



User Guide to the
Mantis ESC

Presented by:



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Important Warnings

- Neither ZTW or Motion RC is responsible for your use of this Electronic Speed Control (ESC) or any damage or injuries you may cause or sustain as a result of its use.
- Always place safety as priority when you use the product. This can involve significant electrical power with the potential for shocks or fire so you should exercise caution when working with RC power systems.
- An electric motor that is connected to a battery and the ESC may start spinning unexpectedly. Always assume the motor will power up when connected to a power source and take suitable precautions.
- It is strongly recommended you to remove the propeller when installing and configuring the ESC in a propeller-driven plane; don't install the propeller until you are sure the airplane's throttle control system is working properly. A propeller that starts spinning unexpectedly can cause serious injury or damage.
- If you install and configure the ESC in with a plane powered by an Electric Ducted Fan (EDF), ensure that nothing can come into contact with the spinning impeller inside the EDF unit and that nothing will be drawn into the fan should it start spinning unexpectedly. A spinning EDF impeller causes a significant amount of suction force so any loose items in the area may be drawn into the fan, potentially causing the spinning blades to shatter, ejecting from the aircraft. This could cause significant damage or injury.
- It is strongly recommended you to remove the rotor blades when installing and configuring the ESC in a helicopter. Should the rotor blades start spinning unexpectedly, serious injury or damage may result. Don't install the rotor blades until you are sure the helicopter's controls systems are working as expected.
- Ensure that the components of the power system (ESC, motor, and batteries) are not used beyond their rated specifications (such as maximum power in amps). Operating components beyond their ratings can result in serious injury or damage.
- Ensure all the components of the power system are in good working condition. For example, ensure that batteries have not been damaged by overheating (e.g., they are not "puffed") and that all wires are in good condition and properly insulated.
- Observe all applicable laws and regulations when operating Radio Controlled (RC)

aircraft.

- Never operate RC aircraft near people who may be injured or property that may be damaged should the aircraft crash.

Introducing the Mantis ESC

An Electronic Speed Control (ESC) transforms the power from your aircraft's flight-pack battery and provides it to an electric motor to spin the propeller on an airplane, the rotor blades on a helicopter, or the impeller in an Electric Ducted Fan (EDF). The ESC translates the position of the throttle stick on the transmitter to a specific motor speed (measured in Revolutions Per Minute or RPM). This speed corresponds to the amount of propulsive thrust provided by the spinning propeller, impeller, or rotor blades.

Mantis ESCs—except for the OPTO or HV types—also include a Battery Eliminator Circuit (BEC) or a Switching Battery Eliminator Circuit (SBEC). A BEC or SBEC provides power to the receiver in the aircraft that in turn provides power to and controls the servos and other devices (such as lights that are plugged into the receiver). A BEC/SBEC is aptly named because it eliminates the need for a second battery pack to power the receiver. A BEC provides a fixed output voltage; however, you can configure the output voltage on a SBEC.

A Mantis ESC is programmable, which means that you can configure certain aspects of how it works. In many cases, you won't need to program it because you can use it with the default settings. If you do need to change the ESC's settings, you can do so through simple programming steps.

In this *User Guide*, you'll find all the information you need to understand, configure, install, operate, and troubleshoot the Mantis ESC successfully. This document contains links to YouTube videos that show you how to perform programming steps and to hear the associated sounds. In order to view these videos, you must access the links in this document on a device that has an Internet connection and compatible web browser or the YouTube app.

Understanding Your ESC's Specifications

This *User Guide* covers a number of different models of the Mantis ESC. The only specifications you need to understand are those for the specific model of the Mantis that you are using. These specifications are important because they indicate how much power you can manage through the ESC (in amps), the type of and number of cells in the battery you use to power it, and so on. The model can be found on the ESC's label, as shown in Figure 1.



Figure 1 The ESC's model can be found on its label.

To determine the specifications of your ESC, look for the model number of your ESC in the following table:

Model	Part Number	Rated Amps Cont./ Burst	Battery Type*: # of Cells	Weight (g)	BEC/SBEC Output (V) Output (A)	Size (mm)	User Programmable?
Mantis 6A BEC	2006101	6A\ 8A	Ni: 5-10 Li: 2-3	6	5V 1A	14x21x7	Yes
Mantis 12A BEC	2012101	12A\ 16A	Ni: 5-12 Li: 2-4	10	5V 1A	22x23x8	Yes
Mantis 25A BEC	2025101	25A\ 35A	Ni: 5-12 Li: 2-4	19	5V 2A	29x28x9	Yes
Mantis 35A BEC	2035101	35A\ 45A	Ni: 5-12 Li: 2-4	31	5V 3A	29x38x10	Yes
Mantis 45A SBEC 5A	2045201	45A\ 65A	Ni: 5-18 Li: 2-6	47	5.0V,5.5V,6.0V adjustable 5A	31x57x12	Yes
Mantis 65A SBEC 5A	2065201	65A\ 85A	Ni: 5-18 Li: 2-6	50	5.0V,5.5V,6.0V adjustable 5A	31x57x12	Yes
Mantis 85A OPTO	2085301	85A\ 100A	Ni: 5-18 Li: 2-6	47	None	35x47x11	Yes

Mantis 85A SBEC 5A	2085201	85A\ 100A	Ni: 5-18 Li: 2-6	57	5.0V,5.5V,6.0V adjustable 5A	35x47x15	Yes
Mantis 125A SBEC 5A	2125211	125A\ 150A	Ni: 5-18 Li: 2-6	145	5.0V,5.5V,6.0V adjustable/5A	48x80x21	Yes
Mantis 155A SBEC 5A	2155211	155A\ 200A	Ni: 5-18 Li: 2-6	147	5.0V,5.5V,6.0V adjustable/5A	48x80x21	Yes
Mantis 90A OPTO HV	2090411	90A\ 100A	Ni: 18-38 Li: 6-12	128	None	48x80x21	Yes
Mantis 120A OPTO HV	2120411	120A\ 150A	Ni: 18-38 Li: 6-12	142	None	48x80x21	Yes
Mantis 150A OPTO HV	2150401	150A\ 180A	Ni: 18-38 Li: 6-12	142	None	48x80x21	Yes

*Ni = NiCad or NiMH; Li = LiPo

Understanding the Tasks to Start Using the ESC

To use the Mantis ESC, you need to perform the following tasks:

1. Learn about the ESC's programming options.
2. Prepare the ESC for use.
3. Install the ESC in an aircraft.
4. Calibrate the throttle.
5. Program the ESC (if required) using a transmitter or programming card.
6. Test the ESC.
7. Troubleshoot the ESC (if necessary).

Each of these tasks is explained in detail in this document.

Learning about the ESC's Programming Options

The following table describes each of the ESC's programmable parameters and lists their options:

Parameter	What It Does	Options (Initial/Default Value in Blue)
Brake	<p>Determines how the motor reacts when you set the throttle to the full down (Off) position.</p> <p>When the Brake is set to Off, the motor will freewheel, which means that it may continue to spin when a propeller-driven aircraft is moving forward so that airflow causes the propeller to rotate.</p> <p>When one of the Brake settings is selected, the brake is applied with various amounts of force. For example, when the Soft Brake is selected, 30% of the braking power is applied; however, when the Hard Brake is set, 100% of the braking power is applied.</p> <p>The Brake should be Off for fixed-wing aircraft with a solid prop, but it should be set to one of the other Brake settings when the aircraft has a folding prop; this makes it easier for the prop to fold and prevents it from rotating when it is folded.</p>	<ul style="list-style-type: none"> • Off • Soft Brake (30%) • Mid Brake (60%) • Hard Brake (100%)
Battery Type	<p>Sets the ESC to work with a Nickel Cadmium (NiCad)/Nickel Metal Hydride (NiMH), Lithium Polymer (LiPo), or Lithium Phosphate (LiFe) battery that will provide power to the aircraft's propulsion system (called the flight-pack).</p>	<ul style="list-style-type: none"> • NiCad/NiMH • LiPo • LiFe
Low Voltage Protection Threshold	<p>Determines the voltage level of the flight-pack battery that triggers the Low Voltage Cutoff feature.</p> <p>The purpose of the Low Voltage Cutoff feature is to provide enough power to the receiver (and thus the flight controls) to be able to land the aircraft safely before the power totally fails.</p> <p>For example, when the Threshold is set to Medium and the voltage reaches 3.0v/cell on a Lithium-based battery or 60% on a Nickel-based battery, the Low Voltage Cutoff kicks in, which either reduces the power to the motor or cuts it off completely, depending on the Low Voltage Cutoff Type setting. The BEC or SBEC (if the ESC you are using is so equipped) will continue to receive power so you will</p>	<p>Lithium batteries:</p> <ul style="list-style-type: none"> • Low (2.8v/cell) • Medium (3.0v/cell) • High (3.2v/cell) <p>Nickel batteries:</p> <ul style="list-style-type: none"> • Low (50% voltage) • Medium (60% voltage)

	still be able to use the aircraft's flights controls to land the aircraft.	<ul style="list-style-type: none"> • High (65% voltage)
Timing	<p>Sets the timing of how the motor is driven, which determines the motor's performance; the timing is measured in electrical degrees (which has to do with the relationship between the electric field and magnetic field inside the motor).</p> <p>When the Automatic mode is selected, the ESC automatically determines which timing should be used for the motor to which it is connected.</p> <p>The Low or High modes set the timing to lower or higher values, respectively.</p> <p>In most cases, you should leave the Timing set to Automatic. Using the Low or High setting usually requires an in-depth understanding of how you want your motor to perform in a specific aircraft. However, the Low or High setting can be useful at times to troubleshoot certain types of problems, such as motor "chattering" when the motor starts up.</p>	<ul style="list-style-type: none"> • Automatic (7-30 degrees) • Low (7-22 degrees)—for most 2 pole motors • High (22-30 degrees)—for motors with 6 or more poles
SBEC Voltage Output	<p>Sets the output voltage of the Switching Battery Eliminator Circuit (SBEC) in the ESC to a specific voltage.</p> <p>The power from the SBEC goes into the receiver to power servos and other systems in the aircraft (typically everything except the motor). The voltage output by the SBEC should match the power requirements of the receiver. (Refer to the receiver's specifications to determine this value for the receiver you are using.)</p>	<ul style="list-style-type: none"> • Option 1: 5.0v • Option 2: 5.5v • Option 3: 6.0v
Governor Mode (Helicopter)	<p>Determines how fast the motor spins up to full speed (Soft Start) or how the Governor works.</p> <p>The Soft Start feature is used in helicopters to minimize the stress on the motor and gears as they overcome the inertia of the rotor blades as they start to spin when the throttle is applied.</p> <p>The Governor feature attempts to keep the blades spinning at a constant RPM as the load on the rotors change (such as when the collective pitch is changed).</p> <p>When this is set to Off, there is no soft start, and the motor speed immediately reacts to the throttle setting. The Off setting should be used for fixed-wing aircraft.</p> <p>When set to Soft Start 1 or 2, there is an eight- or eighteen-</p>	<ul style="list-style-type: none"> • Off • Soft Start 1 • Soft Start 2 • Governor Mode 1 • Governor Mode 2

	<p>second delay, respectively, from powering up the throttle to full RPM. There is no Governor function at either of the Soft Start settings.</p> <p>When set to Governor Mode 1 or 2, there is a soft start delay of 23 seconds powering up the throttle to full RPM. While the throttle is at 80% or more, the governor attempts to keep the blades' RPM constant. If the throttle is set to 80% or less, the throttle stick's position and associated throttle curve programmed on the transmitter determine the blades' RPM. Mode 1 is for low KV motors (50,000 turns or fewer), and Mode 2 is for high KV motors (more than 50,000 turns).</p> <p>When either Governor mode is enabled, the Brake is set to Off, and the Low Voltage Cutoff Type is set to Reduced.</p> <p>Except for the Off setting, when the throttle is shut down after less than three seconds, the next start will be a normal start (no soft start). When the throttle is shut down after three seconds, the next start is controlled by the Soft Start or Governor setting.</p> <p>To determine the number of turns for a motor, use this formula:</p> <p>Number of Turns = Number of Poles x KV Value x Voltage</p>	
<p>Motor Rotation Direction</p>	<p>Changes the direction in which the motor spins when the throttle is applied.</p> <p>You could use this to reverse the direction in which the motor spins to match the direction the motor faces and the type of prop you are using.</p> <p>It's more common to change the direction in which the motor spins by changing how the wires that connect the ESC to the motor are attached (see "Connecting the ESC to the Motor" later in this User Guide).</p>	<ul style="list-style-type: none"> • Forward • Reverse
<p>Start-up Strength</p>	<p>Determines the amount of amperage applied to the motor at start-up.</p> <p>This is grouped into three general categories: Low (10%, 15%, or 20%), Medium (25%, 30%, 35%), or High (40%, 45%, 50%). The default setting should be fine in most cases, but if you know that a specific motor requires more or less amperage at start-up, you can use this setting to adjust to the percentage required.</p>	<ul style="list-style-type: none"> • 10% • 15% • 20% • 25% • 30%

		<ul style="list-style-type: none"> • 35% • 40% • 45% • 50%
Low Voltage Cutoff Type	<p>Determines what happens to the motor when the power pack battery reaches the voltage defined by the Low Voltage Protection Threshold setting.</p> <p>With the Reduce Power setting, the power to the motor will be reduced to a minimal level. This will enable the propulsion system to provide a minimal amount of thrust, hopefully enabling you to land the aircraft safely.</p> <p>With the Hard Cutoff setting, the power to the motor will be shut off, resulting in the propulsion system shutting down. If the ESC has a BEC or SBEC, the receiver will continue to provide power so the flight controls (except throttle) should continue to work. This setting is intended to let you perform a dead-stick landing prior to losing all power.</p>	<ul style="list-style-type: none"> • Reduce Power • Hard Cutoff
Factory Defaults	Returns all options back to the initial/default values, which are shown in blue in the Options column.	N/A

Preparing the ESC for Use

To prepare the ESC, you need to follow these three steps, while the fourth step is recommended for flight-pack batteries that have six or more cells:

1. Add battery connectors to the ESC.
2. Connect the ESC to the motor.
3. Connect the ESC to the receiver.
4. Install an anti-spark device (recommended for power systems using a 6S or larger battery).

A schematic diagram for the ESC's connections is provided in Figure 2.

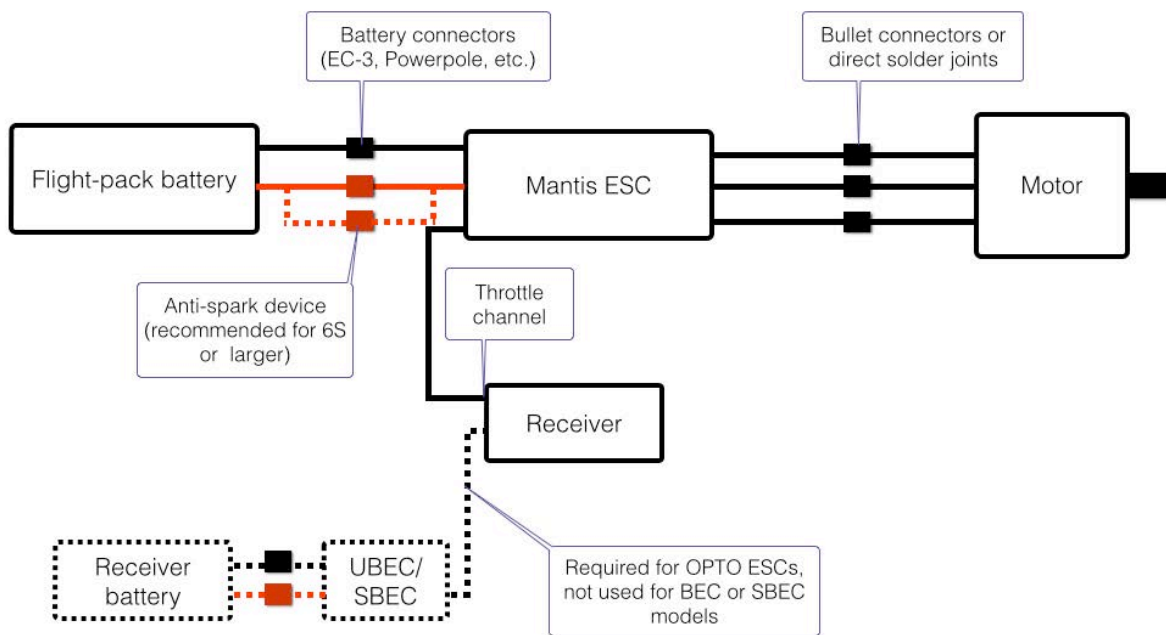


Figure 2 This schematic shows how the Mantis ESC is connected to other components in the aircraft.

Adding Battery Connectors to the ESC

To supply power to the ESC—which then provides power to the motor and receiver (BEC/SBEC models)—you must connect the ESC to a battery. There are many types of connectors for this purpose such as EC-3, EC-5, Anderson Powerpoles, Deans, and many others. Each of these types has benefits, power limitations, and so on, which are beyond the scope of this *User Guide*. Typically, you will standardize on one type of connector for all, or at least specific types, of your batteries (such as using EC-3 for 3S and Powerpoles or Deans for larger batteries).

You will need to attach the appropriate ESC-side connectors (for example, EC-3s have a different connector for the ESC side versus the battery side) to the red-and-black power wires on the ESC. How you do this depends on the type of connector you use. For example, you can solder EC-3 connectors onto these wires while you crimp Anderson Powerpoles to the wires. Figure 3 shows Powerpoles being connected to the ESC.



Figure 3 Powerpoles are being used to connect the output from the battery to the input of the ESC.

Whichever method you use to add the connectors, be sure that there is a good connection between the ESC wires and the connectors. If the joint between the wire coming from the ESC and the connector is not solid, you may experience intermittent power issues that could result in a crash.

Connecting the ESC to the Motor

You also need to connect the three black ESC wires to the input wires for the motor. There are two ways to accomplish this:

Be certain that bare connectors or wires do not come into contact with each other when you apply power to the ESC by connecting it to the flight-pack battery. If bare components do make contact, there could be a short, which might cause damage to the components or injury to you.

- **Use bullet connectors.** You can solder bullet connectors (male or female) to the ESC's output wires (the three black wires) and solder the mating bullet connectors (female if you connected male to the ESC's wires, male if you connected female connectors to the ESC) to the input wires on the motor (see Figure 4). There are various sizes of bullet connectors, and the size you use depends on the size of the motor and the wire size. Many motors include the appropriate bullet connectors so it's best to use the connectors included with the motor you are using. If no connectors were provided, locate connectors appropriate for the size of the wires and the motor's power.

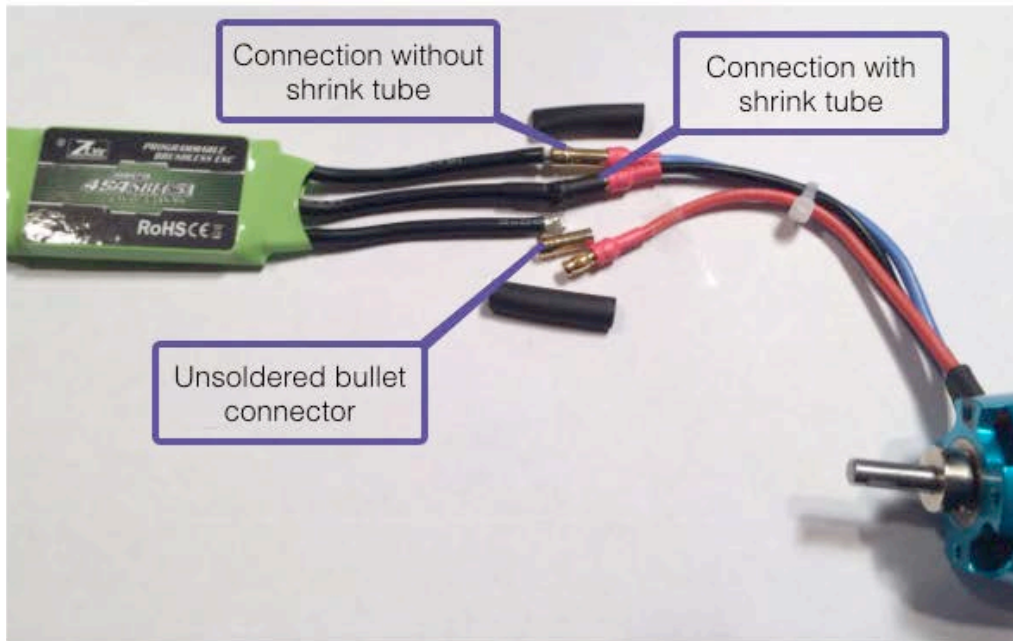


Figure 4 Bullet connectors can be used to connect the output of the ESC to the input of the motor.

After you've soldered the connectors onto the wires, connect the bullet connectors together to provide power from the ESC to the motor. Make sure that bare connectors don't touch each other because if they do, there may be a short causing damage to the components or that could lead to a crash if it happens while you are flying; you should cover each connector in shrink tubing or insulate them in some other way.

You may want to wait to add the shrink tubing until you've tested the system to ensure that the motor spins in the appropriate direction. (See the section "Testing the ESC" later in this *User Guide*.) If it doesn't, you'll need to disconnect two of the wires and swap their connectors, which will reverse the motor's direction. (You can also reverse it through programming, but it's easier to swap the connectors.)

- **Solder the wires together.** You can also solder the output wires of the ESC directly (the black ones) to the input wires on the motor. You may want to temporarily connect the wires to test the direction in which the motor spins before soldering them. (See the section "Testing the ESC" later in this *User Guide*.) Or you can use programming to reverse the motor's direction if you solder them and find out later than the motor should spin in the opposite direction.

Make sure that the bare, soldered connections don't contact each other, or there may be a

short. Be sure to use shrink tubing or another technique to insulate the soldered connections from one another of there may be a short causing damage to the components or that could lead to a crash if it happens while you are flying.

The method you use depends on your preference.

Using bullet connectors is typically easier because soldering the connectors to the wires is simpler than soldering two wires together. And the connectors enable you to easily disconnect the ESC from the motor (such as to reverse motor direction). However, there are also more solder joints when you use connectors, which means more of a chance for a bad solder joint that could cause intermittent problems with motor performance, potentially leading to a crash.

Directly soldering the wires together can be more difficult to do, but does provide a direct connection between the wires. However, a direct solder connection is also more difficult to undo in the event you need to separate the connection.

Connecting the ESC to the Receiver

Plug the connector on the servo wire coming from the ESC into the throttle channel on your receiver. Ensure that you orient the connector to the receiver's input so that the power, signal, and ground connections from the ESC and the receiver are in alignment.

Installing an Anti-spark Device (Recommended for 6S Systems and Above)

For power systems that use batteries with six or more cells, you should install an anti-spark device between the ESC and the battery to prevent sparking that might occur when you connect the battery to the ESC. In addition to being unsettling to see and hear, over time, this sparking could lead to damage of the connectors and result in a power loss leading to a crash.

An anti-sparking device adds resistance to the circuit that is created when you connect a battery to the ESC. This resistance limits the rate at which the power starts flowing, thus eliminating the spark that could occur with very rapid power flow for higher power systems.

There are many options for anti-spark systems available in the marketplace or you can build your own.

Installing the ESC in an Aircraft

There are several factors to consider when determining where to install the ESC in an aircraft,

such as the following:

- **Airflow/cooling.** This is the most important factor in locating the ESC inside the aircraft. The ESC generates heat, and if it gets too hot, it may shut down to preserve itself or fail, either of which may cause a crash. Place the ESC in the aircraft so that air flows over it, and ensure that there is room around the ESC for the air to flow both over and around it (Don't surround it with other devices or stack things on top of it.) Make sure that the label side of the ESC is exposed to the airflow because that is where the heat from the ESC is dissipated.
- **Location relative to the motor.** The ESC needs to be located so that the ESC wires will be able to connect to the motor wires. The location of the motor is typically predetermined for most aircraft, so you'll need to locate the ESC to ensure that it can be connected to the motor. Do not lengthen the output wires from the ESC or the input wires to the motor because this can negatively impact the motor's performance.
- **Location relative to the flight-pack battery.** The ESC needs to be able to connect to the battery. The location of the battery is typically driven by the Center of Gravity (CG) of the aircraft; this location is typically predetermined, so you need to locate the ESC accordingly.
- **Location relative to the receiver.** You'll need to connect the ESC to the receiver. Usually, this is the least restrictive requirement because the wire that connects the ESC to the receiver is fairly long. If it isn't long enough, you can use a standard servo extension wire to increase its length.

Ensure that the ESC is firmly attached inside the aircraft so that it can't move, even when the aircraft is performing extreme maneuvers. Do not place the label side of the ESC against the mounting surface of the aircraft because this side is the primary cooling mechanism for the ESC. The label side should be exposed to airflow to cool the ESC.

When you've determined the location for the ESC in the aircraft, attach it to the aircraft using double-sided hook-and-loop material, double-sided tape, hot glue, or straps (such as tie wraps).

Powering the ESC

When you first power up an ESC, you should remove the propeller or rotor blades so that they don't inadvertently start spinning, which may cause damage or injury. If the ESC is powering an EDF, make sure that nothing can be sucked into the

EDF and that you keep all objects (especially your fingers!) out of the fan blades.

To power up the ESC, perform the following steps:

1. Remove the propeller or motor blades or ensure that nothing will come into contact with the fan blades in an EDF.
2. Turn on the transmitter.
3. Connect the flight-pack battery to the ESC—if you are using an OPTO model of the ESC, connect the receiver battery to the external BEC/SBEC before connecting the flight-pack battery. The ESC will power up and play its normal startup tones. These indicate the number of cells in the battery to which the ESC is connected.
4. Listen carefully to the startup tones to make sure they match the number of cells in the battery you are using. For example, if you are using a 3S battery, you should hear three tones.

Click or tap here to watch a video demonstrating the startup tones for a 3S pack.

5. When the startup tones are done, disconnect the flight-pack battery (and receiver battery if applicable) and turn off the transmitter.

Calibrating the Throttle

When you are calibrating the throttle, you should remove the propeller or rotor blades so that they don't inadvertently start spinning, which may cause damage or injury. If you are calibrating the throttle for an EDF, make sure that nothing can be sucked into the EDF and that you keep all objects (especially your fingers!) out of the fan blades.

To calibrate the throttle, perform the following steps:

1. Remove the propeller or motor blades or ensure that nothing will come into contact with the fan blades in an EDF.
2. Turn on the transmitter and move the throttle to full On position.
3. Connect the flight-pack battery to the ESC—if you are using an OPTO model of the ESC, connect the receiver battery to the external BEC/SBEC before connecting the flight-pack battery.

4. When you hear two beeps from ESC, move the throttle stick to the full Off position.
5. When you hear two more beeps, the throttle calibration is complete. The ESC will then go through its normal start-up process.
6. Disconnect the flight-pack battery (and receiver battery if applicable) and turn off the transmitter.

To watch a video showing these steps, click or tap [here](#).

Using the ESC with Default Programming Options

If you are using the ESC for a fixed-wing aircraft with either a solid propeller or an Electric Ducted Fan (EDF) propulsion system, you can likely use the ESC's default settings (see the section "Learning about the ESC's Programming Options"), meaning that no programming is required. In that case, you can skip to the section "Testing the ESC" later in this *User Guide*.

If you need to change one or more settings, you will need to program the ESC. There are two ways to do this. You can use your RC transmitter to program the ESC, or you can use a programming card.

Programming the ESC with a Transmitter

If you are programming the ESC while it is installed in an aircraft, you should remove the propeller or rotor blades so that they don't inadvertently start spinning, which may cause damage or injury. If you are programming the ESC while it is connected to an EDF, make sure that nothing can be sucked into the EDF and that you keep all objects (especially your fingers!) out of the fan blades.

You can use stick movements on your transmitter to program the ESC. While this method has the benefit of not requiring any additional equipment, it can be difficult to do. That's because the feedback you receive comes through various combinations (number and length) of sounds ("beeps") from the ESC, and these sounds indicate the setting you are currently working with and the value of that setting. The sounds can be difficult to interpret, making it a challenge to be certain of the exact programming you are configuring.

It is much easier to use a programming card to program the ESC (see "Programming the ESC with a Programming Card" later in this *Guide*).

To program the ESC using a transmitter, perform the following general steps:

1. Put the ESC in Programming mode.
2. Allow the ESC to cycle to the parameter you want to configure (for example, Brake). While in Programming mode, the ESC automatically cycles through each parameter, one after another.
3. When the cycle reaches the first parameter you want to change, set the value of that parameter (e.g., Soft Brake).
4. Repeat steps 2 and 3 until you have configured all of the parameters you want to change.
5. Exit the Programming mode by disconnecting the flight-pack battery.

In the following sections, you'll find the detailed steps to enter Programming mode and to configure the ESC's parameters (detailed steps are provided for two parameters that you can use as examples for the rest). Links to YouTube videos are provided to help you understand exactly how these tasks are accomplished.

For an explanation of each parameter and its options, see "Learning about the ESC's Programming Options" earlier in this *Guide*.

Entering and Exiting the Programming Mode

To enter the Programming mode:

1. Remove the propeller or rotor blades from the aircraft or ensure that there is nothing that will get sucked into the EDF should it start up. Doing so will avoid damage or injury in the event that the motor starts spinning unexpectedly.
2. Turn on the transmitter.
3. Move the throttle stick to full On position.
4. Connect the flight-pack battery to the ESC; if you are using an OPTO model of the ESC, connect the receiver battery to the external UBEC/SBEC before connecting the flight-pack battery.
5. After about two seconds, you'll hear four sets of two rapid beeps. This indicates that the ESC is in Programming mode, and you can configure its parameters. (Refer to the specific section for each parameter, such as "Programming the Brake" to program the Brake.) The ESC automatically starts cycling through the parameters you can configure in the order in which they are listed in the table in "Learning about the ESC's

Programming Options.” Sounds are used to indicate which parameter you are currently working with—the first one will be the Brake, which is indicated by a single beep. Sounds are played four times each to give you time to make choices are the appropriate times.

Click or tap here to see a demonstration of putting the Mantis ESC in Programming mode.

6. When you’re finished programming the ESC, exit the Programming mode by disconnecting the flight-pack battery from the ESC.

Programming the Brake

To configure the Brake:

1. Put the ESC in Programming mode.
2. After the ESC has moved into Programming mode, listen for one short beep played four times in a row. This indicates that the Brake parameter is selected.
3. Move the Throttle stick to the full Off position. You hear a confirmation tone, indicating you’ve selected the Brake parameter.
4. The ESC begins cycling through the options for the Brake setting, indicating the setting by the number of beeps in the following order: Off (one beep), Soft Brake (two beeps), Mid Brake (three beeps), and Hard Brake (four beeps). The sounds for each option will be repeated four times, giving you a chance to set that level.
5. When the numbers of beeps corresponds to the Brake setting you want, move the Throttle stick to the full On position. For example, to set Hard Brake, wait until you hear four beeps played rapidly and then move the throttle stick to full On. You hear the setting changed confirmation tone. This means that the Brake parameter is set to the option you selected, and the ESC cycles to the next parameter, which is Battery Type (indicated by two beeps).
6. Refer to the next section to set the Battery Type, or if you’re done programming the ESC, disconnect the flight-pack battery from the ESC.

To watch a video demonstrating setting the Hard Brake option, click or tap here.

Setting the Battery Type

To configure the Battery Type setting:

1. Put the ESC in Programming mode.
2. After the ESC has moved into Programming mode, indicated by the series of two beeps, you hear a single beep played four times followed by two beeps also played four times. When you hear the series of two beeps played rapidly, you are ready to set the Battery Type.
3. Move the Throttle stick to the full Off position, and you hear a confirmation tone, indicating that you've selected the Battery Type parameter. The ESC begins cycling through the options for the Battery Type setting, which are NiCad/NiMH (one beep), LiPo (two beeps), and LiFe (three beeps). As in other areas, the sound for each option plays four times.
4. When the number of beeps corresponds to the Battery Type setting you want, move the Throttle stick to the full On position. You hear the setting changed confirmation sound. The Battery Type parameter is set to the option you selected, and the ESC cycles to the next parameter, which is Low Voltage Protection Threshold.
5. Continue setting other parameters, or if you're done programming the ESC, disconnect the flight-pack battery from the ESC.

To watch a video demonstrating setting LiPo as the Battery Type, click or tap [here](#).

Configuring the Rest of the Programming Options

To program the other options, you follow a pattern just like in the two previous examples (Brake and Battery Type), which is as follows:

1. Put the ESC in Programming mode.
2. When the ESC is in Programming mode, listen for the tones indicating the parameter you want to set. The ESC cycles through the entire list so each time you hear a different set of tones, you know you've moved to the next parameter you can program, starting with the Brake and moving all the way to Factory defaults.
3. When you hear the tones for the parameter you want to set, move the Throttle stick to full Off. You hear the confirmation tone and the ESC then starts cycling the values for that parameter. Like the parameters themselves, the ESC plays a set of tones indicating each value for the parameter that you are programming.

4. When you hear the tones for the value of the parameter you want to set, move the Throttle stick to the full On position. You hear the confirmation tone indicating you have saved the value for the parameter you are configuring.
5. Continue programming other parameters until you've set them all.
6. Disconnect power from the ESC. It operates according to its new programming.

Refer to the section “Learning about the ESC’s Programming Options” for a list of all the programmable parameters and the values available for each. The best way to understand the tones you hear when you program the ESC is to listen to the tones and follow along with the options shown in the table in the section “Learning about the ESC’s Programming Options.” When the ESC is in Programming mode, each time you hear a different grouping of tones, you know the ESC has moved to the next parameter in the table. When you have selected a parameter to program, you know each change in tones indicates the next value of that parameter on the list in the table. Using this approach makes it much easier to figure out the parameter and values you are working with than trying to remember the specific tones for each parameter and value.

Programming the ESC with a Programming Card

If you are programming the ESC while it is installed in an aircraft, you should remove the propeller or rotor blades so that they don't inadvertently start spinning, which may cause damage or injury. If you are programming the ESC while it is connected to an EDF, make sure that nothing can be sucked into the EDF and that you keep all objects (especially your fingers!) out of the fan blades.

A programming card makes programming the ESC simple because it displays the specific value currently set for each parameter, and you can easily change values by pressing buttons (see Figure 5). You need to obtain a programming card separately because it is not included with the ESC. You can purchase a programming card that is compatible with the Mantis ESC by clicking or tapping here.



Figure 5 This programming card makes the task of programming the ESC much simpler and more precise.

To use a programming card to program the ESC, connect the card to the ESC (and battery if the ESC isn't connected to one), as shown in the schematic diagram in Figure 6.

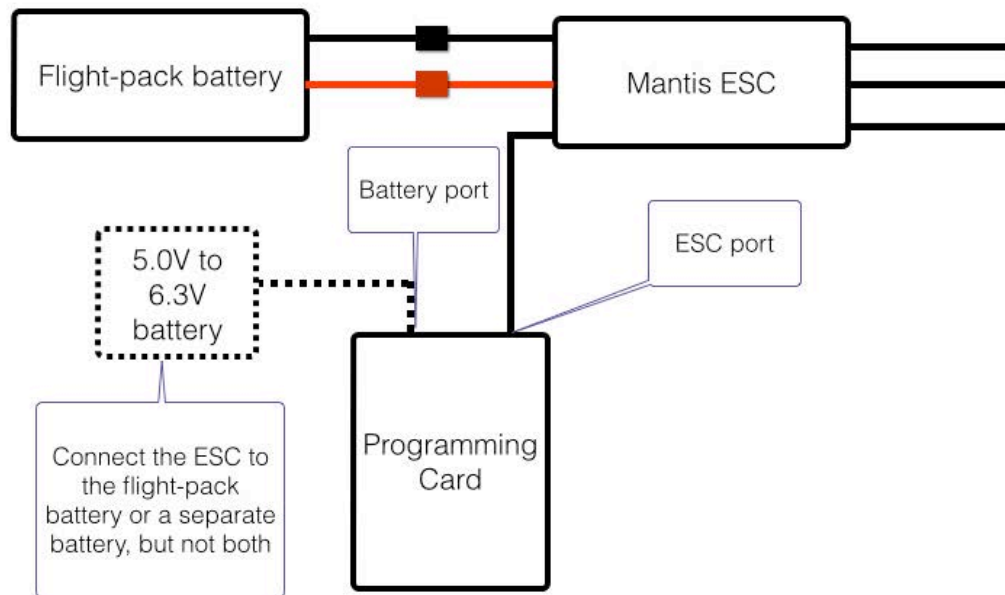


Figure 6 Connecting a programming card to the ESC is easy.

To start using a programming card, do the following steps:

1. Connect the throttle cable from the ESC to the port on the top-right (when you are looking at the front of the card) side of the programming card—the connector is oriented so that the ground wire should be on the left side.
2. Connect the ESC to the flight-pack battery by using its power input wires or connect the programming card to a 5.0V to 6.3V battery to the port on the top-left side of the card. (The ground wire from the battery goes toward the left side of the card.)

When you have completed these connections, the display on the programming card illuminates, indicating it is ready to use, as shown in Figure 7, and you hear the ESC's chimes.

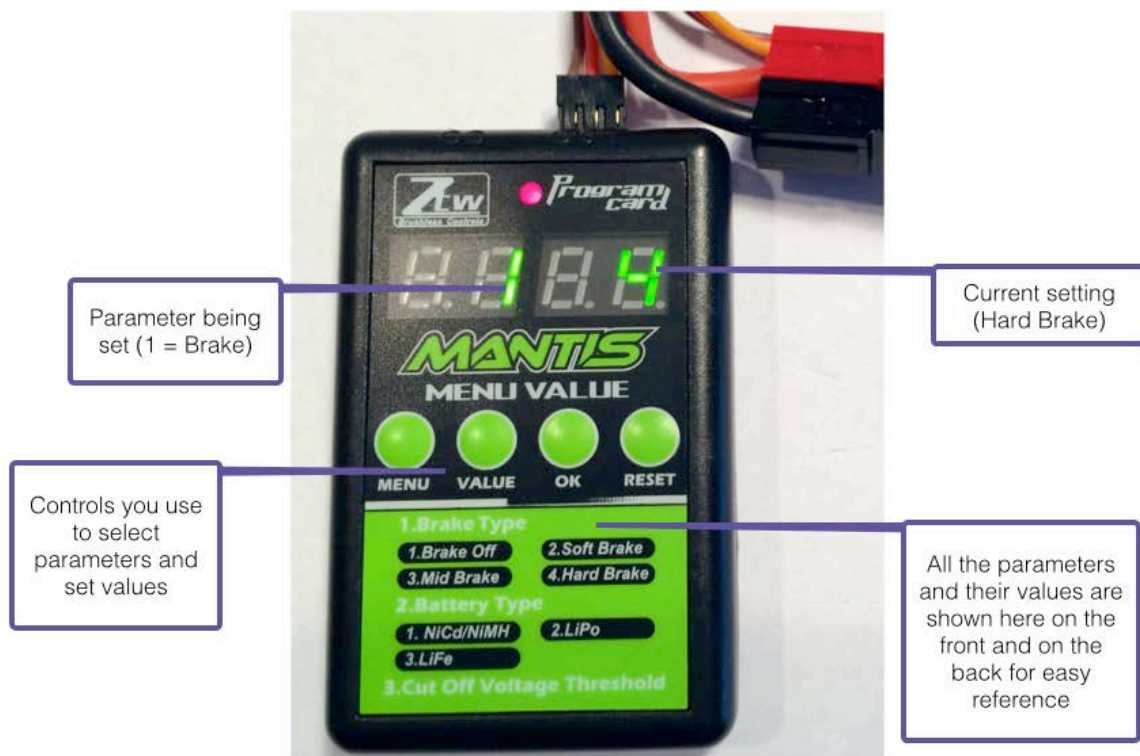
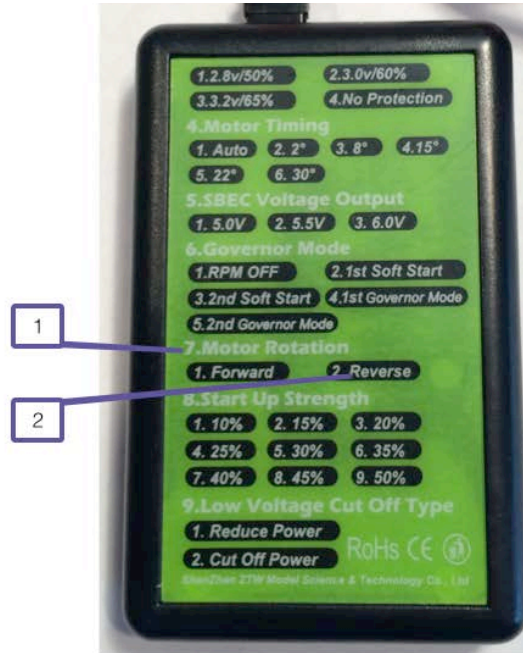


Figure 7 This programming card is connected to the ESC and shows the current Brake setting.

You can use the card to program the ESC as follows:

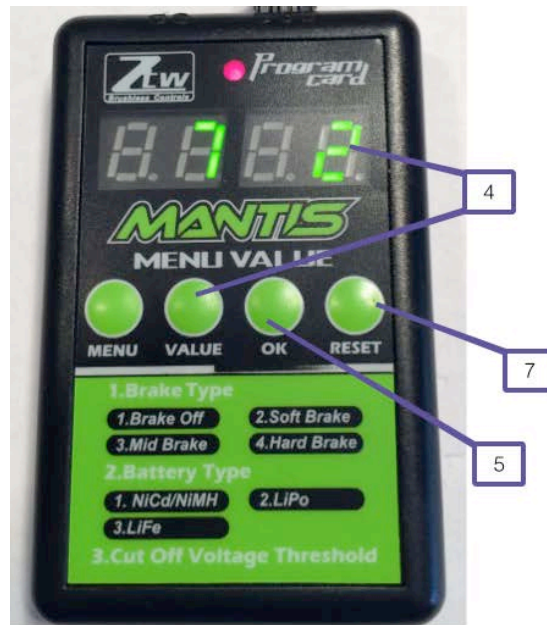
1. Locate the number of the parameter you want to program on the card's label (for example, 7 to program Motor Rotation).
2. Note the setting number of the parameter that you want to set, such as 2 to reverse the motor's direction.



3. Press the MENU button until the parameter's number (e.g., 7) appears in the left window.



4. Press the VALUE button until the setting number you want (e.g., 2) appears in the right window.
5. Press OK to save the setting. The red LED flashes, indicating that the new value for the current parameter has been saved.
6. Repeat steps 1 through 5 to set the other parameters that you want to change.
7. If you want to start over and restore the ESC to its default settings, press RESET.
8. When you're finished programming the ESC, disconnect it from the programming card and battery (if you connected a battery directly to the programming card, disconnect the card from the battery instead).



Testing the ESC

If you are testing the ESC while it is installed in an aircraft, you should remove the propeller or rotor blades so that they don't inadvertently start spinning, which may cause damage or injury. If you are testing the ESC while it is connected to an EDF, make sure that nothing can be sucked into the EDF and that you keep all objects (especially your fingers!) out of the fan blades.

Before you try to fly the aircraft, you should test the performance of the ESC to ensure that it is working as expected.

1. Remove the propeller or rotor blades from the aircraft or make sure that there is nothing that will get sucked into the EDF when it operates. This will enable you to power up the system without causing damage or injury.
2. Turn the transmitter on.

3. If you are using a system with an OPTO model of the ESC, connect the receiver battery to the receiver; if you are using a BEC/SBEC model, this step doesn't apply.
4. Connect the flight-pack battery to the ESC; if you are using an anti-spark device, connect its power lead, wait a few seconds, and then connect the remaining power lead to the flight-pack battery. You should hear the normal start-up tones.

The number of beeps in the first section of the start-up tones indicates the number of cells in the flight-pack battery. You should pay attention to these tones to make sure that the ESC recognizes the correct number of cells in the flight-pack battery.

The last two tones indicate normal ESC operation.

5. When the receiver is bound, work the flight controls to make sure that the servos are powered correctly. Activate several controls at a time, such as ailerons, elevator, flaps, retracts, and so on to ensure that the BEC/SBEC (if you are using a BEC/SBEC model) is providing the power required to operate multiple controls simultaneously.
6. Raise the throttle so the motor starts and check that the motor is spinning in the correct direction.
7. Ensuring that you can do it safely, raise the throttle to full power to make sure the motor spins up to full speed. You should use a watt or amp meter to determine that the motor is receiving the full power required. The motor won't draw full power without a propeller or rotor blades installed or without being attached to a fan in an EDF, but you should get a good idea of the power draw even without a load on the motor. Ideally, you should measure the power used at full throttle with the propeller or rotor blades installed, but only do this if you are sure you can do so safely by securing the aircraft and ensuring that nothing will come into contact with the spinning propeller, rotor blades, or fan in an EDF.
8. Repeat steps 6 and 7 while activating multiple flight controls simultaneously to ensure that the BEC/SBEC (if you are using a BEC or SBEC ESC model) is providing the power required to operate multiple controls simultaneously. Ensure that the receiver doesn't experience a brown-out when the system is under full load.

If the ESC doesn't perform as expected, see "Troubleshooting the ESC."

If the ESC does perform as expected, it is ready to fly.

Troubleshooting the ESC

If you are troubleshooting the ESC while it is installed in an aircraft, you should remove the propeller or rotor blades so that they don't inadvertently start spinning, which may cause damage or injury. If you are troubleshooting the ESC while it is connected to an EDF, make sure that nothing can be sucked into the EDF and that you keep all objects (especially your fingers!) out of the fan blades.

If the ESC doesn't work as it should, use the following list of symptoms to identify potential solutions.

Symptom: The ESC's start-up tones play as expected and the servos operate, but the motor doesn't spin

- Ensure that the throttle is shut off when connecting power to the ESC.
- Re-calibrate the throttle. (See “Calibrating the Throttle” earlier in this *Guide*.)

Symptom: The ESC doesn't make any sounds on start-up, the motor doesn't operate, and no servos operate, or there are intermittent power losses when the battery cables are moved

The most likely cause is a bad connection between the battery and the ESC.

- If the connector for the battery is soldered onto the ESC wires, redo the solder joints ensuring that there is a good connection between the ESC wires and the connector.
- If the connector for the battery is crimped onto the ESC wires, check the crimp to make sure that there is a good connection between the wire and the connector. Redo the crimps, if necessary.
- Try a different battery.
- Check to make sure that the ESC throttle cable is connected to the receiver correctly. (The plug should be inserted into the receiver so that the positive power, signal, and ground wires connect to the corresponding pins in the receiver.)

Symptom: ESC continuously beeps and motor does not spin

- The ESC may be in Programming mode; use the information in “Entering and Exiting the

Programming Mode” earlier in this *Guide* to exit Programming mode.

- The throttle may need to be recalibrated (see “Calibrating the Throttle”).
- Check to make sure that the ESC throttle cable is connected to the receiver correctly. (The plug should be inserted into the receiver so that the positive power, signal, and ground wires connect to the corresponding pins in the receiver.)