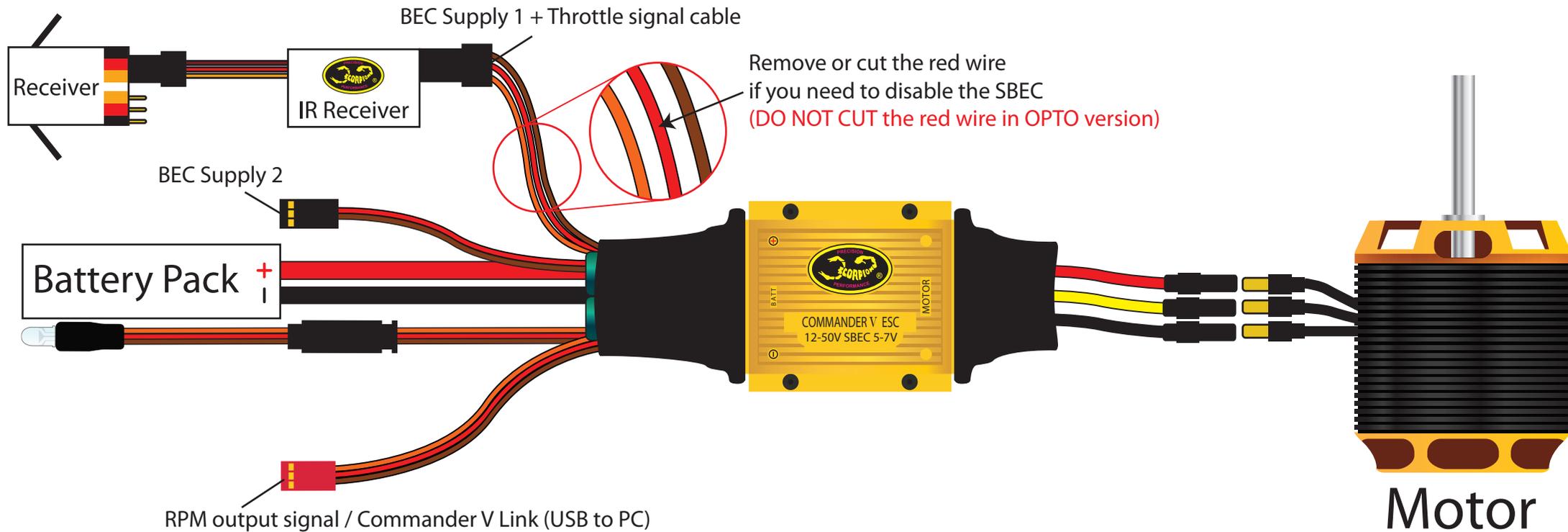RPM = Revolutions Per Minute

ESC Model	Type of BEC
12V 11Amp ESC	LBEC
15V 15Amp ESC	LBEC
15V 25Amp ESC	LBEC
17V 35Amp ESC	SBEC
17V 45Amp ESC	SBEC
17V 60Amp ESC	SBEC
17V 90Amp ESC	SBEC
17V 110Amp ESC	SBEC
26V 30Amp ESC	SBEC
26V 45Amp ESC	SBEC
26V 60Amp ESC	SBEC
26V 90Amp ESC	SBEC
26V 120Amp ESC	SBEC
26V 180Amp ESC	SBEC
Commander V OPTO 50V 90Amp ESC	OPTO
Commander V OPTO 50V 130Amp ESC	OPTO
Commander V SBEC 50V 130Amp ESC	SBEC
Commander V SBEC 50V 90Amp ESC	SBEC

Please visit our website regularly for updates, news and support: www.scorpionsystem.com

Connecting your ESC Diagram

SCORPION ESC

BEC Supply 1 + Throttle signal cable

Remove or cut the red wire
if you need to disable the SBEC
(DO NOT CUT the red wire in OPTO version)

Receiver

IR Receiver

BEC Supply 2

Battery Pack +
‒

COMMANDER V ESC
12-50V SBEC 5-7V

B A T T

MOTOR

PRECISION
PERFORMANCE

Motor

RPM output signal / Commander V Link (USB to PC)

⚠ Never connect the RPM output signal cable to your Receiver and never connect your Commander V Link to any other connecters on the ESC. Failure to do so will destroy your ESC and viod your warranty.

Optional Cables (Sold Separately) :

ESC   SCORPION   SIGNAL
OPTO CABLE   OUT

COMMANDER V LINK