# Summit X Series ESC
Instruction Manual

Specifications ◀◀◀◀

● Summit X series ESC is designed for superior functionality and performance, primarily in multirotors and runs on ARM 32bit MCUs.

● All codes implement damped light mode as default.Damped light does regenerative braking, causing very fast motor retardation, and inherently also does active freewheeling.

● The code supports features to prevent sync loss. There are tuneable parameters that can make the code run well even in the most demanding situations, although default settings will work excellently in normal operating environments.

● The code supports regular 1-2ms pulse width input, as well as Oneshot125 (125-250µs), Oneshot42 (41.7-83.3µs) and Multshot (5-25µs). Dshot is supported at any rate up to at least Dshot1200. The input signal is automatically detected by the ESC upon power up.

● The code also supports a beacon functionality, where the ESC will start beeping after a given time of zero throttle. This can be very useful for finding lost crafts.

Wiring Diagram ◀◀◀◀

SUMMIT X

Receiver

POWERED BY DUALSKY
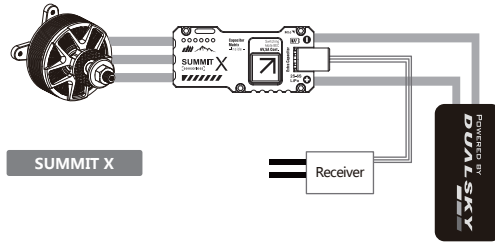
Programming parameters ◀◀◀◀

> Default Basic Settings	默认基本设定
● Motor Direction : Normal	电机方向 : 正常
● Motor Timing : Auto	电机进角 : 自动
● Minimum Throttle : 1040	最小油门 : 1040
● Maximum Throttle : 1960	最大油门 : 1960
● Low Voltage Protection : 3.00V	低压保护 : 3.00V
● Brake On Stop : 80%	停车制动 : 80%
● PWM Frequency : 24kHz	PWM 频率 : 24kHz

● **Rampup Power :**
Rampup power can be set to relative values from 3% to 150%. This is the maximum power that is allowed when ramping up at low rpms and during startup. For low rpms, the maximum power to the motor is limited, in order to facilitate detection of low BEMF voltages.
Rampup power also affects bidirectional operation, as the parameter is used to limit the power applied during direction reversal.

● **Motor Timing :**
Motor timing can be set between approximately 1° and approximately 31° in approximately 1° increments (actual accurate values here are 15/16ths of a degree).
This parameter can also be set to auto. In this case the code monitors demagnetization time,and keeps timing as low as possible without having issues with demag. On well behaved motors, timing can be low in the entire power range,and thereby max power can be reduced.On not so well behaved motors, timing is increased as needed, and thereby improves margins against sync loss.

● **PWM frequency :**
Motor PWM frequency can be programmed in a range that is preconfigured by the ESC manufacturer.

● **Maximum supported speeds :**
For a 48MHz ST MCU, the maximum speeds are approximately:
- Multishot at 8kHz: 510k erpm   - Dshot at 32kHz: 310k erpm
- Multishot at 16kHz: 450k erpm   - Proshot at 8kHz: 480k erpm
- Multishot at 32kHz: 420k erpm   - Proshot at 16kHz: 430k erpm
- Dshot at 8kHz: 470k erpm   - Proshot at 32kHz: 330k erpm
- Dshot at 16kHz: 420k erpm   - Dshot at 16kHz with sine: 280k erpm

● **Demag Compensation :**
Demag compensation is a feature to protect from motor stalls caused by long winding demagnetization time after commutation. The typical symptom is motor stop or stutter upon quick throttle increase, particularly when running at a low rpm. As mentioned above, setting high commutation timing normally helps, but at the cost of efficiency.
Generally, a higher value of the compensation parameter gives better protection.
If demag compensation is set too high, maximum power can be somewhat reduced for some motors.

● **Sine Modulation Mode :**
Sine modulation mode can give a few percent more efficient running, as well as smoother running.
It is a pretty subtle effect. Power is modulated with a sine shape, following the top of a sine wave through the commutation cycle so that the power when commutating shall be ideal for a motor with sine shaped BEMF. Power is varied between sin(60deg)=87% when commutating to sin(90deg)=100% in the middle of a commutation cycle, and then down again to sin(120deg)= 87% at the end of the commutation cycle.
Maximum power is the same for sine mode as for regular mode, as when approaching full power the ESC will transition smoothly into regular mode.

● **Maximum Acceleration :**
Maximum acceleration can be set between 0.1%/ms and 25.5%/ms. It can also be set to maximum, in which case acceleration is not limited. Limiting acceleration is primarily intended as a backup parameter that can be used in cases where too hard acceleration gives desyncs.
When setting to e.g. 10%/ms, it means that the power applied to the motor is not allowed to increase by more than 10% per millisecond.

● **Motor Direction :**
Motor direction can be set to fwd, rev, bidirectional 3D, bidirectional 3D rev, bidirectional soft and bidirectional soft rev. In bidirectional mode, center throttle is zero and above is fwd rotation and below is reverse rotation. When bidirectional operation is selected, throttle calibration is disabled.There are two bidirectional modes, bidirectional 3D and bidirectional soft.The 3D mode applies more power when reversing direction, and also limits minimum throttle to 6%. The soft mode applies less power when reversing, and does not limit minimum throttle.

● **Startup Beep Volume :** Sets the volume of beeps during powerup.

● **Beacon/Signal Volume :**
Sets the volume of beeps when beeping beacon beeps. The ESC will start beeping beacon beeps if the throttle signal has been zero for a given time. Note that setting a high volume can cause hot motors or ESCs!Also sets the volume used for Dshot / Proshot initiated signal tones.

● **Beacon Delay :** Beacon delay sets the delay before beacon beeping starts.

● **Throttle Cal Enable :** If disabled, throttle calibration is disabled.

● **Temperature Protection :**
Temperature protection can be enabled or disabled. And the temperature threshold can be programmed. The programmable threshold is primarily meant as a support for hardware manufacturers to use, as different hardwares can have different tolerances on the max temperatures of the various components used.The ESC measures temperature within the MCU and limits motor power if the temperature is too high. Motor power is limited over a range:
- If the temperature is above the threshold, motor power begins to be limited.
- If the temperature is above the threshold plus approximately 150C, motor power is limited to 25%. Motor power is not limited below 25%.

● **Low RPM Power Protect :**
Power limiting for low RPMs can be enabled or disabled. Disabling it can be necessary in order to achieve full power on some low KV motors running on a low supply voltage.However, disabling it increases the risk of sync loss, with the possibility of toasting motor or ESC.

● **Low Voltage Protection :**
Low voltage protection can be set between 2.5V and 4.0V per lipo cell. Or it can be disabled.When enabled, it will limit power applied to the motor if the battery voltage drops below the programmed threshold. This feature is primarily intended for fixed wing crafts.

● **Current Protection :**
Current protection can be enabled to limit current. If enabled, then current will be limited to maximum the programmed value. The reaction time of the current limiting is quite fast, so current will also be limited during accelerations.

● **Minimum throttle, maximum throttle and center throttle :**
These settings set the throttle range of the ESC. Center throttle is only used for bidirectional operation. The values given for these settings are for a normal 1000µs to 2000µs input signal,and for the other input signals, the values must be scaled.
For Dshot/Proshot input signal, these settings have no effect.

● **Brake On Stop :**
Brake on stop can be set between 1% and 100%, or disabled. When not disabled, the given brake force will be applied when throttle is zero. For nonzero throttle, this setting has no effect. This feature is primarily intended for fixed wing crafts with folding props.
On some ESCs this setting is not linearly programmable, it will just be enabled (at 100% force for any setting 1%-100%) or disabled (this applies to ESCs that have "EN/PWM" style fet drivers).

● **Auto Telemetry :**
When auto telemetry is enabled, the ESC will autonomously output telemetry at 32ms intervals, regardless of whether or not there are telemetry requests from the input signal.

● **LED Control :** LEDs can be controlled on ESCs that support it.

● **Regenerative braking / active freewheeling :**
Damped light mode is implemented by doing regenerative braking, and inherently active freewheeling is also implemented. Then losses due to braking are counteracted by the reduced losses of active freewheeling.It is possible to select nondamped operation (for most ESCs). This will degrade performance in multirotor applications but can be desirable for fixed wing environments.

● **S.BUS :**
S.BUS as input signal is supported. The S.BUS channel is selected with SUMMIT X Android app. If a valid S.BUS channel (0 to 16) is selected, then the input signal will be interpreted as S.BUS.

Arming sequence ◀◀◀◀

The figure below shows an example of throttle value versus time.
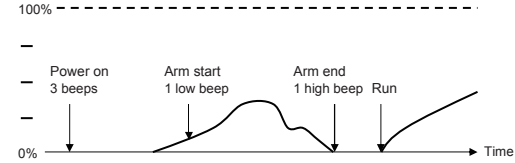
At power on, an activated ESC beeps 3 beeps.
When throttle signal is detected, it beeps one low tone beep. This signals that input signal is detected. Then, or if throttle is zero, it beeps one high tone beep. This signals the end of the arming sequence, and the ESC is ready to run.
Also, if more than 50% throttle is detected at arm start, the ESC starts throttle calibration.If the esc is armed and sees zero throttle for a given time, it beeps beacon beeps, which are approximately one beep per three seconds.
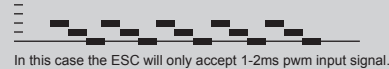
Telemetry ◀◀◀◀

Telemetry is supported. Telemetry is designed to be compatible with the specifications from KISS 24A, and delivers the following data:
- Temperature [°C]   - Voltage [V]   - Current [A]
- Temperature [Ah]   - Rotation speed [electrical rpm]
Temperatures below 0°C are not supported, they will be shown as 0°C.
For conversion from electrical rpm to mechanical rpm, divide by (motor poles)/2.
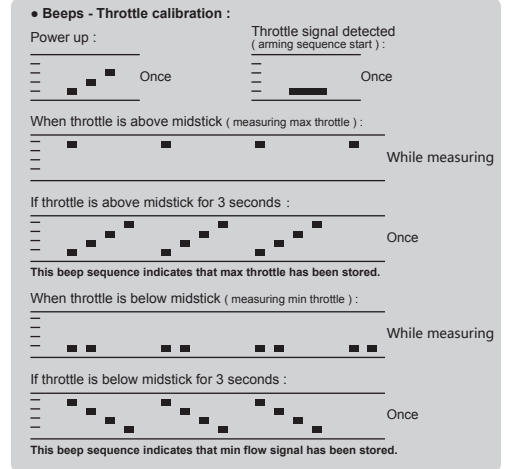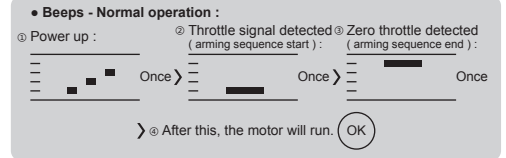
Failures ◀◀◀◀

● **Beeps - Not activated ESC :**
All ESCs shall be activated during manufacturing.
If for some reason this is not done, the ESC will beep like this upon powerup, before the normal operation beep sequence starts:

● **Beeps - Activation failed ESC :**
All ESCs shall be activated during manufacturing.
If for some reason activation has failed and the ESC is not regarded as a valid SUMMIT X unit, the ESC will beep like this upon powerup, before the normal operation beep sequence starts:

In this case the ESC will only accept 1-2ms pwm input signal.

SUMMIT X ESC status and tones ◀◀◀◀

● **Beeps - Normal operation :**
① Power up :   ② Throttle signal detected ③ Zero throttle detected
                      (arming sequence start) :   (arming sequence end) :

Once   Once   Once

④ After this, the motor will run.   OK

● **Beeps - Throttle calibration :**

Power up :   Throttle signal detected
                              (arming sequence start) :

Once   Once

When throttle is above midstick (measuring max throttle) :

While measuring

If throttle is above midstick for 3 seconds :

Once

This beep sequence indicates that max throttle has been stored.

When throttle is below midstick (measuring min throttle) :

While measuring

If throttle is below midstick for 3 seconds :

Once

This beep sequence indicates that min flow signal has been stored.

At this point throttle calibration values are stored. You may remove power from the ESC, or just continue running your ESC.Please note that for some ESCs, throttle calibration beeps are different from the above.
If you are in doubt, consult the manual of your specific ESC.

Disclaimer ◀◀◀◀

Thank you very much for using this product. Please use this product strictly in accordance with the manual. We do not assume any liability arising out of the use of this product or illegal modification or improper operation, including but not limited to indirect damage or joint liability, the maximum compensation is not higher than the price of the product itself. By using this product, you agree to the terms of this statement.

Warranty ◀◀◀◀

Dualsky electronic products warranty is for 12 months from the date of sale.
If you want to claim during the warranty period, please contact your dealer immediately.
The cashier receipt at the model store can prove whether the goods are under warranty. Please note that the warranty period will not be extended under any circumstances. Warranty service is provided free of charge for any functional defects, production failures or material defects during the warranty period. We will not accept any further claims, such as the user is responsible to pay the return shipping cost of the indirect damaged goods, we will pay for the return shipping cost to the user. If the shipping costs are not prepaid, we will not accept the goods. We do not accept the damage caused by transportation and do not make up for the loss of transportation. We recommend you to buy transportation insurance and send your equipment to the service center.
We can process your claim if the following conditions are met:
● Provide cashier receipts
● Operate the equipment correctly according to the instructions
● Use recommended power supplies and accessories
● The damage is not caused by water, reverse polarity, or over load
● Please provide a concise and accurate description of the fault to help us solve the problem

DUALSKY
ADVANCED POWER SYSTEMS