



ANATECH

advanced two-way radio & cellular in-building communications solutions

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technical services since 1993

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A Couple Important Factors Affecting Battery Performance and Battery Life

The two most important factors in determining how a battery will operate and ultimately last in a day and in its long-term life are; the ambient temperature it is used in and the daily percentage discharge depth (charge cycles). We will focus on Li-Ion battery technology as it is the most prevalent today in two-way radio and other electronics. Gel-cell, sealed lead-acid, absorbent glass mat (used in battery backup and solar applications for example) and standard lead-acid (car batteries) all have similar characteristics and the information here can, in a broad sense, apply to them as well.

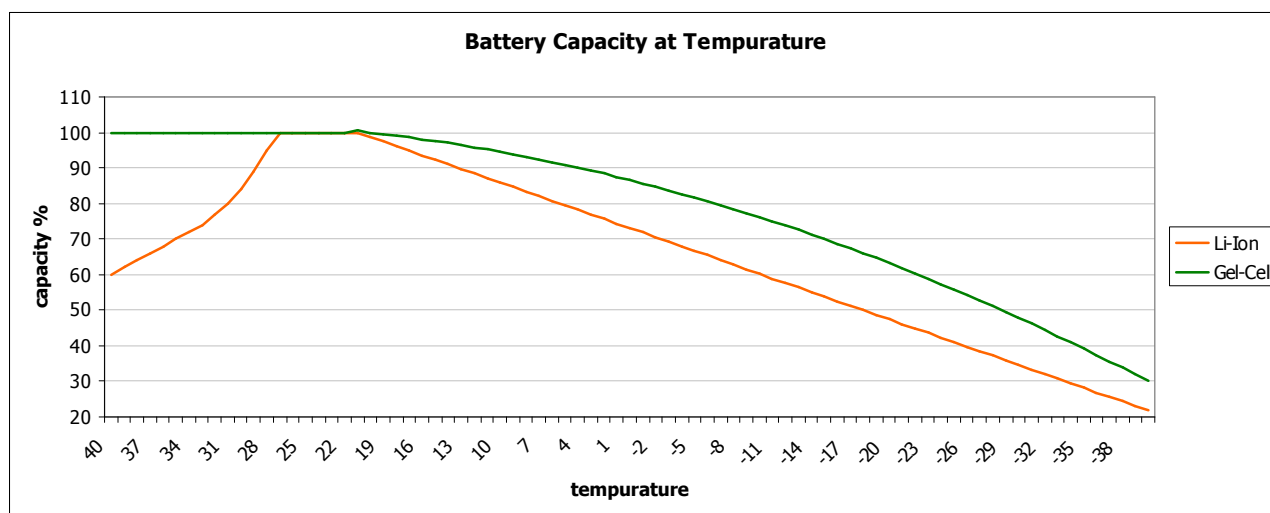
battery performance – the amount of time a battery will last per charge, ie hours in a day

battery life – how many years a battery will last based on daily use conditions

charge cycle – a charge cycle is considered to be a 100% of capacity discharge and a full 100% recharge

Temperature

Cold (and heat) have dramatic affects on battery performance. In cold temperatures, the chemical reactions that hold and create the voltage and current in a battery slow down. The colder it is, the slower they are. This slowing down can be expressed as a loss of usable capacity. For example, a fully charged battery outside in -20° will only last about half as long as it would at room temperature. Heat also has the same affect. In fact heat is more damaging, as the temperature goes up, the cells will vent the built up pressure and capacity loss can be permanent. Most electronics (like cell phones) have circuitry to actually shut the device off before permanent capacity loss can occur. The chart below is typical of standard Li-Ion batteries. As an extra, it also plots deep cycle gel-cell battery capacity at temperature.





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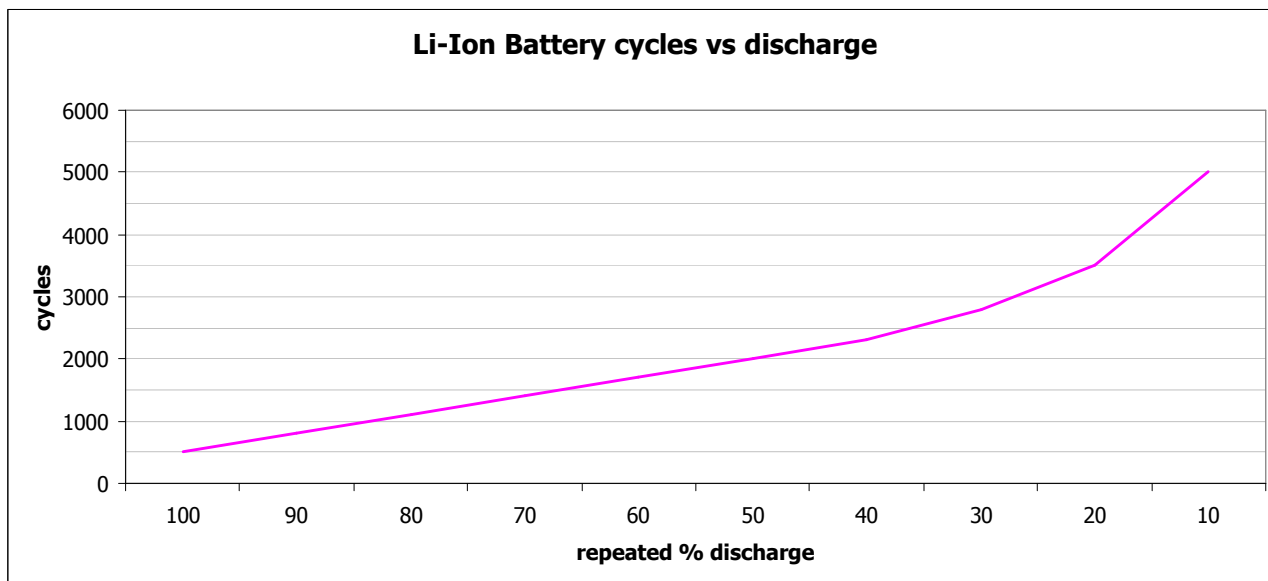
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Discharge Depth / Daily Usage

Unlike older battery technologies (Ni-Cad, Ni-MH), Li-Ion do not like to be fully discharged. In fact, doing so decreases their lifespan. All batteries have a lifespan expressed in charge cycles. A typical rating for a quality Li-Ion battery is 500 cycles. This means the battery can be 100% fully discharged and 100% recharged 500 times before it starts losing rated capacity usage. However, partial discharge/charge cycles actually give you more "charges".

This analogy is nowhere near exact as the relationship is logarithmic instead of linear, but it gets the idea across. A 2000 mA/Hr battery with a 500 charge cycle rating could have a rating of $2000 \times 500 = 1,000,000$ charges per mA/Hr". If you only ever used 10% of its capacity in a day and recharged, you could do that $(1,000,000 / (2000 \times 10\%)) = 5000$ times. If you only used 50% every time, that would be 1000 times.

A typical cycles to discharge depth plot is below.



Best Care

The best ways to maximize the usage and life of a Li-Ion battery are simple.

One, keep it at room temperature. Sure, it can get old cold at times, but don't keep it that way. And only charge it at room temperature. If the battery has been out in freezing temperatures, let it warm up first.

And two, always top it up. Charge it every night, no matter how much "juice" was used during the day. The charge electronics are pretty smart, it won't get overcharged. And don't let it drain to zero, that only shortens its life.