

Understanding Batteries and Chargers for RC Sailing - Abbreviated Version

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Introduction

A working knowledge of the technical issues associated with radio control and in particular on-board servos, and the power supplies required to drive them, is not essential.

However, to optimise your time on the water, avoid loss of signal (and money), a good understanding of your battery is essential. So, this paper has been written to help provide some of that knowledge and to hopefully clarify the confusion among some RC sailors.

Additionally, reference is made to a separate paper by David Flakelar “*Set-up of FlySky FS-i6 Transmitter (Tx) and FS-iA6B Receiver (Rx).*”

Electricity can be dangerous and an electric shock from faulty domestic wiring or appliances can kill - particularly around water. At low voltages of the magnitude encountered in RC sailing this is most unlikely, but the incorrect use and disposal of batteries can cause excessive heating and fire, so care is required, and manufacturer's advice should be followed.

Battery

There are a large group of rechargeable batteries that include LiFe and LiPo batteries. All are based on the use of a lithium compound as the cathode such as lithium ferrite phosphate (LiFePO₄, sometimes shortened to LiFe or LFP, and lithium-ion polymer (LiPo). LiFe batteries are safer to use than LiPo batteries, which are used in mobile phone (which are known to catch fire).

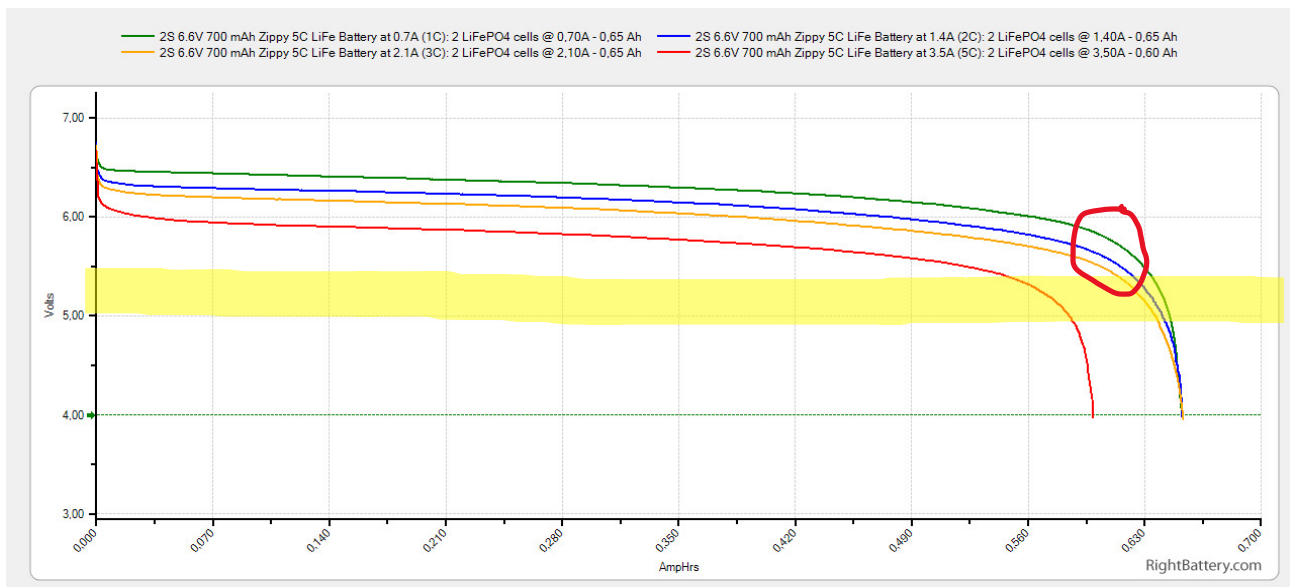
The winches and servos in the DF boats generally operate in the voltage range of around 5.0-6.6 volts.

1. Rechargeable AA batteries at maximum charge hold 1.2 volts each, so 4 will provide only 4.8 volts.
2. Standard AA batteries hold 1.5 volts each, so will provide 6.0 volts with a constantly reducing capacity.
3. LiFe batteries are preferred because they hold over 6.0 volts for a sustained period – see the discharge chart below.

Battery Capacity

Capacity is measured in ampere-hours and in RC applications is usually shown as mAh (milliamp hours). It is the product of the discharge current, I (amps) and the discharge time t, at a given load, and is expressed in amp-hours or milli amp hours (mAh).

This is the typical discharge chart for a LiFe battery. If the transmitter has an alarm function, a warning should be set at around 5.5 volts, so you have enough time to finish a race and get the boat back to shore.



LiFe battery can be permanently damage if discharged below a critical voltage. If using the FlySky-i6 Transmitter/Receiver combination, the user is advised to set the receiver battery alarm voltage to 5.5v and to prevent battery under-volt damage the battery disconnect voltage should be set to 5.0v.

How long will a LiFe battery last?

This depends on how often you need to move the control sticks on the Transmitter. This can depend on:

1. How the rig is set up – the boat should be balanced so it sails by itself to windward.
2. The wind and wave conditions – you may need to steer more actively in stronger winds or higher waves.

A fully charged LiFe battery can typically last 5-7 hours of sailing. Depending on these factors

Chargers and Charging

The popular FlySky receiver battery has two cells in series. Balancing these during charging helps to maximise capacity and service life of the pack by maintaining the state-of-charge in each cell.

Balancing is only necessary for packs that contain more than one cell in series. Parallel cells will naturally balance since they are directly connected to each other, but groups of parallel wired cells, wired in series (parallel-series wiring) must be balanced between cell groups.

Self-Discharge

There are ongoing internal chemical reactions in any cell, and these reduce the stored charge and thus decrease the capacity of the battery over time. This phenomenon is called self-discharge.

The battery shelf life is defined as the longest time a battery can be stored before its capacity falls below 80% of its nominal capacity.

Optimum Charge Rate

Depending on the charger, the user will be invited to set the charge rate, often in amps.

Overall, slow charging is deemed to be better because the thermal heat build-up is less. Temperature extremes, hot or cold, are never good for batteries. There is a lower risk of over-charging which can reduce battery cycle life. So, if you have a choice use the lowest current setting – after all you have plenty of time. The literature also suggests a fast charge rate may result in a lower charge.

For a 850mAh battery, never charge at more than 0.8amps. A slow trickle charge under 0.4 amps is preferred.

Transmitter/Receiver Combinations for DF65 and DF95

By far the most commonly used transmitter/receiver combinations used world-wide and recommended by the DF65/95 manufacturer Joysway is the Joysway J4C05 or the FlySky FS-i6. The FlySky system provides more advanced functions and is favoured by serious sailors. Both require the same batteries.

The type and size of battery required for the transmitter (Tx) is determined by the transmitter voltage, the load and the housing provided to accommodate the battery. Because the receiver requirements are different to the transmitter, a different battery is required. Equally because the batteries are different the chargers are different.

Battery Requirements for FlySky FS-i6 and Joysway J4C05 Transmitters:

Both transmitters provide a housing to accept four AA cells.

- a) four 1.5v AA Alkaline cells, or preferably
- b) Rechargeable cells, say four 1.2v NiMH (Nickel Metal Hydride) AA cells or, four 1.5v Li/FeS₂ (Lithium Iron/Disulphide) AA cells.

The Flysky may be converted to hold a Zippy 700 battery for longer life. YouTube has several instructional videos

Battery Requirements for FlySky or Joysway Receivers

Either:

- a) four 1.5v AA cells mounted on a snap-in tray under main hatch, or preferably,
- b) a single 2S 6.6v battery similar to ONBO 850mAh (a Hobby King look-alike is available) or Zippy 700mAh or similar.

For the DF65, the battery should be mounted with Velcro on the keel box inside the hull and accessed from the forward hatch. An extension lead will be required for this recommended option. With this arrangement, the main hatch can be left in place between outings.



ONBO



Transmitter: Panasonic BQ-CC51 Battery Charger:

The Panasonic shown here accepts 4 x 1.2v NiMH cells. There are three flat pins on the back to allow it to be plugged directly into a 240v AC outlet. Green LEDs glow when charged. Several other brands are available.

Features: Very simple to use and provides a constant current charge. Some brands provide capability to charge both AA and AAA cells at the one time.

Price: AUD 50

Available from: Various sources. Search using "NiMH charger"



Warning

Before purchase, always check the power supply of charger is compatible with your domestic power supply, suitable for the battery you wish to charge and all cables including the black JS/Futaba battery connectors are provided.

Most Popular Chargers

SKYRC e430 Battery Charger (about \$45)

Features: Accepts 2, 3 and 4 cells for balanced charging of LiFe and LiPo cells. Very simple to use but very limited functionality. Does not accept AA batteries.

Price: AUD 29 and includes 240v power supply

Available from: Banggood, eBay and HWH (Aust)

Link to manufacturer site:

https://www.skyrc.com/Charger/e430_Charger



Receiver: SKYRC iMax B6 mini Battery Charger

Features: Accepts 2, 3 and 4 cells for balanced charging for a range of secondary batteries including LiFe, LiPo, NiCd and NiMH. This is an upgraded version of the well-known IMAX B6 and is claimed to be more accurate and stable and has new automatic charging features. Does not accept AA batteries

Approximate Price: A\$45 plus Power supply A\$23

Available from: Hobby Warehouse, Banggood, Amazon (check it has Aust plugs),

Link to manufacturer site: https://www.skyrc.com/iMAX_B6mini_Charger



Multimeter

Multimeters are available from electronics stores such as Jaycar (Australia) and hardware chains (Bunnings) or online. A multimeter is an invaluable tool for fault finding particularly the following conditions and most modern digital types can show negative voltage and thus are suitable for checking polarity:

- battery voltage condition: select V (DC)
- open circuit by selecting resistance (ohms or Ω): should show very large reading
- short circuit by selecting resistance (ohms or Ω): should show zero reading
- polarity: should show negative value if wrong polarity

YouTube have several good sites. Search on "Use of multimeter".

Disposal of Batteries

All unserviceable batteries should be held in a container (an empty PET bottle serves) and at infrequent intervals taken to a waste disposal agency or a battery retailer, such as Battery World, for safe disposal. Batteries in landfill are an environmental hazard.