



Electronics and Batteries

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De-mystifying the subject of electronics and batteries, including battery charging and chargers.

Technology: battery and charger technology is moving at a very rapid pace because of RC car racing, drones, helicopters and model airplanes. The toy runs for, maybe 4 – 8 minutes, and in that time it uses massive battery power. Then the user needs to recharge those batteries in minutes to be ready for the next race.

This is NOT the application in RC sailing. We do not need nearly so much sophistication and the cost that comes with that technology. Most hobby shops are far more familiar with these more popular applications than with radio sailing. When we buy batteries or chargers online there is usually no advice at all. As a result, often radio sailors rely on the local hobby shop and buy technology that is not applicable or “overkill”.

A few basic questions: Do we use “air” radios? Yes. And the best ones to get are stick radios (instead of “wheel” radios such as are used by RC cars and trucks). Further- you want a “**Mode 2**” radio- where the throttle (sail control) is on the left stick, and the “Aileron” (rudder) is via the right stick. On most receivers, the **throttle (sail control) is Channel No. 1, and the aileron (rudder) is Channel 2. Any other port can be used for the battery or power switch.**

I. Transmitters ("radios" or “TX”) - a brief summary:

A. You don't need a particularly sophisticated radio. Any 2.4 GHz aircraft transmitter (sticks instead of wheels) with a compatible receiver will be fine.

As of today, you can't buy a 2-channel radio- so anything you buy will have 4-5-or even 6 or more channels.

As you buy "better" radios, you get the ability to program varied response and sensitivity, and the better radios will work with multiple models- incl. boats, planes, and copters some as many as 250 models! ALL are made in China, Taiwan, or Indonesia, BUT a brand sold in the USA and serviced in the USA can be repaired (or replaced) in the USA.

What radios are “the best”? Brands are:

Spektrum: very good, USA service and repair, very reliable and good about honoring their warranty. Sold through hobby shops or online.

Basic: The Spektrum DXs entry-level radio is \$165 with receiver. It will control ONE boat, car, etc., without re-*binding* it to a second or third.

Better: The Dx6e computer radio- about \$ 250. It will control 250 models, each with different settings for every channel. It allows adjusting the sensitivity of the sticks (a lot of aggressive rudder motion is slow!) The DX6-e also supports *telemetry*- so with a telemetry receiver the voltage reading of the boat battery pack (as a percentage of maximum charge) appears on the transmitter screen to warn of a low receiver battery charge situation, allowing you to sail the boat back before losing control. The DX-6e runs on 4 X AA dry cells, and also offers a rechargeable option at about a \$60 premium.

Still better: the Spektrum NX7e has all the features of the DX6e, but an included rechargeable Lithium Ion battery pack, better rendition (graphics) on the screen and a lower power usage for longer battery life. It is \$300 (about equally-priced to the DX6e with a rechargeable battery pack.)

FlySky: FlySky available online from HobbyKing. The **TGY-i6 Mode 2 AFHDS Transmitter** and 6CH Receiver is less than \$60. The i6 is now probably the most-used radio among RC sailors. It has almost no support, no warranty, BUT it works. It also has **boat voltage telemetry** (with the iA6B Telemetry Receiver that comes with some of the radios, OR that can be bought for around \$18.) The i6 has no rechargeable battery pack option- 4 AA cells.

Why so cheap? Cheaper internals. But they work. Not sold by local hobby shops so no help at the shop at the mall. Also- remember, ANY of them is toast if you get it wet in the rain. So many sailors would rather take any risk with a \$60 vs. as \$ 250 radio. They are not a crummy radio (and a lot of sailors swear by them).

Others: Futaba and JR are fine radios also. But 50-100% more expensive than even the Spektrums.

What should you buy? a basic radio WILL work, but most in the sport end up eventually buying a “computer radio” which seems to make their first “basic radio” sort of a waste of money. If you want local assistance, and value service- buy the Spektrum from your hobby shop. If you are OK with a “throwaway” radio- buy the FlySky - when/if it fails just open a backup one up and go sailing.

II. Good general radio strategies for new sailors:

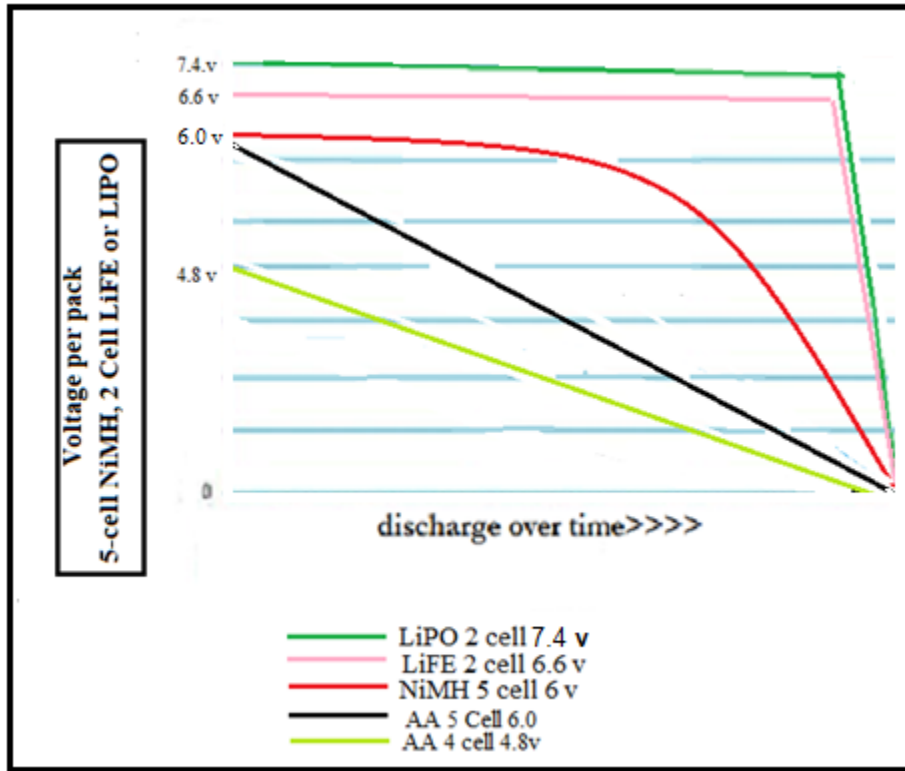
- A. **Buy the brand of radio equipment that most in the club sail.** That way, if there is a failure, somebody will be able to help figure out what's wrong, and even loan you a backup radio. But you will soon be more knowledgeable and this will not matter.
- B. **Buy one sold in the local hobby shop** where likely there is technical assistance available- you will need it, that you will likely need technical help if you are new to our sport.
- C. Take care of your radio. Consider transporting it in a foam-lined plastic gun case (available at any sporting goods store).

III. Batteries: (for the boat)

- A. **There three variables:** battery voltage, and battery capacity, and battery “chemistry”- or type. All are DC- direct current. **The voltages** we use are 4.8 volts, 6.0 vpts and 7.2 volts. The higher the voltage, the higher the power to turn your sails. But, while all servos and receivers are OK with up to 6 volts, a 7.2 volt system requires specialized servos, receivers and even battery chargers.
- B. **Battery capacity** is measured in **milliamp hours**, or **mAh**. 1000 milliamps = 1.0 Amps. A 2000 mAh battery can supply 2000 milliamps for 1 hour, or 500 milliamps for 2 hours, etc. Think of mAh as being like gallons in a fuel tank – the more capacity the longer you can sail.
- C. **Battery types** (in order of complexity) include **Nickel Metal Hydride (NIMH)**, **Lithium Ferrite (LiFE)**, and **Lithium Polymer (LiPO)**. For sailing you should use either NIMH or LiFE.
 1. **AA dry-cells:** what about simple AA dry cells? These are low cost, and they save the cost of a charging system. But you’ll buy and throw away a lot of batteries using them to run the servos and receiver in the boat. AA dry cells might be fine for your radio. Not for a boat pack however. **Rechargeable AAs** put out lower voltage - 1.2 volts - so the transmitter is “starved” from the beginning and may lose range and not last as long as dry cells.
 2. **Rechargeable Nickel Metal Hydride (NiMH)** - have a rechargeable life of a few hundred cycles. They are (opinion) the best for the new sailor because they are very forgiving and the power drops off slower, so you have a better chance of getting the boat in if your battery pack runs low.
 3. **Lithium Ferrite Batteries (LiFE)** have a lot of capacity and **do NOT** have the charging sensitivities or risks associated with LiPO batteries. (LiFE batteries become totally discharged and suddenly drop off- full voltage, and can strand a boat out on the pond with no steering or sail control. (A telemetry radio will warn you of a low battery situation!)

Discharge graph. The LiFE and LiPO packs are strong, then just dump. The dry cells, and the NiMH batteries give you a little warning (generally the sail controls will go dead but the rudder still works- then come IN!!)

This graph depicts the typical performance pattern for recommended cell types:



Recommended: (See Appendix A)

- A. **NiMH** (nickel metal-hydride) 5-cell batteries. Nominally 6.0 volts. Available in many shapes- flat packs, hump packs, stick packs.
- B. **LiFE** (Lithium Ferrite) 2-cell packs. Nominally 6.6 volts. Need a charger that charges LiFE. Switching from NiMH to LiFE battery packs WILL save a little weight.

Buy packs with 1500- 2000 mAh capacity. (For a club race, even 900 would work but hard to find.)

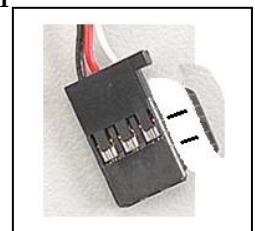
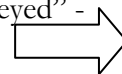
Not Recommended: Lithium Polymer Cells (LiPO)- 7.4 volts. Not recommended for any but the most careful, expert RC sailor AND one using only “high-voltage” servos. Water and charge rate -sensitive.

IV. Proper handling of rechargeable batteries: A quality charger will charge up your battery pack, then switch to a “trickle” charge. A battery charger will typically “peak” a battery pack at more volts than the battery rating. So- 5-cell 6 volt NiMH packs- should actually charge up to over 7 volts when fully charged, but should never be run below about 5 volts.

v. So- enough already!!! What do I need?

- A. You should have one plus a spare battery pack.
- B. For a Soling 1 Meter, you should consider a basic **1500- 2000 mAh 5-Cell 6V NiMH Pack** and a **"peak" charger, capable of adjusting** charging output at (at least as low as) .8 amps. For LiFE Batteries, a 2-cell 6.6 v LiFE pack w/ a charger capable of charging LiFE batteries.

And- buy a pack with a **universal or JR plug**. There is a very similar plug, the Futaba plug is almost identical to the Universal or JR plug, which is “keyed” -



- C. **Chargers: Don't** use a battery charger designed for a car or your garden tractor. They will overcharge and ruin your battery pack(s) maybe even start a fire. Don't buy anything but a **“peak” charger**— one that senses when your batteries are approaching a full charge, and reduces the charge rate to a trickle or "off" entirely.

Useful features are:

1. low adjustable output from say 500 to 1500 mAh (.5 to 1.5 amps).
2. a voltage indicator (light, meter or sound) when the battery pack is fully charged.
3. automatic shut-off when battery IS peaked.
4. useful: the ability to use at home (**AC input**) and in the car (**DC input.**)

VI. “Managing” your batteries:

Once a year, after the sailing season is over, **discharge your battery packs to 1 volt per cell** (unless you have a charger that will discharge, probably you will have to plug into the boat, and leave “on” until it runs flat—3 to 4 hours).



1. **At the end of the sailing season,**

- a. Clean all connections, use a plastic brush (like a toothbrush, OR a plastic wheel brush on your motor tool.
 - b. Charge, then discharge ALL your battery packs. Then at a SLOW rate— .2 amp or less- fully recharge the pack(s). Come back and top it off midway through winter, then once more in April.
2. OR, use a discharge battery charger. These are far more costly, BUT if you are committed to the sport, worth every penny. You can charge the battery to full, then discharge to a level of 1 volt per cell - the mAh discharged is the capacity of the battery pack. If you do this through 2 -3 cycles, you should see the total capacity increase (more mAh discharged getting to the 1 volt).

Store your boat and all battery packs indoors, not on a concrete floor.

Good sailing!!!

Appendix A- Common (to RC sailing) battery TYPES are termed by the cell chemistry. See below.

Type of battery chemistry	Capacity- milliamp hours of capacity	Weight	Reliability
<p>NiMH – nickel metal hydride – 4 AAA cell (4.8v) 5 cell (6.0 v.) or 6 cell (7.2 v)</p>  <p>(recommended)</p>	<p>Range from about 750 mAh to in the 4000s.</p> <p>You need: About 1200 mAh for 2 hours of sailing, assuming you never run the pack down below 5 v.</p>	<p>Relatively heavy. A 6v weighs about 95 - 360 g</p>	<p>Very. These cells generally will last a couple of years, or 200-300 re-charges. IF you do not charge them too fast/ too high charge rate. For long life, charge at max. 10% of rated capacity- a 750 at .75, a 2300 at 2.3 MAX.</p> <p>Can use almost any charger.</p>
<p>LiFE – Lithium ferrite – 2 cell (6.6 v)</p> 	<p>700- 2100 in a 2-cell pack.</p>	<p>65- 300g</p>	<p>Good- they have a second lead for balancing the cells. Less commonly available- since most RC flyers use LiPOs Also must use a charger built for LiFE batteries.</p>
<p>LiPO- Lithium polymer – 3.7 v per cell. Therefore a 2-cell = 7.4 v- too much voltage for standard servos.</p> <p>The 3.7v is not enough for medium-heavy winds; and 7.4 v can blow a standard servo and/or receiver</p>	<p>Varies</p>	<p>A 1 Cell 3.7 volt (essentially a phone battery) weighs about 50 g. and a 2-cell 7.4 volt 300 g. (BUT at 7.4 volts needs upgraded servos and receivers.)</p>	<p>I am not a fan. If you overcharge a LiPO it can catch fire.</p> <p>It is gets exposed to water- same thing, can catch fire. *</p>

*I have fortunately only seen one incident where a LiPO battery actually caught on fire in an RC sailboat while racing. There are others I have heard about. I personally am not willing to risk using LiPOs unless the weight factor is huge, like in my Micro Magic. BUT- they must be kept away from water.

Appendix B

Battery Packs and Charging: To manage all this:

- A. Understand you should not discharge below about 50%. Your battery pack has a capacity rating in milliamp hours (mAh)- so maybe 900, 1100, 1600, 2000 etc.
- B. A Soling uses **280- 400 mAh for a 2 hours of actual racing.** (12 Races typically take 2.5 hours.)
- C. **You need a decent charger.** Buy one that will charge at a low rate- like .5 amps. If you use LiFE batteries- you need a charger that is capable of charging LiFE batteries- it will have a balancing plug in addition to the charging lead.

Battery capacity>>>>	1000 mAh Battery (500 useful)	1500 (750 useful)	2000 (1000 useful)
Approx. hours sailing if fully charged/ then discharged to 50%	2 hours	3 hours	3.5 - 4 hrs
Time to recharge from 50% discharged state			
Wall charger charging rate 150 milliamp	3.33 hours	5 hours	6-2/3 hrs
AC or DC charger set at: .5 Amp 500 mAh	1 hour	1.5 hours	2 hours
1.0 Amp 1000 mAh	30 minutes	45 minutes	1 hour




You should charge at a charge rate lower than 1.0 amps- 1000 milliamps.

The **lower charge rate you use- the longer your battery pack will last.**

Appendix B

Battery Charger choices: basic to sophisticated

There are dozens of chargers available. If you know nothing about charging batteries- get recommendations from other sailors or your local hobby retailer. Remember to buy the needed cables!!

Charger	Features	But:
<p>Dynamite Prophet Sport Mini 50W Multichemistry Charger DYNC2030</p>  <p>About \$35</p>	<p>5-Year Limited Warranty AC powered with detachable power cord. 50W charge power provides quick charge times. Charges NiMH (6-8 cell), LiPo (2S-4S), LiFe (2S-4S and LiHV (2S-4S) batteries Space saving case design</p>	<p>You cannot charge at less than 1 amp using this charger- hard on the batteries! You want to charge at .5 amps or so.</p> <p>AC (wall plug) powered only- cannot charge in the car.</p> <p>No charge status indicator, meter, or light indicator.</p>
<p>Hitec RDX1 AC/DC Battery Charger/Discharger</p>  <p>About \$72</p>	<p>AC/DC wall or car powered. Microprocessor-controlled battery charger/ discharger 1-6 cell LiFe, LiIon, 1- 15 cell NiMH and LiPO batteries.</p> <p>Variable charge current in .1 increments from .1 – 6.0 amps</p> <p>Discharges batteries as well.</p> <p>Meter display with 3.2-inch LCD screen indicates battery voltage and more.</p>	<p>Charges 1 battery pack at a time</p>
<p>Dynamite Passport P2 100W AC/DC Dual Charger</p>  <p>About \$150</p>	<p>Charges 2 battery packs at a time Discharges 2 packs at a time AC and DC - car or wall power Charge Rate: 0.1A-10A x 2 outputs .1 increments Discharge Rate: 0.10A-2.0A x 2 .1 increments Voltage Meter: LCD display</p> <p>Bluetooth Connectivity works with your phone or tablet (or reading the LCD display) - monitor the charge status of your batteries, view real time battery stats including; battery type, battery cells, charge current, voltage, battery capacity, battery charge level and more. Low Input Voltage Protection: Yes Multiple battery pack memory Safety Timer Cooling fan Programmable Integrated Balancing of LiFE cells.</p> <p>5-Year Limited Warranty</p>	

See your hobby shop for the many other (and often changing) options.