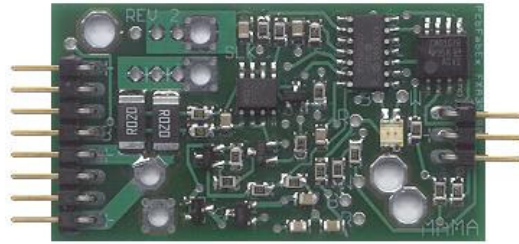


MilliAmp Monitor/Analyzer Instructions



- Keeps track of current in/out of pack
- Compatible with all 2-cell A123 (LiFePO4) packs
- Visual indication of remaining capacity
- Low-throttle blips (option) to warn of low remaining capacity
- Handles up to 10 amps continuous, 25 amps peak
- No need to unplug, can remain connected for several months
- Automatically adjusts to pack capacity
- Keeps track of partial charging
- Draws 5 ma. with receiver on, less than 100 ua. idle
- 2.05" x 1.10", 12 grams

Overview

Two-cell A123 (LiFePO4) receiver packs are superior replacements for 5-cell Ni* receiver packs, offering lower resistance and lighter weight. A123 cells employ a different chemistry that is much safer than LiPo cells. They also have a flatter discharge curve than either Ni* or LiPo. While this is a performance advantage, the flat discharge curve makes monitoring remaining capacity difficult with traditional voltage techniques. **MAMA** has been designed to continuously monitor pack discharge and charge **current** and provide a visual “fuel gauge” of remaining capacity. **MAMA** can be *permanently* mounted to or near the receiver pack. It automatically goes into a low-power mode when the pack is not charging or discharging so that it can be attached for several months without discharging the pack. An optional remote LED can be mounted on the plane to monitor capacity without accessing the **MAMA** board.

MAMA keeps track of milliamp-hours of charge and discharge and displays remaining capacity as a sequence of red and green blinks. This sequence is intuitive and divides capacity into ten segments. **MAMA** is self-calibrating. Performing a charge-discharge cycle on your charger defines full capacity. Periodic cycles will adapt **MAMA** to any long-term decrease in pack capacity. It can be used with any size Lithium Iron Phosphate cells, including paralleled cells. It will work with the small “1100” cells, the standard “2300” cells, or parallel packs, e.g. 2S2P.

As further protection, **MAMA** offers an optional throttle alert. When your pack is in the last 30% of capacity, **MAMA** will blip the throttle low periodically to alert the pilot to land immediately. **MAMA** is simply inserted between the receiver and the throttle servo or speed control. It can be programmed for 1- or 2-millisecond low throttle. Blips do not go to full low to avoid ‘killing’ the engine. Blips are noticeable but will allow safe control of the aircraft. **MAMA** also monitors pack voltage to warn of a premature empty condition. This emergency condition causes **MAMA** to cut the throttle.

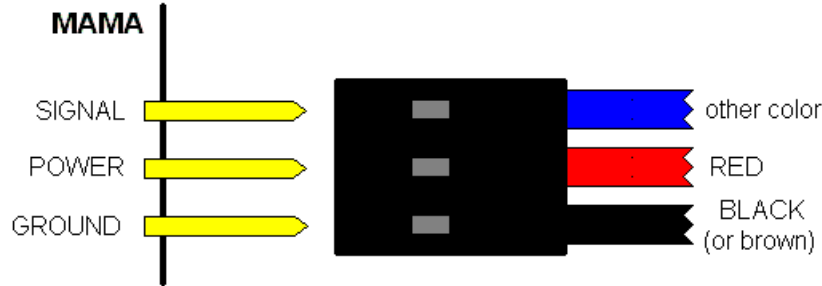
Remaining %	Visual	Low throttle	every
30 - 20	3 red blinks	¼ second	4 seconds
20 - 10	4 red blinks	½ second	4 seconds
10 - 0	cont. blinks	½ second	2 seconds

Initial Setup

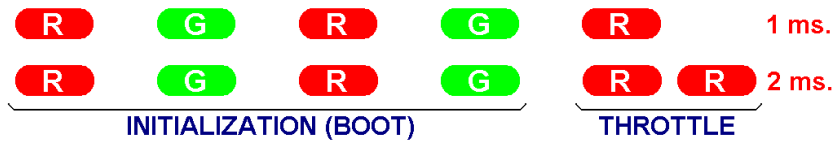
IMPORTANT: read [all](#) instructions before making any connections.

Fully charge your pack before attaching to **MAMA**

If you have the optional throttle alert, **MAMA** comes configured assuming that a nominal one-millisecond pulse is low throttle. This can be set on most transmitters. Electronic speed controls almost universally use this. If you must use two milliseconds for low throttle, it is necessary to tell **MAMA** during setup. You do this by hooking up the **MAMA** receiver throttle cable to the 3 pins as shown above, forming a loop [ONLY FOR 2-MS. LOW THROTTLE]. Later you will be able to verify that you have the correct timing.



Carefully plug your pack into **MAMA** (refer to **Connectors** section below). You should see 2 seconds of alternating red and green (boot), followed by either one red blink (1 millisecond) or two red blinks (2 milliseconds). This will be followed by the normal blink sequence for a full pack. The blinking should stop after a few seconds if no equipment is connected. Disconnect the loopback cable if used for setup.



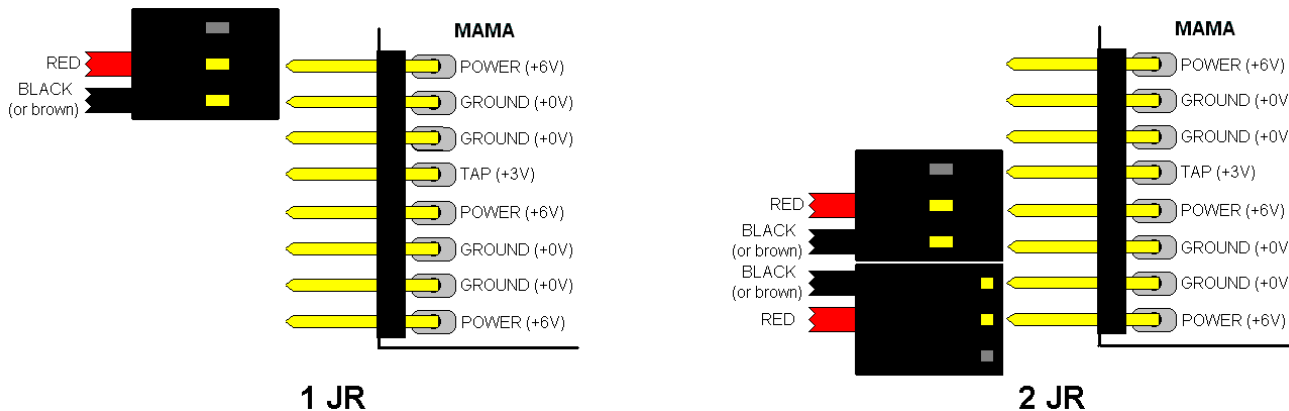
Connect any remaining pack and/or balance connectors per the drawings. This completes the initial setup.

Connectors

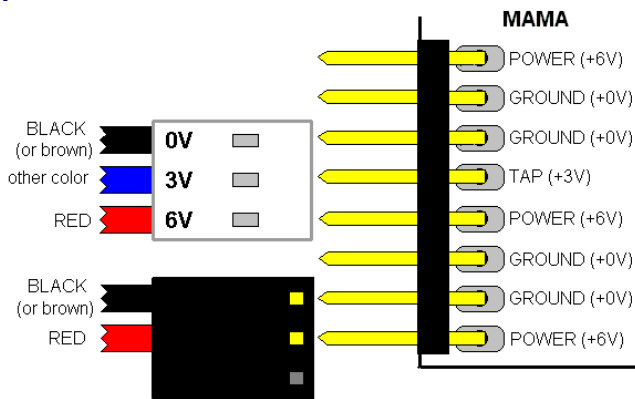
The drawings below show the proper way to connect packs with various configurations. Connecting the balance connector through **MAMA** allows it to properly account for charge current. This also provides an additional current path for redundancy and lower resistance. If your pack does not have a balance connector, we strongly recommend adding one. Packs should use heavy-duty JR-type cables (22-gauge).

WARNING:
Be absolutely sure before plugging in connectors.
Mistakes can result in severe damage.

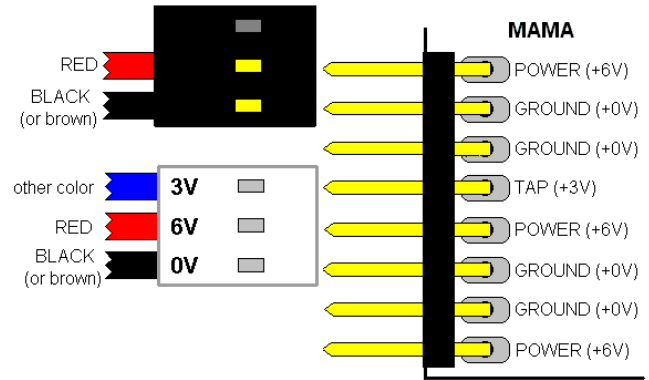
It should be apparent that wrong connections could short out a pack. NOTE: any unused pins are “hot” and could cause a short. Either cut off these pins or cover with small pieces of heat-shrink tubing.



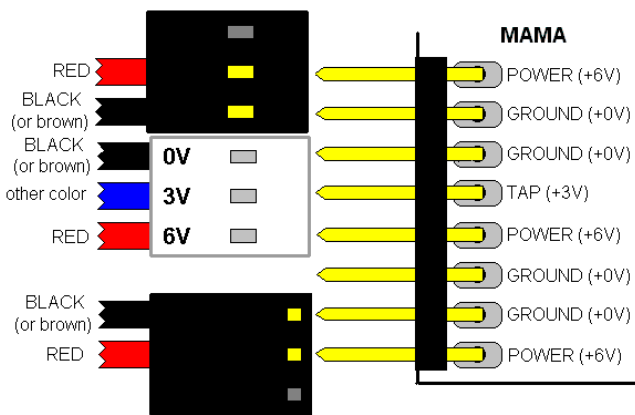
We have no way of knowing your balance connector color scheme, but you need to in order to safely connect your balance connector.



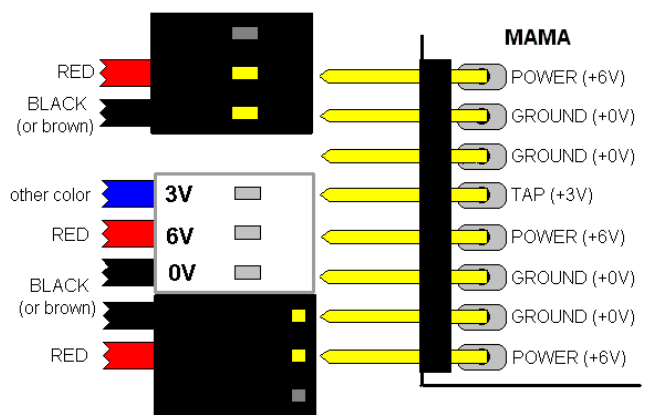
1 JR + CTR. TAP



1 JR + END TAP



2 JR + CTR. TAP



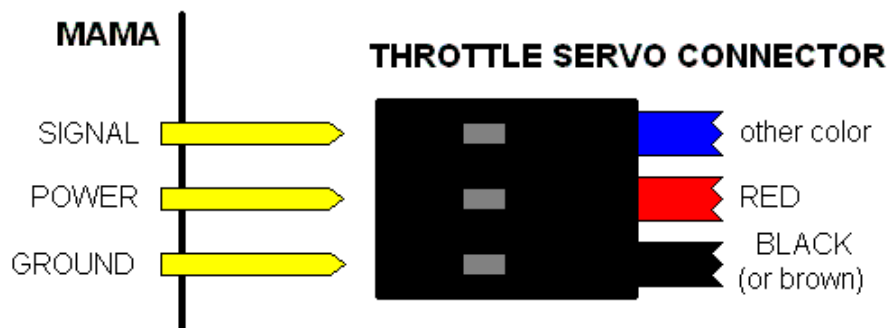
2 JR + END TAP

Installation

Once connected, **MAMA** can be mounted to the pack using shrink wrap, hook-and-loop, servo tape, or whatever. It can also be mounted separately, perhaps in a location where the LED can be viewed more readily. A small hole could be made in the fuselage and **MAMA** mounted against the inside with the LED showing through. The ability to safely charge A123 cells in the plane plus **MAMA**'s very low standby drain means they don't need to be easily accessible. It is recommended, however, that **MAMA** be disconnected if storage for several months is anticipated. A fully-charged 2300 pack will power **MAMA** for a year, and an 1100 pack for 4 months, but don't chance it.

Do not connect your receiver and servos to **MAMA** until initial setup is complete. Connect your receiver switch(es) but do not turn on yet.

If you have the throttle alert, connect the **MAMA** throttle cable to your receiver throttle channel and your throttle cable to the 3-pin connector as shown.



The first time you turn on your receiver, **MAMA** will simulate a low battery condition so that you can check your servo setup. This will only happen on the first power-up after your pack is connected. Turning your receiver off and on again will indicate a full pack.

Using **MAMA**

The blink sequences are shown below. They probably look confusing at first, but are actually quite easy to remember. The capacity of the pack is divided into ten roughly equal sections. A full pack will blink green continuously. As the pack discharges below 90% full, the blinking will shift to groups of 4 blinks separated by a pause. As the pack empties, you get smaller groups of green blinks. When the pack reaches 50%, a red blink is added. As the pack further discharges, more red blinks are added. When the pack reaches 30%, there are no more green blinks and the optional throttle warning starts blipping the throttle. . In the final 10%, **MAMA** blinks red continuously.

Summarizing, all green you're more than half full, red and green you're more than half empty, and all red, you have no business flying!

90-100%	G	G	G	G	G	G	G	G	G	G	G
80-90%	G	G	G	G		G	G	G	G		
70-80%	G	G	G		G	G	G		G	G	G
60-70%	G	G		G	G		G	G		G	G
50-60%	G		G		G		G		G		G
40-50%	G	R		G	R		G	R		G	R
30-40%	G	R	R		G	R	R		G	R	R
20-30%	R	R	R		R	R	R				
10-20%	R	R	R	R		R	R	R	R		
0-10%	R	R	R	R	R	R	R	R	R	R	R

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You should be able to learn how often you need to charge your pack from **MAMA** and how much charge it takes to fill your pack. A prudent flyer will not depend solely on the throttle warning. It is a last line of defense.

In addition to capacity monitoring, **MAMA** also monitors charge and discharge voltage. When a fully charged voltage is detected, the LED blinks green at twice the normal rate. This will stop after about 2% discharge. When a low voltage is detected, the LED blinks red at twice the normal rate and the throttle is forced low. At this point you probably have less than 3% capacity remaining and landing cannot be delayed.

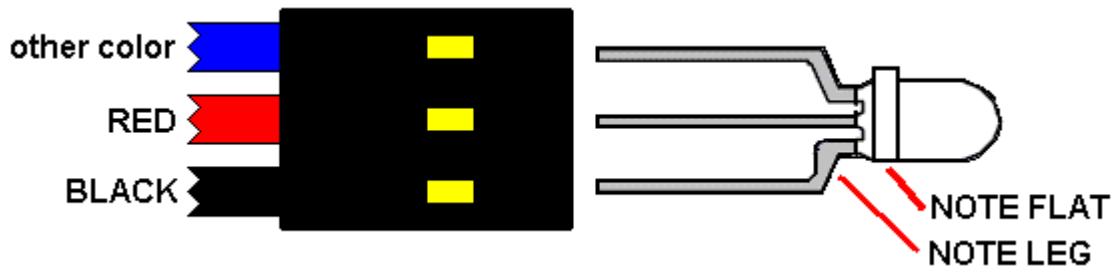
MAMA comes initialized assuming a fully charged 2300 mah. pack with an initial capacity of about 1800 mah. You can accept this conservative setting or discharge your pack after connecting **MAMA**. The *West Mountain Radio CBA* is a great tool for discharging packs using your computer. Many chargers have a discharge function. The setting for 5 Ni* cells is appropriate for 2S LiFePO4. If you are using the smaller A123 cells, you **MUST** do a charge/discharge cycle after connecting **MAMA**. If you are using a pack with parallel cells, e.g. 2S2P, the discharge will properly set **MAMA**.

Balance Tap

Your **MAMA** comes with a balance tap in standard **0V-3V-6V** configuration. If you need 0V-6V-3V, carefully remove and swap the connector pins using a #16 knife blade to lift the plastic tabs retaining the pins **Do this before connecting MAMA to the pack.**

Optional Remote LED

The optional remote LED allows you to mount the display away from **MAMA** for easy viewing. This could be in the cockpit or near your switch or charge connector. The remote consists of a servo-type connector and a 3-pin LED. If more length is desired, a servo extension can be used. The LED requires a 0.118-inch (3.0 mm.) hole and can be fastened with some silicone applied to the back after insertion. Drill for a snug fit. We recommend mounting the LED recessed (e.g. in thick balsa) for best viewing in sunlight. Connect the cable as shown:



If you have both the remote LED and the throttle override, the correct cable is the one closer to the center of the board. If the boot sequence starts GREEN-RED instead of RED-GREEN, you need to reverse the LED.

Disconnecting/Reconnecting

MAMA can be disconnected for long-term storage or to be moved to another pack. When reconnecting, follow instructions above, keeping in mind:

- pack must be fully charged
- **MAMA** remembers last capacity
- **MAMA** needs to be reminded if 2-ms. Throttle

To place back in service, simply charge the pack and reconnect **MAMA**. It will remember its last calculated capacity. It is recommended that Lithium cells be stored at half capacity. Simply observe MAMA blinking while charging until you no longer see red blinks, or until you start to see red blinks while discharging.

Warranty

- ❑ If your **MAMA** 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 **MAMA** 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.

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www.SLKelectronics.com/mama
(to view or print latest instructions in color)