How to choose a good power system for my aircraft

By Ray Gholamipour

What is a good power system for my plane?

A good power system should have the following:

1. Enough capacity for number of times you want to fly without having to recharge.
2. Offers good discharge rate so your servos don't starve for current and exhibit surface blow backs.
3. Holds good voltage under load so your voltage drop won't cause the receiver to reboot.

Other factors to consider:
1. Weight.
2. Cell balancing.
3. Flammable or non-flammable.
4. Life Span of the batteries and number of cycles you can use them.
5. Cost.

Depending on your application there are varieties of batteries that can meet or exceed your requirements. There is no best battery as all have advantages and disadvantages when compared to each other however there is always one battery that can be best suited for your application.

Size of the plane, number of servos, type of servos, regulator or no regulator, set up and your type of flying are things you need to know before you make a power selection.

I will provide two examples later in this article but those examples are for your reference only.

How about regulator?

Many pilots would rather have regulators in their airplanes. With the use of regulators your servos receive a constant voltage. This also means that the speed and torque as well as the feel remain the same throughout your flights. Also servo life span won't be shortened by seeing high voltage that is beyond their designed operating voltage.

In choosing a regulator keep in mind the servos should not draw more than the rated capacity of the regulator by more than 20%. The duration of this burst should be very short. It is very important that right regulator be used for your aircraft!

It is important to match the battery, regulator and servo demand. They must all work together for your system to be trouble free. If your battery is up to the task but your regulator cannot handle the demand then there will be poor servo control and if the voltage drops far enough a possible brown out or reset of the radio system.

Test case I:

QQ-Python 100cc equipped with:

7 (8711) servos, Powerbox SC-12 and two Li-Mn 2s2p 3000 mah batteries:

Max amp draw of the system in 12 minutes of hard but reasonable 3D flying at 14.5 amps. Minimum Voltage drop 7.98 volt from 8.3 v. Each battery drew about 7.25 amps. I do not expect to see max amp draw to exceed 18 amps even if you manage to break the aircraft in the air! Please keep in mind that duration of Max load is very short, lasting not more than 2-3 seconds and most cases fraction of a second.

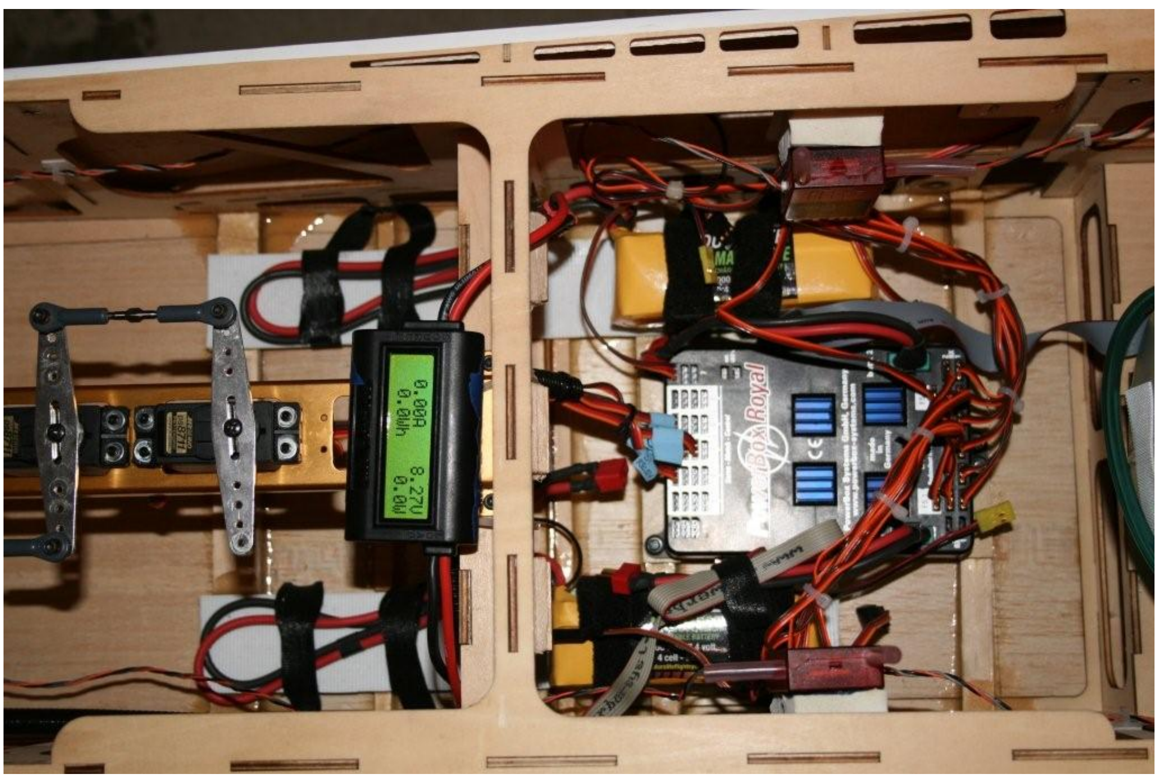
One thing to keep in mind and understand is this is a 100cc plane with no ganged servos. If you hypothetically equip a 150cc plane, a 40% let's say, with same number of servos, you will experience much higher draw because your servos will be pushed to their torque limit and hence stall current. Your draw can potentially be increased by 60%-100%

It is safe to say that a 100cc plane equipped with all 8711s will not exceed max16-18 amps if set up right with matched servos! In reality I do not expect to see more than 10-12 amps. Also keep in mind not any kind of flying is considered 3D flying. You need to have a sense of the gs that you are putting on your aircraft. If you fly your plane at full throttle in a long down line of over 400 ft you can reach very high speeds. Entering a blender can induce max current draw to the extent of stalling the servos, damaging airframe, and even stripping servo gears in some cases. My test did have a high speed blender and looked violent enough to wow the crowd but again I made sure that I didn't over do it! Please try to have a sense of the airspeed of your plane before entering extreme maneuvers!

My test flight also included numerous high speed horizontal, vertical, and 45 degree kinds of snap-rolls! High speed snap rolls are considered very high draw cases! Remember the higher the speed along with high deflection the higher the current draw. Most 3D maneuvers like harrier rolls, harriers and such do have max deflection but do not have the speed factor therefore as long as you have good matched servos the draw is not of a concern. So in reality slow 3D maneuvers are not considered high draw case but they are consistent! So you pull 2.5-4 amps continuously in a harrier roll circle with a 100cc plane.

Test Case II,

QQ-Yak 120", (11) 8711, PowerBox Royal, Two 2s2p 3000 Li-Mn



I set up my PB Royal to regulate the voltage to 7 volt on my 8711 servos and used a voltage step down for my throttle servo to see 6 volt. Please be advised that Horizon Hobby does not recommend voltage higher than 6v for 8711 and won't honor any damage or loss caused by servo with the use of high voltage! I personally have heard of many reports of some using them on 8.4 volts with no regulators with success but I am afraid to do so just yet. However monitoring my servos and heat sinks with 7 volt has shown no indication of problems to me yet and power is just incredible! I actually notice the difference from 5.9 to 7v in high speed snaps.

With this the set up I described I have observed the following.

Max amp draw in IMAC Advanced sequence 17 amps that is 8 to 8.5 amps from each battery, Min Voltage 7.9 from 8.35 volt! Keep in mind that max amp draw can increase if you run the servo at 5.9 volts. Additionally when running on 5.9 volts, and under hard flying conditions, my PB regulators were getting really HOT. I checked with the PowerBox crew and that seemed to be OK as they mentioned regulator temperature can go up to 150C this is equal to 302F. WOW! But this can only be allowed for a very short time! I personally decided to start flying at 7v and see how my servos and regulator like them. Well, it worked out in the best way possible. I dropped the temperature of regulators to the extent that they are just warm and increased the power and speed of my servos.

Mah spent from each battery 350-400 mah in 11 minutes flight time. That would make about 700-750 mah in one IMAC flight in advanced sequence.

All the test cases above used Li-Mn batteries.

Now let's talk about A123 batteries. These batteries hold the voltage under load very consistently with very minimum voltage drop until they get to the point that battery is almost completely discharged and then the voltage drops like a rock! They are unforgiving when they get to this point, unlike Li-Ion,Li-Mn,Li-Po where there is still 10-20% juice left when they get close to their threshold.

I replaced my 3000 Li-Mn with 2300 A123 in my Python 100cc, and connected them to my PB SC-12 as I did not want to change my set up. Since the battery voltage is low in comparison with Li-Mn or Li-Ion, PB shows a red light (No Flight) on its case but that does not mean that PB won't use the battery in flight, PB will continue drawing from the battery.

I put the plane through its paces for abour 11 minutes and managed to draw about 13 amps out of both batteries, 6.5 amp from each. Min voltage drop from a fully charged A123 was 6.45v this stayed the same in the next two flights! So by discharging the pack to half its capacity, voltage drop did not go below 6.35! This is truly remarkable how steady these batteries hold voltage.

Then I kept one A123 and replaced the other one with Li-Mn 3000. So I had two different kinds of battery in flight. Given both batteries were not fully charged at this point (both had two previous flights from fully charged) I flew the plane.

Min voltage drop from A123 under 7 amp load was 6.35v and from Li-Mn was 7.87v at 7.1 amp draw. These two batteries are outstanding under load.

Synopsis

Li-Mn

1. Excellent battery with 20c discharge rate and 10C charge
2. Holds great voltage under high loads.
3. Fast charge at 10c
4. Cells are available in variety of capacities such as 1500,2200,3000,3800.
5. Gives you steady voltage for running servos at 7volts for utmost power and speed.
6. Charge status can be checked by traditional load test
7. Can be charged by traditional li-Ion charger
8. Non-Flammable
9. Still needs regulator
10. Higher cost to A123
11. Weight very similar to A123

A123

1. Excellent battery with 30c discharge
2. Holds unbelievable voltage under load
3. Fast charge capable
4. Cell capacities are not as diverse as Li-Mn
5. No regulators is needed
6. Non-Flammable
7. Need to keep track of mah spent as they are not forgiving when they hit their threshold
8. Traditional load test does not give you the status of charge
9. Can not be charged with traditional Li-Ion charger unless it is Duralite A123 packs with circuit
10. Costs less than Li-Mn
11. A123 has higher life cycle according to manufacturer of the cell rated at 1000. Li-Mn manufacturer claims 500. Life cycle depends on so many different variables that would really make it hard to judge the life cycle in our applications but they certainly both out last the Li-Ion and Li-Po. We think in reality A123 will give us around 500 while Li-Mn 300 but we have no solid data on this.
12. Weight very similar to Li-Mn

Conclusions

Quite frankly I think these two batteries are awesome for any Giant Scale application. I love the fact they are both non-flammable and yet have very high discharge rate. I like A123 because they do not need regulators but at the same time, I like providing constant 7v to my JR 8711 servos using Li-Mn and PB Royal. I find the servos to be much faster and powerful and yet see same voltage through out all of my flights.

I am changing one of my 100cc planes to A123 and AR9100 receiver and my 50c with one A123 2300, no regulator. Both are excellent batteries and way superior to Li-Ion. You can't go wrong with either!

Hope this helps you in understanding behavior of both batteries. I am sure you can make a decision for your own aircraft once you have all the facts lined up along with the cost.

Regards,
Reza Gholamipour,
reza@giantrcsupport.com www.RCModelAviator.co