

SPEEDMAX-40

PROGRAMMABLE 40 AMP ELECTRONIC SPEED CONTROLLER

INTRODUCTION

SpeedMax-40 is an advanced, compact and light-weight 40 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-40 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 and the propeller brake to be enabled or disabled. Setting the cut-off voltage is critical in preventing over-discharge of the battery pack for Li-Po and Ni-Cd or Ni-MH packs.

FEATURES

Programmable brake	Enabling the brake will stop the propeller wind-milling when throttle is set to zero.
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	40 A	Typical on resistance	2.3 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	25.6 x 17.6 x 6mm
Programmable cut-off	5, 6, 7, 8, 9, 10V	Weight with/out power leads	17g / 8g

INSTALLATION

Connect SpeedMax-40 to the motor using the red (Positive +) and blue (Negative -) power leads, marked as M+ and M- respectively. Make sure the motor has RF interference suppression capacitors. 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, 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-40 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.

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 1 below. Move the throttle stick forward to apply

¹ Requires airflow cooling above 35A continuous.

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 AND BRAKE

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-40 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 without using a jumper:

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!) and move onto the brake enable/disable mode. The following table shows the relationship between throttle position and brake enable/disable.

Throttle Position	LED Flash	Example (* indicates flash)	Brake
0 – 50%	1	* pause * pause * ...etc.	ENABLE
50 – 100%	2	** pause ** pause ** ...etc.	DISABLE

In a similar way to programming the cut-off voltage, select the number of flashes to enable or disable the brake. Leaving the throttle stick for 10 seconds will allow the ESC to store this setting to memory. This is indicated by a 2 second pause in flashing. Once stored, remove the jumper (if used to enter programming mode) and continue with normal operation (see “*OPERATION*” on page 1 for more details). This programming procedure may be carried out at any time as and when required. Note: the cut-off voltage and brake must be programmed in the same programming session.

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.

Table 1: Cut-off voltage guideline

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	5V	6V	7V	8V	9V	10V		
	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

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