

Model Boat Electronics

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This write up is one way of describing some of the problems we encounter and are suggestions on how you might accomplish some of your models wiring. This is not the only way and I'm sure that there may be other and better ways of doing this. So use this information at your own discretion

Here's how I've broken up this write up:

Section 1: Definition of Voltage and Amperage & Amp meter hookup

Section 2: Picking the best motor for your application

Section 3: Picking the best speed controller for your application

Section 4: Finding the optimum power output (Best speed with the most optimum Amp draw)

Section 5: Protecting your electronics with fuses

Section 6: Clean versus dirty wiring and how to layout your electronics

***** SECTION 1 *****

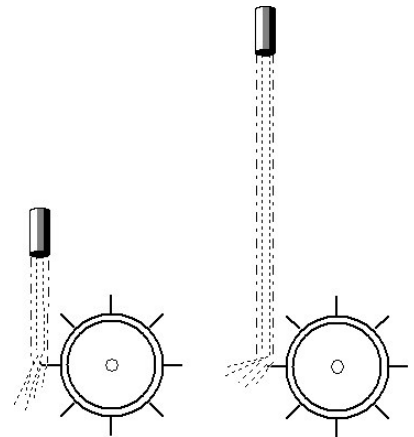
Definition of Voltage and Amperage

For illustration purposes I'll use a paddle wheel to clarify the meaning of Current/Amps versus Voltage/Power

If we want the paddle wheel to turn faster in the diagrams below there are several ways we can accomplish this:

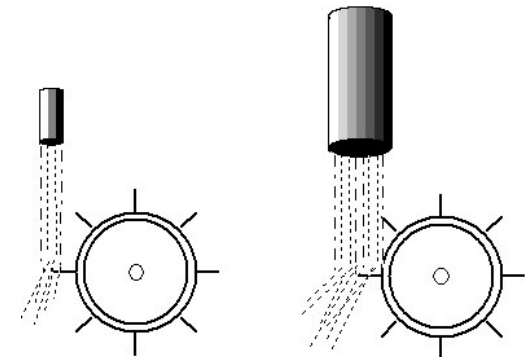
Power/Voltage

- 1) Given that the volume (Amount) of water coming out of the same diameter pipes shown below, we can make the paddle wheel turn faster by raising the pipe higher allowing the water to hit the paddle wheel at a higher velocity resulting in the wheel turning faster. The same is true for our motors. If the Amperage (Volume of water) is the same we can make a motor turn faster by raising the voltage (Velocity of water). For example if we have two batteries both rated at 4 Amps but one is 6V and the other is 12V then the 12V 4Amp batter will make our motor turn faster.



Current/Amps

- 2) We can also make the paddle wheel turn faster by keeping the pipe height the same but increase the water volume going through the pipes. In the illustration on the right the height (Voltage) of the pipe is the same, meaning we kept the voltage the same, but by increasing the volume of water, meaning we increase the Amperage, (More current (Higher Amperage)) the increase in water volume will result in more water hitting the paddles, resulting in the paddle wheel turning faster. With our motors if we have two 12V batteries but one is rated at 4 Amps and the other is rated at 7 Amps then the one rated at 7 Amps will spin our motors faster



***** SECTION 2 *****

Picking the best motor for your application

What I'm about to describe I'm sure is not the only way or for that matter probably not the most ideal but it is one way of finding a motor that works. Before I start you need to have some answers that will help in you choosing the right motor:

- 1) How many volts are you planning on using to power your model

Here are some pros and cons:

12 Volts		6 Volts	
Pro	Con	Pro	Con
1) Typically longer running times	1) Battery typically heavier	1) Battery is lighter	1) Typically not used for motors that require a lot of power
2) Typically more power available again	2) Battery is typically bigger	2) Battery is typically smaller	2) Run times are not too long, but depend on type of motor being used
3) Easier to find use batteries	3) Battery is typically a little more expensive than 6V	3) Battery is typically cheaper (Not much)	
4) Chargers typically easier to find			

- 2) What type of boat do you have (Do you want speed, power, or just leisurely cruising)

Speed	
Slow	Fast
1) Longer running times	1) Looks really good
2) Easier to maneuver your boat	2) If you model is meant to go fast it looks scale.
3) Typically more scale looking	3) If using a gear reduction system you can get a lot of torque
4) Speed controller is typically cheaper as your drawing less amps	4) Battery duration is short
5) Speed controller typically runs cooler.	5) Need to make sure your speed controller is matched based on the high amp draw

Once you have an idea of what type of motor you're looking for you have a couple of options as to how to obtain the motor. You can purchase a motor at a hobby store but be aware that the "typical" can motors (Motors used in RC cars & planes) are usually not the best option as these are usually geared or high revving motors. To give you an idea of what a typical configuration would be based on several configurations, here's several examples:

For the Shelly Foss 36" using the Dumas "Pitman" motor is a good choice as you have power and long run times. See specs below:

For the Dumas Chris Craft boats using a Graupner Speed 600 is a good choice as you have both power and speed. See specs below:

Some suggestions as to where to purchase a new motor would be one of the following:

Hobby Lobby :

They sell all the “Speed” line of motors ranging from the Speed 500 to the Speed 900

Description	Voltage	Amp Draw	No Load RPM
Speed 600 BB 6V	6V	7.5 Amps MAX	11,000 RPM
Speed 600 BB 12 Volt	12 Volt	7 Amps MAX	17,200 RPM

They also sell gear reduction systems that are good for taking a fast spinning motor and converting it to a high torque motor

Tower Hobbies:

Sell Dumas line of 6V and 12V motors. Very low amp drawing & high torque motors (Especially the 12V)

Description	Voltage	Amp Draw	No Load RPM
6V Pittman	6 Volt	4 Amps MAX	5000 RPM
12V Pittman	12 Volt	2 Amps MAX	5000 RPM

Your best deals can usually be found at an electronic surplus store. Look in the phone book for the closest surplus store to you. Also stay tuned, as we will be publishing a list of local hobby vendors!

When you’re buying a motor try and get the specifications such as what the voltage range is, MAX Amp draw at a stall (Motor stopped while under power), no load RPM, and shaft diameter.

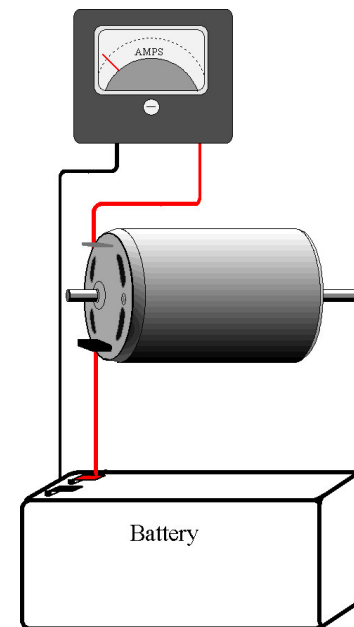
If you’re buy a new motor you should have access to most of the specs above as they are usually documented somewhere on the package.

If you’re buying a used motor at a surplus store you need to at least know what the voltage range is. This is typically marked on the package or written on the motor somewhere.

If **you’re buying a used motor** get your hands on a AMP meter and ask the store owner if you can measure the amp draw on the motor. Be sure and take an appropriate volt battery along with several jumper wires with alligator clips on the ends with you. Hook the AMP meter as shown in the diagram to the right. **If you find out that it’s drawing more than 10 –20 AMPS this maybe too much and you should look for something that will draw less AMPS.** Also see if you can get a feeling for the RPM’s. 5000RPM’s is really not all that fast, but when you’re running a 3” prop on a tug you would be surprised how fast 5,000 RPM’s will move that tug.

Hooking up a Amp meter:

- 1) First find an Amp from either a surplus electronics store or get a cheap one at Radio Shack, or better yet borrow one. If you get desperate call me and I’ll let you borrow mine.
- 2) Hook up one Amp meter lead to the negative terminal of the battery, hook up the other amp meter lead to one terminal of the motor and then hook up a jumper wire between the remaining terminals of the motor and the battery



***** SECTION 3 *****

Picking the best speed controller for your application

This is usually pretty easy once you know what the maximum AMP draw is for your motor (Motor at a full stall under power) and what voltage you're running at. What you want is a speed controller that is rated for at least 10 AMPS past a stall AMP draw. So if your motor is a 12-volt motor and stalls with a 5 AMP reading then get a speed controller that is rated for at least 15 to 20AMPS surge. To figure out what the continuous APM rate is identify what the stall AMP draw is and a no-load AMP reading is the mid point of these two numbers is your continuous AMP draw. This should be the continuous amperage rating that you need in a speed controller. For example hooking up the AMP meter to your motor using the diagram above if your no-load reading was 1AMP and your stall reading was 5AMPS then your continuous amperage would be around 3 Amps. So when purchasing a speed controller look for one that is rated at 12 volts has a continuous AMP rating of 3 Amps or more and has an AMP surge rating of 15AMPS or more.

***** SECTION 4 *****

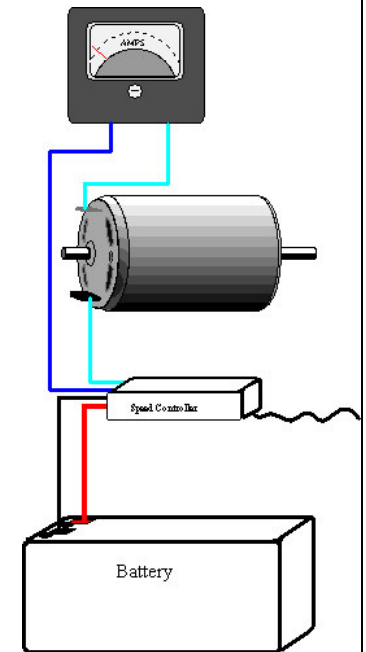
Finding the optimum power output

Optimum power output for a motor is at a point where the amperage draw is at a mid point between a stall draw and a no-load draw. Running your motors at this point will result in a long battery duration as well as a long motor and speed controller life and should result in a cool running motor and speed controller.

The ideal maximum amp draw on a scale model motor should be somewhere between 5 & 10 amps. If you're above this then you're motor is considered to be a high speed high power motor and would typically be used on high-speed race boats or large models requiring lots of torque. These high Amp drawing motors typically drain a battery pretty fast pretty warm or even hot and typically requiring a cooling system. I know I own several of these types of boats!

Finding the optimum speed for your motor (Somewhere between no load & stall)

- 1) Measure no load amp draw on motor only
 - a. Amperage draw should be very low
- 2) Measure a no load amp draw on the motor installed in the boat and hooked up to shaft. Boat will be tested out of the water
 - a. With the motor running there should not be a noticeable raise in the amp draw. If there is then you have a serious binding problem with your shaft/stuffing box that is causing this. **Fix this problem!**
- 3) Measure the amp draw with model in the water running at full speed.
 - a. If the amp draw surges then you're over loading the motor. Meaning you are running too big a prop or too much pitch on the prop. To solve this try one or more of the following
 - i. Go with a smaller diameter prop
 - ii. Try a prop with less pitch
 - iii. Try a gear or pulley reduction system



***** SECTION 5 *****

Protecting your electronics with fuses

Fusing the power supply and how to figure out what AMP to use:

Selecting a fuse:

There are two scenarios in which we want protection for our speed controllers, motors and electronics in general

- 1) Shorting
- 2) Over loading

1) Shorting is pretty easy to understand. It's when we cross the batteries hot wire to a ground wire which results in a short. I think everyone at one time or another has had this experience.

2) Overloading. This happens, when for some reason or another the motors end up drawing more amperage than the wiring, speed controller or motors they can handle. To prevent this from happening we need to make sure that the equipment that we have can handle the current and voltage required for our setups and have some form of protection when these conditions are exceeded.

Don't be fooled into thinking that if you have a 20-amp speed controller that all you need is a 20-amp fuse. For example if your findings show that your motor draws 10 amps at stall you may think that a 10-amp fuse will protect you. Unfortunately this is not the case as a typical "Quick acting" fuse can take a 10% overload for 4+ hours. If the over load is increased to 40% a typical fuse will handle this for a little less than 1 hour. A 100% over load (twice the rating) will take about 5 seconds before the fuse blows. What this means is that both the speed controller and motor are subject to an overload for sometime before the fuse blows. Meaning the speed controller and motors could get damaged.

The solution is to get a fuse matched to your model and speed controller. Here's how you would figure this out: If your speed controller is rated at 20 amps and your motor draws 5 amps under normal use (in the water under power) then a 10 amp fuse would be what you would use. This would allow for a slight overload (props get tangled in weeds) and still allow you to get your model back to shore, but in case of a serious problem (complete stall) your fuse would protect your speed controller.

As for the location of this fuse you need to have it as close to the battery connectors

***** SECTION 5 *****

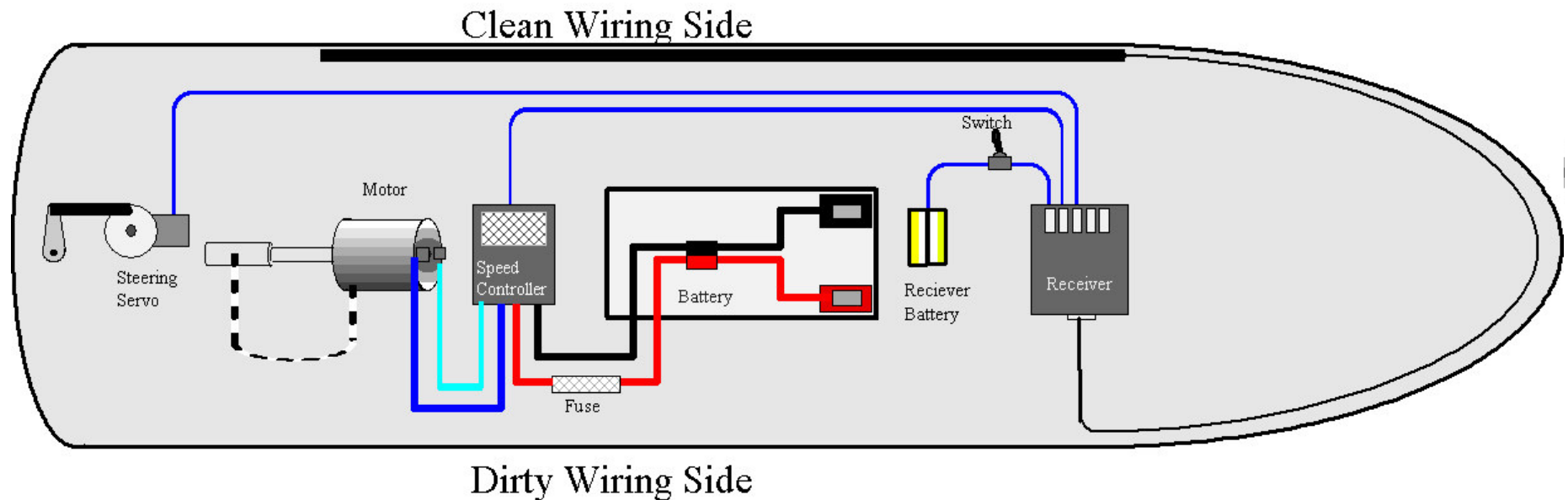
Clean versus dirty wiring and how to layout your electronics

How many times have you put all of your electronics in and turned on your radio and receiver only to see your servos jitter like they had a mind of their own. Or worse yet you get your boat on the water and get it 10 feet out and all of a sudden it goes wild. Well one of the problems could be that your wiring in the boat may be placed wrong. The reason is that there could be some interference between your motor wiring and your radio wiring. To solve this problem you need to separate these two "types" of wiring as much as possible. The motor wiring is known as

“dirty” wiring and the radio wiring is known as clean wiring. Dirty wiring consists of your battery wiring, speed controller wiring including the wiring to the motor. Clean wiring is your receiver wiring including all of the wiring to your servos and your antenna. See the diagram below as an example of how to keep this wiring separate. For twin motors and speed controllers keeping the wiring can be a bit more challenging but can still be done.

Other things to try and remember:

- 1) Keep receiver as far away from possible from your speed controller and motor
- 2) If possible connect a jumper wire (ground wire) between your motor and your stuffing box.
- 3) If possible run your receiver vertically through your deck and super structure. This will allow for the best reception as well as minimize the amount of interference you’ll get from inside.
- 4) Make sure the connections from your steering servo horn to your steering arm are not totally metal as this could also be another point of interference



Another important step is putting capacitors on your motor terminals. This cuts down on the motor brush noise by placing a capacitor on each terminal. These capacitors should be of a value of 1000pF, 0.001 microfarad or 1 nanoFarad. You can pick these up very cheaply at radio shack. Hook them up using the diagram to the right. Be sure and place some form of heat shrink tubing around the bare capacitor wires to prevent shorting between capacitor wires and motor casing. (See yellow segments on diagram on the right)

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