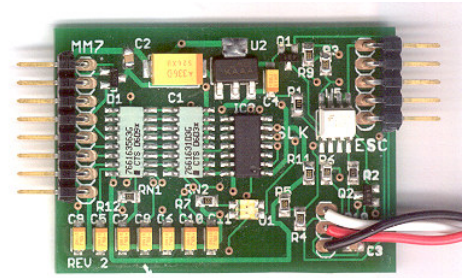# MM7 Instructions
Multi-cell Monitor - up to 7s

Overview

MM7 is designed to monitor Lithium cells in flight to prevent over-discharge. Over-discharging a cell will likely result in a ruined pack ($$$$$). Modern **E**lectronic **S**peed **C**ontrols provide some discharge protection but only look at the overall pack voltage. If the cells are not balanced and/or not matched, one cell can discharge before the others. This will be masked by the higher voltage of the other cells. If a pack that is not fully charged is used, many ESCs will set a lower threshold, allowing an over-discharge scenario. **MM7** monitors each individual cell via the balancing tap connector 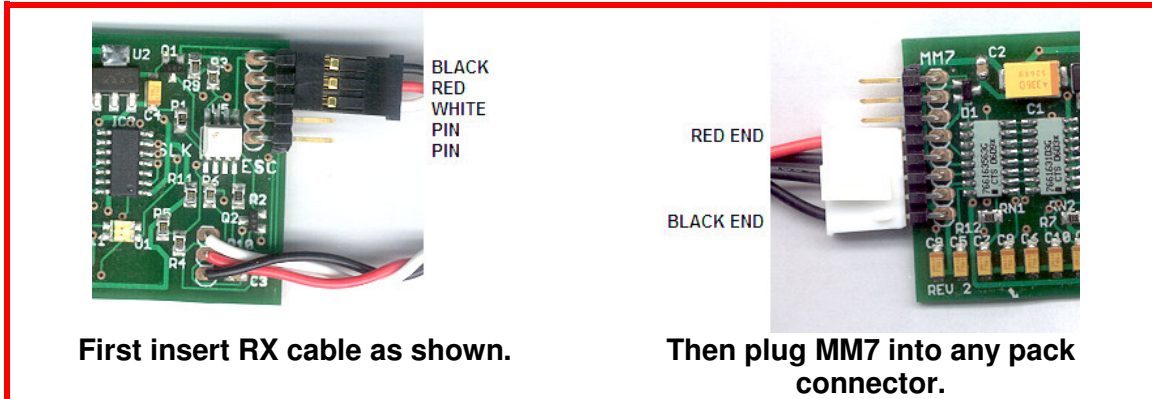and cuts the throttle to protect your pack. **MM7** allows the user to select thresholds for LiPo (including eMoli) and the new M1 (DeWalt 36V) cells from A123 Systems. **MM7** lowers the voltage cutoff as a function of throttle position, preventing premature cutoff due to voltage drop under load. Cutoff voltages are user-selectable, as are cutoff (warning) methods. **MM7** allows the user to override the throttle cutoff, if desired, to save the aircraft. **MM7** uses a filter algorithm to prevent cutoff due to current spikes. **MM7** is designed to accept most standard connectors, and works with ESC's with either BEC or optical coupling.

Programming Cell Type (LiPo/M1)

Your MM7 comes programmed for LiPo cells. You can change between LiPo and M1 cells with the following procedure:

First, plug the **MM7** Rx cable into **MM7** 5-pin connector pins closest to the board edge, with the black lead closest to the board edge. Plug **MM7** into a pack.
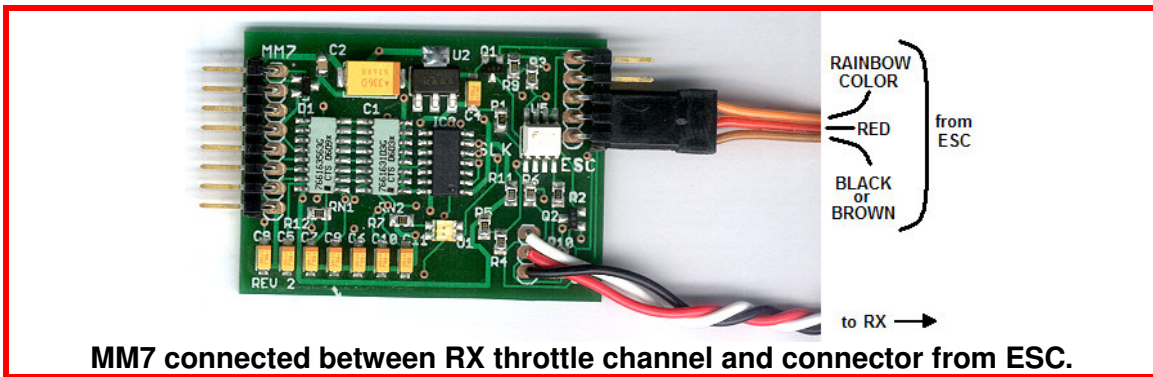

First insert RX cable as shown.   **Then plug MM7 into any pack connector.**

The processor will first "boot up" (**RED**-pause-**GREEN**-pause). The LED will alternate rapidly between **RED** and **GREEN** for 2 seconds. The LED will blink **GREEN** again. The LED will then blink the cell type number (2=LiPo, 1=M1) in **RED**. There will be a pause followed by a 2-second **GREEN**. If the setting is already what you want, unplug the RX cable during the **GREEN** and unplug **MM7** from the pack. Otherwise, the LED will blink slowly in **RED**. Unplug the RX cable after the number of blinks corresponding to the desired cell type (2=LiPo, 1=M1). When you remove the cable, the LED will blink **GREEN**, blink the cell type in **RED**, then blink **GREEN** again. If the number is correct, unplug **MM7** from the pack. Otherwise, plug the RX cable back in to start the sequence again.

Installation

The **MM7** is inserted between the ESC and RX to provide control of the motor as shown below:

MM7 connected between RX throttle channel and connector from ESC.

When you are ready to fly, install your pack so that **MM7** can be plugged into the [balancing] tap connector. A small amount of Velcro™ can help neaten things up. **MM7** comes with one of two pack tap connector configurations:

- 0.1-inch (2.54 mm.) pin spacing for Polyquest, Hobby Lobby "Twenty", etc.
- 2 mm. (.0787-inch) pin spacing for Thunderpower, FMA CellPro, etc.

MM7 automatically detects the different wiring schemes. All connectors are plugged in such that the most negative wire from the pack (normally black) is connected to the pin closest to the seven mustard-colored parts. The most positive wire (normally red) is toward the large mustard-colored part. The pics below show some typical pack connections.

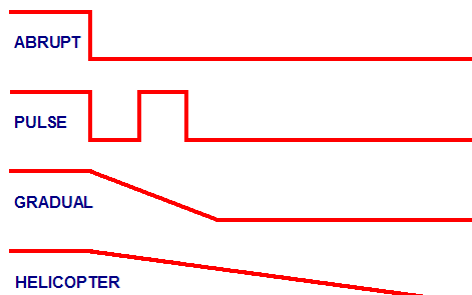| **3-cell PolyQuest pack** | **3-cell Thunderpower pack** | **7-cell 0.1" connector** |

When plugged in, **MM7** will first "boot up" (**RED**-pause-**GREEN**-pause). The LED then will blink the cell count in **RED**. Finally, A crude indication of capacity is shown. Steady **GREEN** means full or almost full. Blinking **GREEN** indicates partially full, and **RED** means nearly empty. The LED shuts off after a few seconds.

Setup (programming)

To set up your **MM7**, you select cell type (described previously), warning method, and cutoff voltage. All thresholds start at about 3.5V (LiPo) or 3.0V (M1) at low throttle. They decrease with throttle position. Settings can be adjusted down to about 2.5V (LiPo) or 2.0V (M1). If you're cruising around at part throttle, **MM7** will not allow the voltage to get too low. You can start off with a high cutoff voltage and change your setting if you determine you're not using most of your pack capacity. It would be prudent to run your motor on the ground for a minute the first time you use **MM7** to be sure to don't have a cutoff during takeoff/launch. Recharge your pack.

Be aware that M1 cells have a much flatter discharge curve than LiPo. This means that remaining capacity at cutoff can vary significantly or be very small.

There are 4 warning methods. The first is an abrupt cutoff. The second is an abrupt cutoff followed by a short throttle burst. The burst will never go higher than your throttle setting. This is for safety considerations, e.g. you've just landed. The third is a gradual decrease in power over about 5 seconds. Note that if you are floating around at low throttle you might not notice the cutoff until you raise the throttle. There is also a helicopter-friendly option that *very* gradually lowers the throttle (about 20 seconds) .

The chart below is a guide for an initial cutoff setting. If you are using older generation cells, you will probably need to pick a higher cutoff number (lower voltage). To use the chart, choose the row closest to the milliamp capacity of your pack (LiPo), the 1P row for M1 packs, or the 2P row for packs with 2 M1 cells in parallel. In the selected row, go to the number (amps)

closest to the current draw of your motor. The number at the top of this column is the suggested cutoff number to start with for your application. You will probably need a higher number if you have older technology cells or poor pack connections. The gray area represents current that is probably too high for your pack. If your motor cuts off too soon, increase the number.

		MM7 CUTOFF SETTING (BLINKS)							
		1	2	3	4	5	6	7	8
PACK MAH (LiPo)	1000	4	8	13	17	21	25	29	33
	2000	8	17	25	33	42	50	58	67
	3000	13	25	38	50	63	75	88	100
	4000	17	33	50	67	83	100	117	133
	5000	21	42	63	83	104	125	146	167
	6000	25	50	75	100	125	150	175	200
	7000	29	58	88	117	146	175	204	233
	8000	33	67	100	133	167	200	233	267
M1	1P	10	20	30	40	50	60	70	80
	2P	20	40	60	80	100	120	140	160
		MOTOR AMPS							

To set up your **MM7**, first select a set of option numbers (blinks) from the option charts and the chart above:

1 - CELL TYPE:	BLINKS:	2 - CUTOFF: (LiPo/M1)	BLINKS:
LIPO	2	3.2V/2.7V	1
M1	1	3.1V/2.6V	2
		3.0V/2.5V	3
3 - WARNING:	**BLINKS:**	2.9V/2.4V	4
ABRUPT	1	2.8V/2.3V	5
PULSE	2	2.7V/2.2V	6
GRADUAL	3	2.6V/2.1V	7
HELI	4	2.5V/2.0V	8

The cell type is programmed using only the throttle cable and a pack. The other options are programmed using your transmitter throttle stick.

The remaining options can be programmed with the **MM7** installed in the plane. Before connecting **MM7** to the pack, turn on the transmitter and receiver. Set the TX stick for high throttle. **MM7** will not allow this signal to get to the ESC, but always treat your plane as if the motor could start without warning. Plug **MM7** into the pack. The processor will first "boot up" (**RED**-pause-**GREEN**-pause). The LED will then turn **RED** for two seconds. You must move the stick to low while the LED is **RED** to program options. This is to minimize the chance of reprogramming by mistake. The LED will then blink alternately **RED** and **GREEN** rapidly for two seconds. The LED will then blink the cutoff number (1-8) in **RED**. This will be followed by a 2-second **GREEN**. If the setting is not what you want, move the throttle stick to high during the **GREEN**. The LED will blink slowly in **RED**. Move the throttle stick back to low after the number of blinks corresponding to the desired cutoff (1-8). The LED will then blink alternately **RED** and **GREEN** rapidly to start the sequence over again. If the blink count is OK, wait for the 2-second **GREEN** to finish. The LED will then blink the warning type in **RED**. This will be followed by a 2-second **GREEN**. If the setting is not what you want, move the throttle stick to high during the **GREEN**. The LED will blink slowly in **RED**. Move the throttle stick back to low after the number of blinks corresponding to the desired warning (1-4). The LED will then blink alternately **RED** and **GREEN** rapidly to start the sequence over again. When you are satisfied with your settings you can unplug **MM7** from the pack. If you leave **MM7** plugged in, it will revert to normal operation after going through the setup display twice. Feel free to experiment. The initial setup is:

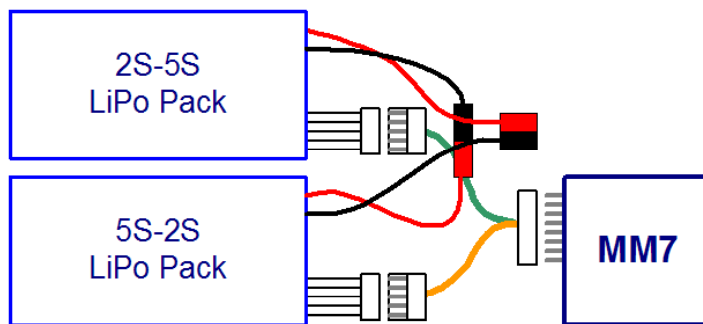> CELL TYPE = 2   > CUTOFF = 3   > WARNING = 1

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Flying

MM7 will monitor each cell and cut the throttle signal when a cell voltage gets too low. Hopefully the manner of cutoff is what you selected. You are now "dead stick." You are without power in order to save your pack from damage. If you are gliding around with the throttle off, you won't get an indication. When you next raise the throttle, the motor will stay off. If you need some power to save your plane, move the throttle stick to low and then back to high. This will override the cutoff for 20 seconds. Note that **MM7** will not recognize this sequence during the first 3 seconds after cutoff. This is to minimize inadvertent override.

When you land, the LED will be blinking **RED** if **MM7** cut your throttle. The number of blinks indicates which cell caused the cutoff. Cell #1 is wired to the negative power lead, #2 is the next higher voltage, etc. This does not mean the indicated cell is bad, only that it was the first to hit the threshold. It could be a clue, but periodic checking/balancing of cells is always prudent.
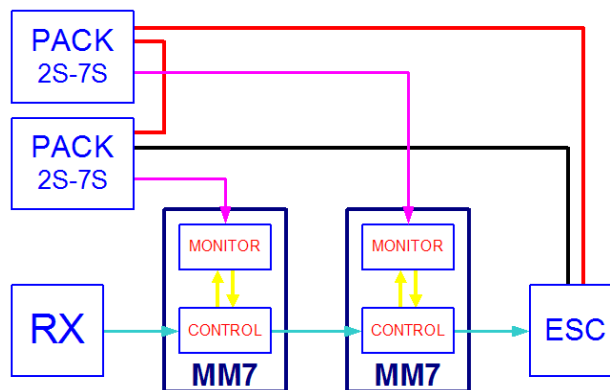
Plug in **MM7** *only* when you are ready to fly. Unplug as soon as possible. **Do not forget it! MM7** does not draw a lot of power, but leaving anything plugged into your pack (RX, ESC, etc.) for a long time will damage your pack. Balance your packs periodically.

Special Installations

MM7 can monitor two packs as long as the total number of series cells is 7S or less. This will require an adapter cable and careful attention to proper connections.

MM7 can also be used for installations of more than 7S by "chaining" multiple **MM7** units. This is made possible by the optical isolation between the throttle wires and the pack [balancing] tap.

Warranty

- ❑ If your **MM7** does not work properly with your pack or you're otherwise not satisfied during the first 30 days, return it undamaged and we will refund your money.
- ❑ If your **MM7** fails during the first year (not due to obvious abuse) we will repair or replace it at our option free of charge.
- ❑ After the first year, repair or replacement will be at a flat fee of $20.00 including return shipping.
- ❑ We cannot be responsible for damaged packs.

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www.SLKelectronics.com (to view latest instructions in color)

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