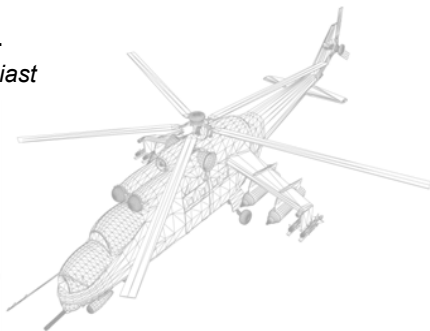
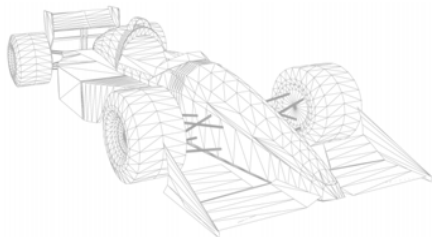




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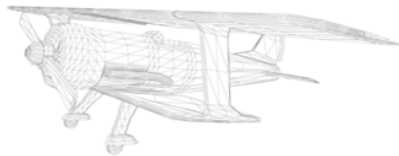
*Engineered Products for the RC Enthusiast*



## **Spectrum / FUSION ELECTRONIC SPEED CONTROLLER**

**Operation Manual**

Models: MR-ESC-xxxx-Bx



[www.MedusaProducts.com](http://www.MedusaProducts.com)

**OVERVIEW**

Medusa Research Electronic Speed Controls are designed to be the heart of any electric R/C model. They are designed primarily for R/C aircraft, but they will work in any R/C model requiring unidirectional drive of a brushed motor



Spectrum		FUSION	
• 10 Amp	(MR-ESC-1210-BB)	• 30 Amp	(MR-ESC-2430-BB)
• 18 Amp	(MR-ESC-1218-BB)	• 40 Amp	(MR-ESC-2440-BB)
• 30 Amp	(MR-ESC-1230-BB)	• 50 Amp	(MR-ESC-2450-BB)
• 40 Amp	(MR-ESC-1440-BB)		
• 50 Amp	(MR-ESC-1450-BB)		

In addition to the features of our **Spectrum** line, **FUSION** ESCs include a state-of-the-art 24V BEC. Fusions can run 4 standard servos with a 17 NiMH/NiCd or a 5 cell lithium battery pack! Fusion is an all-in-one solution for models with high voltage battery packs.

# FEATURES AT A GLANCE

II

<b>Features</b>	<b>Spectrum</b>		<b>FUSION</b>
	10 Amp	18, 30, 40 and 50 Amp	30, 40 and 50 Amp
<b>Auto Cell Count</b> —Automatically detects number of battery cells for lithium, NiCd or NiMH	✓	✓	✓
<b>Low Battery Detection</b> for NiMH, NiCd, and Lithium batteries	✓	✓	✓
<b>Auto-Scaling Throttle Range</b> or customizable fixed points	✓	✓	✓
<b>User Programmable Options</b> — set and forget	✓	✓	✓
<b>2 kHz</b> output switching frequency	✓	✓	✓
<b>Active Freewheeling</b> — For superior efficiency		✓	✓
<b>Remote Arming Switch</b> —shuts off ESC without removing battery		✓	✓
<b>Lost/bad Signal Detection</b> —automatically shuts off motor	✓	✓	✓
<b>Safe Start</b> —Will not enable motor without first setting throttle at off position	✓	✓	✓
<b>Current peak limiting – smoothly reduces output</b> , no abrupt shutdowns		✓	✓
<b>Output short circuit protection</b>		✓	✓
<b>Over temperature protection</b> — smoothly reduces output, no abrupt shutdowns		✓	✓
<b>3 programmable brake modes</b> , Hard, Soft and Off		✓	✓
<b>BEC</b> circuit with 5V output for your runs receiver and servos off your main battery	✓	✓	
<b>24V Switching BEC</b> — up to 24 volts input, 2 amps at 5 volts output			✓

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**CAUTION INPUT VOLTAGE LIMITATIONS**

See the Specifications section for input voltage limitations for your ESC. Exceeding rated voltage will permanently damage the ESC.

**CAUTION HARDWARE AND CONNECTIONS**

Follow proper assembly and ratings for wires and connectors. The user is responsible for correctly attaching connectors rated to handle the voltage and current that will be applied in the user's application.

Reverse polarity connections and connecting the battery to the wrong side of the ESC *WILL DAMAGE* the unit and can create a hazardous condition. Ensure that all wiring and connections are rated to handle the input and output current, and are assembled correctly for each application. High current connections should be made by those experienced to do so.

**CAUTION PROPELLER HAZARD**

When a battery is connected to the ESC, ensure the arming switch is off until you are ready to use the model. **Never leave a model with a battery connected unattended, and handle the model with caution at all times when the battery is connected.** Keep a safe distance from the propeller at all times and never point the model towards another person.

*ALWAYS have your transmitter on first, BEFORE turning on the ESC arming switch.* When the transmitter is off, the receiver may pick up stray signals, causing the motor to run, and you may lose control of your model.

**Tools Needed**

- Soldering Iron, 25-40 watts
- Crimper (if connectors are crimp on)
- Wire cutters and strippers

**Recommended Tools for Optimizing Performance**

- *Power Analyzer*
- Propeller tachometer

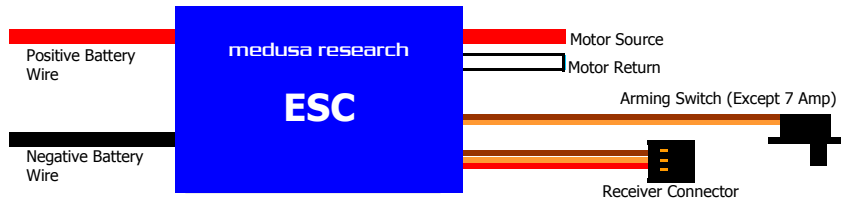
NOTE: The *Power Analyzer* is a model tuning and diagnostic tool by Medusa Research. Contact your dealer, or visit our website for more information

**Materials Needed**

- Connector to attach to battery pack
- Solder made for electronics (do not use acid core plumbers solder)

**Optional or Recommended Materials**

- Extra set of connectors for motor connection



## CONNECTING THE BATTERY AND MOTOR

Looking at your ESC as pictured above with the label upright and facing you, the wire functions are as shown. The label on the ESC indicates which side is connected to the battery, and which side is connected to the motor.

Follow the directions provided in your battery connector documentation and attach a connector to the battery leads of the ESC. Connect the *male* type connector to the battery input wires. **Polarity is vitally important; connecting a battery with the wrong polarity will damage the ESC.** The total length of wire between the ESC and battery pack should be as short as possible, and cannot exceed 12 inches. For long runs of wire, you should keep the battery wires as short as possible, and make up the length with the motor wires.

Attach a female connector to the motor wires, observing polarity for the correct direction of rotation. Most motors are designed to run optimally in one

direction only, or they may have adjustable timing to change the direction of rotation. Check the documentation that came with your motor. You may also directly connect the ESC to the motor without a connector.

### **CONNECTING TO A RECEIVER:**

The arming switch and receiver harness are pre-wired. When mounting the arming switch, choose a location that you can reach easily and is a safe distance from the propeller.

The 3-conductor brown-orange-red wire connects to your receiver. If your ESC model has a Battery Eliminator Circuit, you should not use a receiver battery with the ESC. If you need to use a separate battery with your receiver, you have two options:

1. The 3-wire plug that connects to your receiver has small plastic clips that retain the wires in the plastic plug. Using a knife, carefully pry back the clip and slip out the **red** wire. Secure and insulate the exposed wire with tape or heat shrink.
2. Use a Medusa Research *Opto-Isolator*. The *Opto-Isolator* will allow you to use a separate battery for the receiver without modifying any wiring, as well as isolate potentially harmful motor interference away from the receiver.

If you are using a separate battery because your model has too many cells or servos to be compatible with the on-board BEC, you may replace your flight pack battery with a smaller and lighter *Potencia BEC* from Medusa Research. See our website, or contact your dealer for more information.

### **ELECTRIC MODEL LAYOUT TIPS FOR BEST PERFORMANCE:**





- Keep battery-to-ESC and ESC-to-motor wires as short a possible. If there is a long distance between the motor and battery, it is generally better to make the motor wires longer and to keep the battery wires as short as possible.
- Locate the receiver/antenna away from the ESC, battery wires, and motor wires
- Locate the ESC in a place where there will be some airflow to carry away heat. If the ESC gets too hot during flight, the thermal protection feature will reduce the power output to the motor.
- Twisting the positive and negative wires around each other will help reduce the amount of electrical “noise” emitted by the wires. This will be especially helpful if wire runs to the motor or battery are long.

**PREPARING TO FLY**

- Set the *arming switch* to **OFF**. Keep hands and limbs away from the propeller, and then connect a battery to the ESC.
- Put the throttle stick in the *Full Off* position, and switch on your transmitter.
- Keep hands and limbs away from the propeller, ensure the area around the plane is clear of debris that may be drawn into the propeller, do not point the model at anyone.
- Switch **ON** the *arming switch*.
- After a few seconds, you will hear the startup beeps. See *Table 1* on page 8 for their meanings.
- After hearing the “Ready to fly” beep, the ESC is ready to run
- Ensure the ESC controls the motor properly by running the throttle up and down.

When using a new ESC or when your setup changes, perform a *range check*. Ensure the receiver, servos, and ESC will operate smoothly with the transmitter a good distance away from your model, *before* you start flying.

*Table 1: STARTUP BEEPS (in order left to right)*

Soft Brake Enabled Beep	Hard Brake Enabled Beep	Brake Disabled	Low Battery Detection Off	"Ready to Fly" beep....
 One Beep	 Two Beeps	No Beep	 Warning Beep	 Ready To Fly Jingle

## DURING FLIGHT

Running your model with the Medusa Research ESC is very straight forward. Should you have a problem, check the "Troubleshooting" section for solutions to common problems.

## UNDERSTANDING LOW BATTERY BEHAVIOR

During your flight, you should pay attention to the sound of the motor and how the model responds to your throttle input. As you fly, the battery will drain. Pay attention to the signs your battery may be getting low. The ESC has two thresholds for low battery detection. These two thresholds are designed to alert you that the battery is low, and to prevent the battery from becoming so

drained that you lose control of your model.

The first, and higher voltage threshold is the *Warning* threshold. This will either reduce the speed of the motor, or create a “pulsing” effect depending on what options you have set (see programming section). If you notice the ESC is trying to warn you the battery is low, land the plane as soon as possible.

The second, lower voltage threshold is the *Shutoff* threshold. As the battery continues to drain, the ESC will shut off the motor to make sure you have enough power to control your model. To restart the motor, first bring the throttle to the *Full Off* position, and then slowly raise the throttle. Be careful not set the throttle too high, as the ESC will shut off again. In this state, your battery is critically drained and you must land your plane as soon as possible.

## INTRODUCTION

All Medusa Research ESCs have programmable options that allow you to customize the ESC to your needs. All the options are listed below, and grouped into *Menus* with the factory defaults indicated. The PROGRAMMING OPTIONS-DESCRIPTIONS section on Page 21 has more detailed information about the functions of each option.

### Program Options *Quick Reference* chart

<p><b>Menu 1: Brake Modes</b> (except on 10 Amp)</p> <p>Option 1: No Brake            Option 2: Soft Brake            Option 3: Hard Brake (default)</p>	<p><b>Menu 2: Throttle Profile</b></p> <p>Option 1: Linear            Option 2: Exponential (default)</p>
<p><b>Menu 3: Throttle Range</b></p> <p>Option 1: Auto Range (default)            Option 2: Fixed Range</p>	<p><b>Menu 4: Battery Type</b></p> <p>Option 1: NiMH/NiCd Low Cutout (default)            Option 2: Lithium Low Cutout            Option 3: NiMH/NiCd High Cutout            Option 4: Lithium High Cutout</p>
<p><b>Menu 5: Low Battery Behavior</b></p> <p>Option 1: Soft Pullback            Option 2: Pulsing Pullback (default)            Option 3: No Low Voltage Warning</p>	<p><b>Menu 6: Throttle Ramp Speed</b></p> <p>Option 1: Fast (default)            Option 2: Medium            Option 3: Slow</p>

### ENTERING PROGRAM MODE

The diagram below shows how the ESC divides the range of your transmitter into three positions. Use these three positions to indicate *NEXT* item, or to *SELECT* an item.

There is a six-step sequence to enter program mode. The sequence serves two purposes. One, it makes it difficult to accidentally enter program mode, and two; it calibrates the range of your transmitter for the programming sequence.

Setup for entering programming mode:

1. We recommend **removing the propeller for safety**. If you do not remove the propeller, keep hands and limbs away from the propeller at all times. Secure the model so it cannot move. Make sure there are no objects that could be drawn into the propeller if it were to start running.
2. Setup your ESC as you would to run your model. Make sure the *arming switch* is **OFF** and connect a battery to the ESC.
3. Turn on your transmitter and move the throttle to the *Full On* position
4. Move the throttle stick as described in the six-step sequence in *Table 2* on the next page

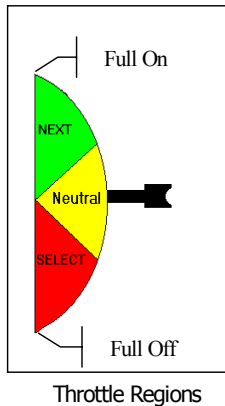


Table 2: Enter Programming Sequence

STEP	1	2	3	4	5	6
<b>Your Action:</b>	Turn on arming switch	Move throttle to <b>NEUTRAL</b> Position	Move throttle to <b>NEXT</b> Position	Move throttle to <b>NEUTRAL</b> Position	Move throttle to <b>SELECT</b> Position	Finally, Move throttle to <b>NEUTRAL</b> Position
<b>ESC Response (Motor)</b>	3 tones, escalating frequency	2 short beeps	2 short beeps	2 short beeps	2 short beeps	3 tones, escalating frequency

During the *Enter Programming Sequence*, if you make a mistake on a step, the ESC will make an error tone and halt. To start again switch the *arming switch* to the off position for one second, then back on again.

**If you start the ESC with the throttle in the *Full On* position, but DO NOT want to go into programming mode**, immediately bring the throttle to the *Full Off* position. This will restart the ESC in normal running mode.

**BASIC SEQUENCE FOR USING PROGRAMMING MODE**

After completing the *Enter Programming Sequence*, the ESC will be in *Menu Mode*. The ESC indicates what menu or option it is on by beeping. Long beeps indicate the current menu, short beeps indicate the current option. The ESC will always repeat the beeps indicating what menu or option you are on every 5 seconds. Below are the three basic steps needed to set or change an option:

**Step #1** : Starting from *Menu Mode*, choose the menu you want to enter from *Table 4*.

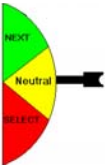
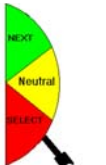
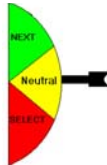
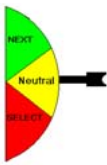
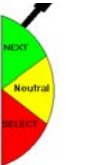
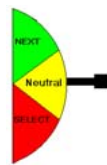
The current menu will increment every time you do a **NEXT** (see table 3) motion. Keep moving the throttle to **NEXT** until you are at the menu you want to enter, then move the throttle to **SELECT**. (see table 3)

**Step #2** : Now the ESC will now be in an *Option Menu*. *Table 4* tells you what page has the list of options for a particular menu. Moving the throttle stick to **NEXT** will increment the current option, just like in *Menu Mode*. Keep moving the throttle to **NEXT** until you are at the option you want to choose.

**Step #3** : Finally, while you are at the option you want, choose the option by moving the throttle to **SELECT**. The ESC will save the setting, repeat the option beep to confirm what option was chosen, and then make 2 fast chirps indicating the option was successfully saved in memory. The ESC returns to *Menu Mode*.

You may shut off the ESC at any time to end programming mode EXCEPT **after** choosing an option, and **before** hearing the 2 chips. Shutting the ESC off during this time may erase all settings to their factory defaults.

Table 3: How to do "SELECT" and "NEXT"

How to <b>SELECT</b> a menu or option			How to go to the <b>NEXT</b> a menu or option		
<p><b>Step 1</b> From <b>NEUTRAL</b></p> 	<p><b>Step 2</b> Move to <b>SELECT</b>, wait 1 second</p> 	<p><b>Step 3</b> Move back to <b>NEUTRAL</b></p> 	<p><b>Step 1</b> From <b>NEUTRAL</b></p> 	<p><b>Step 2</b> Move to <b>NEXT</b>, wait 1 second</p> 	<p><b>Step 3</b> Move back to <b>NEUTRAL</b></p> 

### OTHER FEATURES IN PROGRAMMING MODE

The ESC senses the position of the throttle in-between beeps. Move the throttle only after the ESC is done beeping to ensure it reads the position. If the ESC fails to react to your input, simply return the throttle to the *NEUTRAL* position for 1 second, and try again.

If you increment all the way to the end of the menus, the ESC loop back around to the first menu.

If you increment all the way past the last option in *Option Mode*, the ESC will return to *Menu Mode*.

Table 4: SELECT MENU MODE

MENU:	ESC Beep for menu:	Your Action: SELECT	Your Action: NEXT
0. Exit Programming Mode?	3 long beeps, escalating frequency	ESC flashes model and serial number code, then halts	Go to the <i>Brake</i> menu
1. Brake (Not available on 10 Amp)	1 long beep	Selects the <i>Brake</i> menu <b>Table 5, Page 16</b>	Go to the next menu, <i>Throttle Profile</i>
2. Throttle Profile	2 long beeps	Selects the <i>Throttle Profile</i> menu. <b>Table 6, Page 16</b>	Go to the next menu, <i>Throttle Range</i>
3. Throttle Range	3 long beeps	Selects the <i>Throttle Range</i> menu. <b>Table 7, Page 17</b>	Go to the next menu, <i>Battery Type</i>
4. Battery Type	4 long beeps	Selects the <i>Battery Type</i> menu. <b>Table 8, Page 18</b>	Go to the next menu, <i>Low Battery Behavior</i>
5. Low Battery Behavior	5 long beeps	Selects the <i>Low Battery Behavior</i> menu. <b>Table 9, Page 19</b>	Go to the next menu, <i>Throttle Ramp Speed</i>
6. Throttle Ramp Speed	6 long beeps	Selects the <i>Throttle Ramp Speed</i> menu. <b>Table 10, Page 20</b>	Go to "Exit Programming Mode" option

Table 5: **1 "BRAKE" OPTION MENU** (Not Available on 10 Amp)

<b>OPTION:</b>	<b>ESC beep for option:</b>	<b>Your action: SELECT</b>	<b>Your action: NEXT</b>
1. No Brake mode	1 beep	Sets No Brake option, exits to <i>Select Menu Mode</i>	Goes to next brake option
2. Soft Brake mode	2 beeps	Sets Soft Brake option, exits to <i>Select Menu Mode</i>	Goes to next brake option
3. Hard Brake mode	3 beeps	Sets Hard Brake option, exits to <i>Select Menu Mode</i>	ESC Plays 2-tone beep to indicate "end of options" Return to <i>Select Menu Mode</i> (Table 3)

Table 6: **2 "THROTTLE PROFILE" OPTION MENU**

<b>OPTION:</b>	<b>ESC beep for option:</b>	<b>Your action: SELECT</b>	<b>Your action: NEXT</b>
1. Linear Throttle mode	1 beep	Sets Linear Throttle option, exits to <i>Select Menu Mode</i>	Goes to next Throttle Profile option
2. Exponential Throttle mode	2 beeps	Sets Exponential Throttle, exits to <i>Select Menu Mode</i>	ESC Plays 2-tone beep to indicate "end of options" Return to <i>Select Menu Mode</i> (Table 3)

Table 7. 3 "THROTTLE RANGE" OPTION MENU

OPTION:	ESC beep for option:	Your action: <b>SELECT</b>	Your action: <b>NEXT</b>
1. Auto-Range	1 beep	Sets Auto-Range option, exits to <i>Select Menu Mode</i>	Goes to next Throttle Range option
2. Fixed Range	2 beeps	Sets Fixed-Range, exits to <i>Select Menu Mode</i>	ESC Plays 2-tone beep to indicate "end of options" Return to <i>Select Menu Mode</i> (Table 3)

Table 8: 4 "BATTERY TYPE" OPTIONS MENU

OPTION:	ESC beep for option:	Your action: <b>SELECT</b>	Your action: <b>NEXT</b>
1. NiMH/NiCd Low Cutout	1 beep	Sets NiMH/NiCd , exits to <i>Select Menu Mode</i>	Goes to next Battery Type option
2. Lithium/LiPoly Low Cutout	2 beeps	Sets Lithium/LiPoly, exits to <i>Select Menu Mode</i>	Goes to next Battery Type Option
3. NiMH/NiCd High Cutout	3 beeps	Sets NiMH/NiCd, exits to <i>Select Menu Mode</i>	Goes to next Battery Type option
4. Lithium/LiPoly High Cutout	4 beeps	Sets Lithium/LiPoly, exits to <i>Select Menu Mode</i>	ESC Plays 2-tone beep to indicate "end of options" Return to <i>Select Menu Mode (Table 3)</i>

Table 9. 5 "LOW BATTERY BEHAVIOR" OPTIONS MENU

OPTION:	ESC beep for option:	Your action: <b>SELECT</b>	Your action: <b>NEXT</b>
1. Soft Pullback	1 beep	Sets Soft Pullback, exits to <i>Select Menu Mode</i>	Goes to next Low Battery Behavior option
2. Pulsing Pullback	2 beeps	Sets Pulsing Pullback, exits to <i>Select Menu Mode</i>	Goes to next Low Battery Behavior option
3. No Low Voltage Warning	3 beeps	Sets No Low Voltage Warning, exits to <i>Select Menu Mode</i>	ESC Plays 2-tone beep to indicate "end of options" Return to <i>Select Menu Mode</i> (Table 3)

Table 10: 6 "THROTTLE RAMP SPEED" OPTIONS MENU

OPTION:	ESC beep for option:	Your action: <b>SELECT</b>	Your action: <b>NEXT</b>
1. Fast	1 beep	Sets Fast throttle ramp speed, exits to <i>Select Menu Mode</i>	Goes to next Throttle Ramp Speed Behavior option
2. Medium	2 beeps	Sets Medium throttle ramp speed, exits to <i>Select Menu Mode</i>	Goes to next Throttle Ramp Speed option
3. Slow	3 beeps	Sets Slow throttle ramp speed, exits to <i>Select Menu Mode</i>	ESC Plays 2-tone beep to indicate "end of menu" Return to <i>Select Menu Mode (Table 3)</i>

## 1. Brake Modes (Not Available on 10 Amp)

### 1.1. No Brake

In *No Brake* mode, the ESC disables the brake. When you bring the throttle to the full off position, there will be no braking action

### 1.2. Soft Brake

In *Soft Brake* mode, the ESC “pulses” the brake for approximately half a second before turning on the brake. This creates a braking action that is in between having the brake on, or having the brake off.

### 1.3. Hard Brake **DEFAULT**

In *Hard Brake* mode, the ESC turns on the brake at full strength once the throttle is put in the full off position.

## 2. Throttle Modes

### 2.1. Linear Throttle

The position of your throttle directly translates to the voltage applied to the motor. For example, having the throttle at 75% in this mode means the voltage on the motor is 75% of the voltage at the battery pack. This however, does not mean the power the motor puts out is directly translated.

### 2.2. Exponential Throttle **DEFAULT**

An exponential curve is applied to the throttle range so that the voltage change is more sensitive at lower throttle positions and less sensitive at high throttle positions. This makes the *power* delivered to the motor more linear

### 3. Throttle Range Modes

#### 3.1. Auto-Range mode **DEFAULT**

*Auto-Range* mode automatically adjusts the Full On and Full Off endpoints as you fly. The Full Off endpoint is set when the ESC is first turned on, then the Full On endpoint is set the first time the throttle is set Full On.

#### 3.2. Fixed-Range mode

*Fixed-Range* mode custom programs the ESC to your transmitter by storing your transmitter endpoints in memory and recalling them every time the ESC is turned on. The ESC determines the endpoints of the transmitter in the *Enter Programming Sequence* step of programming. It is important to move the throttle fully on and off when entering programming mode to get the correct endpoints. **If you change to a different transmitter** with this mode enabled, re-calibrate the Fixed Range mode by setting this option again using the different transmitter.

### 4. Battery Type Modes

#### 4.1. NiMH/NiCD-Low Cutout **DEFAULT**

For NiMH and NiCD battery packs. This sets the warning threshold at 0.80 V/cell and the shut off threshold at 0.70 V/cell. (See the OPERATING THE ESC section for threshold information.) Low cutout will drain the battery more before the ESC will react. This will allow longer run times, but gives you less time to land your plane after the ESC “warns” you the batteries are low.

#### 4.2. Li/LiPoly-Low Cutout

For all lithium type battery packs. Low cutout mode sets the warning threshold at 3.1 V/cell and the shut off at 3.0 V/cell. This option allows longer run times, but will leave less battery power to land the plane after the warning threshold is tripped.

*For ESCs sold before July 2005, the thresholds are set to 2.8V/cell warning and 2.7V/cell shut-off. If you would like your ESC updated to these levels, please contact us.*

#### 4.3. NiMH/NiCD-High Cutout

For NiMH and NiCD battery packs. High cutout sets the warning threshold at 0.85 V/cell and the shut off at 0.75 V/cell. This option will “warn” you that the batteries are low sooner than the low cutout, giving you more time to land your plane.

#### 4.4. Li/LiPoly-High Cutout

For all lithium type battery packs. High cutout sets the warning threshold at 3.2 V/cell and the shut off at 3.1 V/cell. This higher threshold will warn you the batteries are low sooner, giving you more time to land your plane.

*For ESCs sold before July 2005, the thresholds are set to 2.9V/cell warning and 2.8V/cell shut-off. If you would like your ESC updated to these levels, please contact us.*

## 5. Low Battery Behavior Modes

### 5.1. Soft Pullback

In *Soft Pullback* mode, the ESC will slowly reduce the motor speed in proportion to how much the battery cell voltage is under the *Warning* threshold. If the battery voltage reaches the *Shutoff* threshold, you will have to bring the throttle to the Full Off position to restart your ESC. This “soft” reduction in motor speed isn’t as distinct a warning as *Pulsing Pullback*, however it is easier on the model and gearbox.

### 5.2. Pulsing Pullback **DEFAULT**

In *Pulsing Pullback* mode, the ESC will shut off the output when the battery cell voltage falls below the *Warning* threshold. When the voltage rises above the threshold, it will re-enable the motor. The battery voltage in this mode usually rises and falls reasonably quickly, creating a “pulsing” effect. The pulsing motor speed is a distinct indication that the battery is low. If the battery voltage reaches the *Shutoff* threshold, you will have to bring the throttle to the Full Off position to restart your ESC.

### 5.3. No low battery detection

In no low battery detection mode, battery voltage is ignored. The ESC will run until the battery voltage drops below 4V, when it shuts off to protect its own circuitry. It is strongly suggested you don’t enable this mode unless you know what you are doing. Draining the battery to this point may cause loss of control of your model when using the BEC circuit. You should also be aware that draining lithium chemistry batteries too much can damage them; low voltage protection should always be enabled when using lithium batteries.

## 6. Throttle Ramp Speed

Throttle Ramp Speed controls how fast the speed of the motor can change.

### 6.1. Fast Ramp **DEFAULT**

Limits the fastest transition from *full off* to *full on* (or *full on* to *full off*) to be no faster than  $\frac{1}{4}$  of a second. This allows the fastest response while still protecting propellers and gearboxes against abrupt changes in motor speed.

### 6.2. Medium Ramp

Limits the fastest transition from *full off* to *full on* (or *full on* to *full off*) to be no faster than  $\frac{1}{2}$  of a second. Slower ramp speed is smoother than fast speed, but the motor will respond slower to your throttle input.

### 6.3. Slow Ramp

Limits the fastest transition from *full off* to *full on* (or *full on* to *full off*) to be no faster than 1 second. Slowest ramp speed is the smoothest ramp speed, but the motor will take even longer to speed up and slow down.

Symptom	Solutions
1. After flying for several minutes, the motor keeps shutting off requiring that I bring the throttle to Full Off re-enable the motor	<ol style="list-style-type: none"><li>1. Battery is low, land as soon as possible</li><li>2. Batteries lose the ability to hold a charge over time, and flight times will get shorter as the battery wears out. If your flight time is getting unacceptably short, try using a new battery pack</li></ol>
2. Motor shuts off, requiring that I bring the throttle to Full Off to re-enable the motor. This problem gets worse when I lower the antenna, or as the model gets further from the transmitter.	<p>In general, this indicates the signal to the receiver is too weak, or there is too much interference getting into the receiver. Check the following:</p> <ol style="list-style-type: none"><li>1. When using a separate receiver battery, ensure the pack is in good condition and fully charged</li><li>2. Ensure the transmitter battery pack is in good condition and fully charged.</li><li>3. Follow the "layout tips for best performance" in the <b>CONNECTING THE ESC TO YOUR SYSTEM</b> section</li><li>4. Make sure your motor has bypass capacitors installed</li><li>5. Higher power systems, like those with lots of cells, generate more electrical noise than lower power ones, and may be interfering with your receiver. You may need to isolate the receiver from the ESC by using an Opto-Isolator,</li></ol>

Symptom	Solutions
3. After flying hard at high throttle positions, the plane seems to slow down.	Your ESC is thermally protected and will limit the output current if it gets too hot. Try relocating the ESC where there is more airflow.
4. I connected a battery pack to the ESC, turned on the arming switch, and the LED is blinking once a second. I cannot run a motor	You are attempting to use the ESC with too many cells. See the specifications section for cells/voltage for different model ESCs
5. Everything is connected, the servos are working, but the motor will not turn	<ol style="list-style-type: none"><li data-bbox="681 458 1255 521">1. Check that the ESC is connected to the correct channel of the receiver</li><li data-bbox="681 521 1255 684">2. If the servos are unsteady or twitching, there may be excessive interference, or the signal is weak. Try the solutions in Symptom 2.</li></ol>
6. Low battery detection activates before the battery is discharged, or activates too late	<ol style="list-style-type: none"><li data-bbox="681 695 1255 858">1. Ensure you have set the correct battery type option (Lithium or NiMH/NiCd.). The ESC is shipped with NiMH/NiCd set as the default. See the <i>Programming Options</i> section for more information.</li><li data-bbox="681 858 1255 983">2. If the low battery detection is activating too early, try letting the battery "cool down" after charging for 10 minutes before plugging it into the ESC.</li></ol>

## All Models

Parameter	Value
Input servo pulse width	0.7ms - 2.3ms
Thermal protection trip point	100°C / 212°F (except 10 Amp)
Battery voltage detection resolution	100mV
Switching frequency	2 kHz
Output PWM discreet steps	250
BEC output voltage (servo / current ratings, pg 30)	5 volts

## Weight and Dimensions

Model	Weight without wires	Weight with all wires and switch	Width	Length (w/o wires)	Max Thickness
<b>Spectrum</b>					
10 Amp	3 g	11 g	13 mm	18 mm	8 mm
18 Amp	5 g	18 g	18 mm	26 mm	7 mm
30 Amp	9 g	28 g	26 mm	31 mm	12 mm
40 Amp	14 g	33 g	26 mm	51 mm	13 mm
50 Amp	21 g	35 g	26 mm	57 mm	13 mm
<b>FUSION</b>					
30 Amp	19 g	42 g	26 mm	31 mm	15 mm
40 Amp	24 g	46 g	26 mm	51 mm	15 mm
50 Amp	31 g	47 g	26 mm	57 mm	15 mm

Performance Specifications					
Model	FET On Resistance	Current: Continuous/Peak	Cells NiMH/NiCd	Cells Lithium	Operating Voltage
<b>Spectrum</b>					
10 Amp	0.004 $\Omega$	10/15	5 to 10	2 to 3	5V to 12V
18 Amp	0.002 $\Omega$	18/30	5 to 10	2 to 3	5V to 12V
30 Amp	0.0013 $\Omega$	30/45	5 to 10	2 to 3	5V to 12V
40 Amp	0.001 $\Omega$	40/60	5 to 12	2 to 4	5V to 14.4V
50 Amp	0.0008 $\Omega$	50/75	5 to 12	2 to 4	5V to 14.4V
<b>FUSION</b>					
30 Amp	0.0013 $\Omega$	30/45	5 to 17	2 to 5	5V to 24V
40 Amp	0.001 $\Omega$	40/60	5 to 17	2 to 5	5V to 24V
50 Amp	0.0008 $\Omega$	50/75	5 to 17	2 to 5	5V to 24V

## BEC Specifications

## Maximum Recommended Number of Servos for:

Model	BEC Peak Current	6 NiCd/NiMH or 2 to 3 Lithium Cells	8 NiCd/NiMH or 3 Lithium Cells	10 NiCd/NiMH or 4 Lithium Cells	12 NiCd/ NiMH or 4 to 5 Lithium Cells
<b>Spectrum</b>					
10 Amp	1.6 Amps	2	2	Not Recommended	Not Recommended
18 Amp	1.6 Amps	2	2	Not Recommended	Not Recommended
30 Amp	4.5 Amps	6	4	3	Not Recommended
40 Amp	4.5 Amps	6	6	5	3
50 Amp	4.5 Amps	6	6	5	3
<b>FUSION</b>					
30 Amp	2.4 Amps	4 Servos for any cell count within the "Operating Voltage" range			
40 Amp	2.4 Amps	4 Servos for any cell count within the "Operating Voltage" range			
50 Amp	2.4 Amps	4 Servos for any cell count within the "Operating Voltage" range			

**About servo ratings**

Servo counts are based on the peak BEC current divided by the stall current of a standard servo. The servo counts above use about 600mA peak current per servo, which is the stall current for many standard servos. Some servos can draw less than 600mA while large, high torque servos can draw significantly more. See your servo specification for the exact stall current

For all BEC models **except** the **FUSION**, the servo count is de-rated at higher voltages because the BEC will generate more heat than at lower voltages. **FUSION**s use a special "switching regulator" BEC that will supply 4 servos over the entire input voltage range.

## **SUPPORT**

If you are still having difficulties, or have questions that aren't covered in this manual, you can contact Medusa Research for support.

Our contact information is:

### **World Wide Web**

<http://www.medusaproducts.com>

### **E-Mail**

[support@medusaproducts.com](mailto:support@medusaproducts.com)

### **Telephone Support**

Hours: Monday-Friday 10am to 5pm eastern time, excluding business holidays  
Phone Number: 508.675.0200 (in Fall River, Massachusetts)

**LIMITED WARRANTY**

Medusa Research Incorporated warrants all ESCs to be free of manufacturing defects in material and workmanship for a period of 12 months from the original date of purchase. Should any defects covered by this warranty be found, the ESC shall be repaired or replaced with a unit of equal performance by Medusa Research Incorporated.

In the event of a product defect during the warranty period, see the directions in the "Returns and Return Authorization" section.

**LIMITS AND EXCLUSIONS:**

This warranty may be enforced only by the original purchaser, who uses the ESC in strict accordance with the information provided in this operation guide.

This Warranty does not apply to:

1. Damage resulting from failure to follow instructions provided in this operations guideline
2. Damage resulting from misuse, reverse polarity on input or output wires, abuse or neglect.
3. Damage occurring as a result of poor solder joints, connector incompatibility, or mechanical failure of user installed input and output connections.
4. Damage resulting from any repair or alteration performed by someone other than Medusa Research Inc.

**LIMITATION OF LIABILITY**

- (i) UNDER NO CIRCUMSTANCES WILL MEDUSA RESEARCH, INC. BE LIABLE FOR ANY INDIRECT, THIRD PARTY, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY EXPENSES, COSTS, LIABILITY, LOSS, OR DAMAGE WHATSOEVER IN ANY CONNECTION WITH THE USE OR MISUSE OF, OR INABILITY TO USE THIS PRODUCT;
- (ii) that Medusa Research, Inc. shall not be liable for any harm, loss, damages, expenses, costs, suit, claim or demand whatsoever against the user of this product;
- (iii) that neither Medusa Research, Inc., nor any of its representatives, employees, officers, directors, agents, distributors, affiliated corporations or any other person, shall be responsible for nor shall incur, any liability, damages, loss, obligations or responsibility whatsoever (whether in equity, contract, tort or otherwise) for any harm, loss, reliance, or damages, whatsoever, that may arise in any connection with or result from any promise, advice, arrangement, agreement, statement, technical support or maintenance, representation, warranty, or information whatsoever, that may have been made to by Medusa Research, Inc.;

**RETURNS AND RETURN AUTHORIZATION:**

For warranty and repair returns, please download a *returns form* from our website. Instructions for packaging and shipping returns are also on our website.

If you do not have access to the internet, please call or fax us at the number below.

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