Skymaster

95 Amp Programmable Speed Controller

General

Skymaster was especially designed for high performance electric planes running large motors on 6 to 12 cells (7 to 18V) and currents over 150 Amps on variable throttle with ventilation. Significant gains can be achieved when using Skymaster with smaller motors drawing lower currents due to the very low on resistance and extremely low losses.

Features

- High variable current (150 Amps for 10 seconds, 95 Amps continuous)
- BEC, 1 amp continuous with low voltage battery, up to 2 Amps peak.
- Low battery cut out, programmable for 5.00 to 14.38 V
- Very low on resistance (~0.7mΩ) for minimum loss and high available currents.
- Small package, lightweight. (32mm dia x 9mm thick & ~5g without leads)
- Micro controller controlled full digital operation for proper performance under adverse conditions (dust, moisture, electrical interference and vibration).
- Innovative design with direct motor mount for shortest and simplest wiring, least interference and better ventilation.
- Uses the very latest and best available surface mount components for the highest possible power output from the smallest package.
- Programmable for full power and off throttle positions, ramp up, brake delay & Low Battery Voltage Cut Out.
- Accommodates all radios, allowing complete control over throttle spans.
- No Radio Signal failsafe. Applies brake after 1/8th sec. without radio signal, and flashes LED.
- LED which shows radio signal failure, full throttle, off, and assists in programming.
- Programmable soft power up to prevent high motor torque and propeller damage. Ramping can be from 0 sec to approx. 0.6 sec. for full throttle range. Throttle range is from 20% to full on. 20% throttle is just enough to open folded propellers.
- Programmable Brake, which can be programmed as no brake for ducted fan and helicopter applications, or as a ramping brake which can be programmed to take from ~0.1 to 1.5 seconds to become fully on. The ramping brake prevents high torque and propeller damage.
- Switch less programming.
- Ramp Up, Brake and Low Battery Voltage Cut Out (LBV cut out) are programmed in a separate programming sequence, so that these variables can easily be changed without effecting throttle positions programming.

Mounting

Skymaster is designed to be mounted directly to the motor. Simply bend the 2 copper terminals to match your motor and solder in place, ensuring the B/M+ terminal is soldered to the positive terminal of the motor for normal rotation. The copper terminals have been soldered to Skymaster with high temperature solder. Tin the terminals on the motor and Skymaster before joining them together, and then apply the soldering iron for no longer than necessary to achieve a good bond.

Important :- It is extremely important that the motor has RF capacitors to prevent radio interference and damage to Skymaster. If you have any doubt as to whether your motor has capacitors inbuilt, solder a capacitor from each motor terminal to the motor casing & one between the terminals. Capacitors are supplied with Skymaster for this purpose.

Other Connections

Skymaster requires no external schottky diode, as it is included in the device. Keep battery wires as short as possible to reduce power loss and radio interference and keep radio wires away from power leads as much as possible.

Mount switch to fuselage if required (recommended).

Plug radio plug into throttle position of receiver.

Operation

Throttle

Throttle response is as follows :-

- Increasing throttle above off. Motor starts at 20% power so that folding propellers will be activated. Motor speed ramps up at the ramp rate till the current throttle position is reached. LED is off.
- Throttle over Full Throttle. Motor ramps to full speed. Additional throttle has no effect. At full speed LED is on. Note:- Skymaster rejects signals which are outside the normal range of an RC transmitter. If you have a transmitter, which is or has been adjusted outside the normal span, the signals in this region will be rejected (glitch rejection) and Skymaster will respond to the last received acceptable signal. This means that if the throttle were to be increased quickly on this transmitter, then Skymaster may not reach full throttle. If this occurs, reduce the span in this direction.
- Reducing throttle to Off. Motor responds immediately to throttle reduction (no ramping). When off is reached, motor turns off and brake ramps from 0 to full at the rate programmed. If zero programmed no brake is applied. Throttle movement below Off position has no effect. LED is on when full brake is reached or in Off with no brake.

LBV cut out

LBV cut out operates constantly from 1 second after an increased throttle movement has finished ramping. When the **loaded** battery voltage reaches the programmed limit, the motor behaves as if returned to off, and the brake is applied as programmed. The throttle is now inactive and the motor cannot be restarted till Skymaster is turned off.

Battery Eliminator Circuit

The BEC operates from a single Low Voltage Drop-out regulator, which can handle 1.5A continuous and peaks up to 2.9A, with power dissipation of 2.9W. This means that at battery voltages above 6.9 V you can no longer draw 1.5A continuously. The amount you can draw is given by the following formula :-

$$\text{Cont. Current Draw (A)} = \frac{2.9}{\text{Battery voltage} - 5}$$

This means that with a battery of 18 V, only 223 mA can be drawn continuously. Peak currents can still be 2.9A. Over currents will cause the BEC to reach its thermal limit, reducing the current available.

This may not be a problem, as 800 mA will run 2 standard size JR servos stalled (maximum current).

If required, the red wire can be removed from the Skymaster servo lead, and a separate battery can be used to run the radio.

Programming

Skymaster is programmable for Full Throttle and Off positions, Ramp Up (Soft Start), Brake (including no brake) and Low Battery Voltage cut out level.

To program Skymaster (SM) follow this procedure :-

1. Turn on the transmitter and apply full throttle.
2. Whilst still applying full throttle, plug in the controller to the battery. If switch is fitted, turn on the switch. (SM will need to have been unplugged for at least 3 seconds prior to this step).
3. SM replies with two (2) flashes on the LED. (If 2 flashes aren't received, increase the throttle trim and repeat steps 1 & 2 again. If still no response, reverse the throttle output from the radio repeat steps 1 & 2 again).
4. After receiving 2 flashes, move the throttle to the Off position. After 2 seconds SM saves the Off setting and responds with 1 flash.
5. Move the throttle to the full throttle position. After 2 seconds SM saves the Full Throttle setting and responds with 3 flashes.
6. Programming is finished and SM is programmed with no ramping, no Brake and 5V LBV cut out.
7. SM will not respond till throttle is moved to below the Off position, so as to prevent sudden motor operation.

So normal sequence is :-

F.Throttle ✳✳ _ _ Off ✳ _ _ F.Throttle ✳✳✳ ready

where (✳) = LED flash and (_) = 1 second

Ramping, Brake & LBV Cut Out

i. If after step 3 above the throttle is held at Full Throttle for a further 2 seconds, SM will reply with two (2) more flashes on the LED.

ii. Return the throttle to Off and re-apply within 1 second. The LED goes off and then back on. SM counts 1 step of Ramp. You can skip this step or repeat it up to 8 counts. Each count programs SM with approx. 0.07 seconds of ramp (it will take SM 0.07 sec to achieve full throttle from off if full throttle is applied suddenly) up to a max. ramp time of ~0.6 seconds.

iii. Return the throttle to Off. SM will wait 1 second and flash 3 times as before.

iv. Apply the throttle again during the next 1 second and Step ii will be repeated but this time for Brake. As before, this step can be skipped or repeated up to 8 times. **Zero Counts = No Brake.** Each counts adds ~0.16 seconds of time to the brake ramp. i.e. with 1 count the brake will go from zero to full in ~0.16 seconds. With 8 counts it will take 1.28 seconds.

v. Return the throttle to Off. SM will wait 1 second and flash 3 times as before.

vi. Apply the throttle again during the next 1 second and Step ii will be repeated again, this time for Low Battery Voltage Cut Out Level. As before, this step can be skipped or repeated up to 15 times. Zero Counts = Cut Out at 5V. Additional counts add 0.63V to the level, with 15 counts = 14.38 V.

vii. Return the throttle to Off. SM will wait 1 second and flash 3 times. Ramping and Initial Brake are now programmed.

Sequence is :-

F.Throttle ✳✳ _ _ maintain F.Throttle ✳✳ Pulse throttle (0 to 8 times for Throttle Ramping) Off _ ✳✳✳ Pulse throttle (0 to 8 times for Brake Ramping) Off _ ✳✳✳ Pulse throttle (0 to 15 times for LBV cut out) Off _ ✳✳✳ ready

where (✳) = LED flash and (_) = 1 second

Note :- Both the previous sequences can be repeated as often as you wish, each one being completely independent of the other, so that Ramping, Brake & LBV can be readily reprogrammed without effecting the throttle positions.

If any of Ramping, Brake or LBV is programmed to maximum steps, SM will automatically proceed to the next Step without waiting for the 1 second of Off.

Warranty - Skymaster is warranted for life against faulty parts or workmanship. Abuse, reverse connections & exceeding maximum ratings are not covered.

Specs

Dimensions	32mm dia x 9 mm
Weight	~5g without leads
Rating	6 - 18Vdc, 150Amp
Max. current	644 Amp continuous, 2480A peak (mosfet spec.)
Tested continuous current	95 Amp
On Resistance	0.0007Ω or 0.7 mΩ
BEC radio connection	5Vdc, 1Amp cont., 2Amp peak
PWM frequency	4kHz fixed
Throttle	Fully variable from 20% to full
Throttle Ramping	Adjustable 0 to 0.6 seconds (8 steps)
Brake Ramping	Adjustable from No Brake to 1.28 seconds (0 – 8 steps)
LBV cut out	Adjustable, 0 - 15 steps (5.0, 5.63, 6.25, 6.88, 7.5, 8.13, 8.75, 9.38, 10.0, 10.63, 11.25, 11.88, 12.5, 13.13, 13.75 & 14.38 V)

Contact Ian Armstrong
email iarmstrong@austarnet.com.au
Web http://home.austarnet.com.au/iarmstrong