

SPEEDMAX-LP

PROGRAMMABLE 20 AMP ELECTRONIC SPEED CONTROLLER

INTRODUCTION

SpeedMax-LP is an advanced, compact and light-weight 20 Amp Electronic Speed Controller (ESC) driven by a powerful RISC microprocessor and employing the latest MOSFET driving techniques, including variable frequency PWM and reverse exponential power curve using real-time polynomial solving. These features make SpeedMax-LP one of the most efficient ESCs across the full power range and provide the user with linear power output with respect to throttle stick position. The programming feature allows the BEC cut-off voltage to be set which is critical in preventing over-discharge of the Li-Po, Ni-Cd or Ni-MH battery pack.

FEATURES

| | |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Compact and light weight | See technical specifications. |
| Reduced RF interference | Passive interference counter-measures means no servo jitter! |
| Programmable BEC cut-off voltage | The cut-off voltage is used to cut power to the motor while still providing power to the servos and receiver. Programming the correct cut-off voltage protects expensive battery packs against over-discharging which damages cells. |
| Programmable end-points | During the programming procedure, the end points of the RC signal is detected and stored to memory allowing the throttle stick range to be correctly mapped to the power setting from start-up. |
| Reverse exponential power curve | A smooth reverse exponential power curve is calculated in real-time to map propeller thrust linearly over the throttle range. |
| Variable frequency PWM | The PWM switching frequency is dynamically varied which significantly increases brush and winding life of the motor, as well as improve efficiency which results in increased running time. |
| Battery Elimination Circuit (BEC) | Power is supplied to the receiver from the ESC via the servo lead, which eliminates the need for a separate receiver battery pack. |
| False start protection | On power-up, the ESC waits for zero throttle to be applied before arming itself. |
| Lost model protection | Power output to the motor will be disabled if the receiver is out of range of the transmitter, or if the transmitter is switched off. |
| Noise and "glitch" immunity | Multiple algorithms have been implemented to reject noise and "glitches", protecting against erroneous or unexpected behaviour. |

TECHNICAL INFORMATION

| | | | |
|----------------------------------------------|--------------------|------------------------------------|---------------------|
| Continuous current rating¹ | 20 A | Typical on resistance | 4.6 mΩ |
| LiPo cells | 2 – 3 | PWM Frequency (variable) | 1.25 kHz to 2.5 kHz |
| Ni-Cd cells | 5 – 10 | PWM Resolution | 160 steps |
| Operating voltage | 5.0 V – 12.0 V | Current consumption | 13.2mA @ 12V |
| BEC | 1A : 5V | Module size | 18.4 x 14.2 x 6mm |
| Programmable cut-off | 5, 6, 7, 8, 9, 10V | Weight with/out power leads | 14.98g / 6.22g |

INSTALLATION

Connect SpeedMax-LP to the motor using the red (Positive +) and blue (Negative -) power leads marked M+ and M- respectively. If there are no suppression capacitors on the motor, it is highly recommended that two 47nF ($\pm 47 \times 10^{-9}$ Farad) ceramic capacitors be installed, one between the positive terminal of motor and the metal motor casing and the other between the same point on the casing and the negative terminal of the motor.

Next, connect the ESC to the battery using the red (Positive +) and black (Negative -) power leads marked B+ and B- respectively, trimming them to the minimum possible length (do not exceed 4.7in / 120mm) and paying careful attention to the polarity. If the distance between the battery and motor is large, rather increase the cable length between the ESC and motor, not the ESC and battery!

WARNING: SpeedMax-LP does not have reverse battery protection. Reversing the polarity of the battery may result in permanent damage to the ESC and the battery. ALWAYS follow the correct connection procedure and use polarised connectors, which cannot be connected the wrong way around.

¹ Requires airflow cooling above 16A continuous.

OPERATION

Be sure your frequency is not in use by someone else before turning on the transmitter. With the jumper removed, connect the battery or turn on the ESC's switch (if installed). Move the throttle stick to minimum position (zero throttle) for a half second to arm the ESC (*false start protection feature*). The LED will flash in rapid succession until the ESC is armed. When armed and at zero throttle, the LED will flash the programmed cut-off voltage, which is represented in Table 2 below. Move the throttle stick forward to apply power to the motor. At full throttle the LED will turn on – this may be useful for troubleshooting. If the RC signal to the ESC is lost, power to the motor will be cut (*lost model protection feature*). If the battery voltage falls below the programmed cut-off voltage, power to the motor will be cut. The cut-out condition can be (temporarily) reset by briefly moving the throttle stick back to minimum throttle.

PROGRAMMING THE CUT-OFF VOLTAGE

To enter programming mode, remove power to the ESC and then do one of the following:

Method 1: 1-Insert the jumper, 2-connect the battery, 3-turn on transmitter, 4-follow instructions in "**Programming Mode**" below.

Method 2: SpeedMax-LP conveniently provides an alternative method to enter programming mode if the jumper pins have been removed or if a jumper cannot be found while at the field. To enter programming mode using this method:

1. Centre the throttle stick and trims (try to be accurate with the centre position) then turn on the transmitter.
2. Connect the battery to the ESC. The LED will illuminate for 2 seconds. See Troubleshooting below if necessary.
3. When the LED turns off, quickly move the stick to top position (full throttle). The LED will illuminate for 2 seconds.
4. When the LED turns off, quickly move the stick to bottom position (zero throttle). The LED will illuminate for 2 seconds.
5. When the LED turns off, quickly (**and carefully**) move the stick to centre position. If successful, the ESC will be in programming mode (see below).

Programming Mode:

Programming mode commences by the LED flashing 1 to 6 times with a pause, then repeating. If the throttle stick is moved, the number of flashes between pauses will change. The table below shows the relationship between the number of flashes and the throttle stick position. But before setting the cut-off voltage and in order for the ESC to 'learn' your particular transmitter's end points (they're all slightly different), move the stick to the full throttle position for about 1 second and then to zero throttle for about 1 second. Now move the throttle stick to the position that gives the correct number of flashes according to the cut-off voltage you require.

| Throttle Position | LED Flash | Example (* indicates flash) | Cut-off V |
|-------------------|-----------|---------------------------------------|-----------|
| 0% – 16.7% | 1 | * pause * pause * ...etc. | 5 V |
| 16.7% – 33.3% | 2 | ** pause ** pause ** ...etc. | 6 V |
| 33.3% – 50% | 3 | *** pause *** pause *** ...etc. | 7 V |
| 50% – 66.7% | 4 | **** pause **** pause **** ...etc. | 8 V |
| 66.7% – 83.3% | 5 | ***** pause ***** pause ***** ...etc. | 9 V |
| 83.3% – 100% | 6 | ***** pause ***** pause ***** ...etc. | 10 V |

The ESC will store the setting to memory when the number of flashes has not changed for 10 seconds. Once the required number of flashes has been selected, leave the throttle stick in that position and 10 seconds later the ESC will store the associated cut-off voltage (indicated by a 2 second pause – watch carefully!) Once stored, remove the jumper and continue with normal operation (see "**OPERATION**" for more details). This programming procedure may be carried out at any time as and when required.

Troubleshooting: If the LED rapidly flashes at any time during this setup, you will need to start again. It means that the stick was not in the expected position at the expected time. If the LED does not flash at all, the ESC has not detected a valid RC signal.

CUT-OFF VOLTAGE GUIDELINE

Please use the following guidelines for programming the cut-off voltage. Pay particular attention to the Li-Po cut-off voltage as over-discharging these cells may cause them to explode or catch fire.

| Cell chemistry | Li-Po | | Ni-Cd / Ni-MH | | | | | | | |
|-------------------|--------------|-----------------|---------------|---|---|---|---|----|-----|----|
| | No. of cells | Cut-off voltage | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 |
| Number of flashes | 6V | 9V | 5 | 6 | 7 | 8 | 9 | 10 | 10V | 6 |
| | 2 | 5 | 1 | 2 | 3 | 4 | 5 | 6 | | |

CONTACT

This product is designed and manufactured by FirmTronics. Visit us at www.firmtronics.com for more information, including troubleshooting, updated user manuals and other product information. If you have any suggestions, comments or general feedback, please email us at info@firmtronics.com.

WARRANTY

FirmTronics guarantees this product to be free from defects in materials and workmanship for a period of 90 days from the original date of purchase, verified by a sales receipt. This warranty does not cover incorrect application, incorrect installation, components worn by use, reversed voltage, improper voltage, tampering, misuse or shipping. Our warranty liability shall be limited to repairing the unit to our original specifications and in no case shall liability exceed the original cost of the product. By the act of installing or operating this product, the user accepts all resulting liability. We reserve the right to modify the provisions of this warranty at any time without notice.