

The information below is my best shot at a guide based on my personal experience. This article may be corrected or updated at any time. If you find a mistake or a better way of doing any of this please let me know.

Warning! Like myself, scientists, engineers or other technologists may find the vagueness and mixing of some terms in this article rather painful!

Most servo supply voltages are described something like "4.8 - 6V", but what does this actually mean? Can we use them with a 6.6V LiFe battery? If the answer was simple we wouldn't have to ask! As far as I can establish it works like this:

Cells and Batteries

A battery is a number of cells connected together. A two cell battery is often described as 2S, three cell as 3S etc. The voltage of a battery is the sum of the voltages of the cells it is made of.

In general the voltage of a battery will start relatively high and drop during use.

There are three voltages associated with a battery:

Nominal Voltage

This is the voltage written on the battery. The battery will be somewhere around this voltage half way through being discharged with a moderate load. Heavy loads, such as electric flight motors, are likely to make the voltage drop below this.

Maximum Voltage

This is the highest voltage we are likely to get from the battery. In the case of LiPo and LiFe batteries it will be the voltage we charge it to. NiMH batteries are not usually charged to a specific voltage but can reach 1.5 volts per cell.

Minimum Voltage

This is the lowest voltage we should discharge a battery to in normal use. It can be a bit of a gray area, but discharging batteries to too low a voltage risks permanently damaging them.

NiMH Batteries

NiMH cells have a nominal voltage of 1.2 volts per cell. Most NiMH receiver batteries are 4 or 5 cells so have nominal voltages of 4.8 or 6 volts, although their maximum voltages could be as much as 6.0 volts or 7.5 volts when fully charged.

LiFe Batteries

LiFe cells have a nominal voltage of 3.3 volts per cell and are charged to 3.6 volts per cell which limits the maximum voltage to 7.2 volts for a 2 cell battery and 10.8 volts for a 3 cell battery.

LiPo Batteries

LiPo cells have a nominal voltage of 3.7 volts per cell and are charged to 4.2 volts per cell which limits the maximum voltage to 8.4 volts for a 2 cell battery and 12.6 volts for a 3 cell battery.

We can put these on a chart:

Battery Type	Nominal Voltage	Minimum Voltage	Maximum Voltage
NiMH 4S	4.8	4.0	6.0
NiMH 5S	6.0	5.0	7.5
LiFe 2S	6.6	5.6	7.2
LiFe 3S	9.9	8.4	10.8
LiPo 2S	7.4	6.6	8.4
LiPo 3S	11.1	9.9	12.6
LiPo 4S	14.8	13.2	16.8

Our question at the start was something like: Can we use a servo specified 4.8 to 6.0V with a 6.6V LiFe battery?

Most servo power supplies are specified something like “4.8 to 6.0 volts”. What this actually means is that they are suitable for 4 or 5 cell NiMH batteries and the manufacturers are stating their nominal voltages.

From our chart we can see that these servos should work OK between the minimum voltage of a 4 cell NiMH (4.0 volts) and the maximum voltage of a 5 cell NiMH (7.5 volts). i.e. from 4.0 volts to 7.5 volts.

We can now look at the chart and see that our 6.6 volt LiFe 2 cell battery has a minimum voltage of 5.6 volts and a maximum of 7.2 volts. This is well inside the 4.0 to 7.5 volts the servo needs so it should be OK.

Higher Voltage Servos

If we look at specifications of “high voltage” servos we will also see numbers like 7.4, 11.1 and 14.8 volts meaning nominal voltages of 2, 3 and 4 cell LiPo batteries. We can use the chart in the same way to determine maximum and minimum voltages.

I have also seen a servo voltage specified as “6.0 to 8.4” volts meaning it is suitable for use with a 5 cell NiMH or a 2 cell LiPo battery.

Receiver Supply Voltages

A receiver I use is specified with an “Operating Voltage Range” of 3.5 to 10 volts. This is not related to nominal battery voltages but is the minimum and maximum voltage the receiver will tolerate. We have to check that the minimum and maximum voltages of the battery we intend to use falls within this range. From our chart we can see that the receiver should be OK with a 2 or 3 cell NiMH, a 2 cell LiFe or a 2 cell LiPo battery.

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