Smart Battery Chargers – 3/17/2011

We've discussed lead acid batteries and touched upon their charging requirements. Still the most popular type of battery for emergency communications is the lead-acid battery. This includes automotive and marine deep cycle, and many gel-celled batteries, including AGM, and several others. The main differences in these types are how the acid is suspended between the lead plates, either as a liquid, gel, or absorbed into a cloth like structure.

Lead-Acid batteries can be cycled down, but how you recharge them will dramatically determine how quickly they are restored to 100% capacity. You can set your charge voltage to some pre-determined level and forget about it, but even after a very long time the battery may never quite reach 100% capacity. This is where Smart Battery Chargers come into play, and can automatically control the charging requirements for each of the 3 stages in a lead-acid charging cycle.

Here are some technical notes based upon a tech article from the A&A Engineering web site, with edits from N1JOY. A&A is a small company that was started by Hams and specializes in smart battery chargers, and some years ago N1JOY and N1QKZ worked with A&A to perfect their 24 Volt chargers for a US Navy project. A&A's web site is: http://www.a-aengineering.com/

Smart Battery Chargers have three distinct operating modes: BULK, ABSORPTION and MAINTENANCE. In the BULK mode, the charger limits the maximum charging current to a preset Imax (Max Current) value while monitoring the battery voltage. This is normally around 10% of the rated amp/hour rating of the battery for smaller batteries of a few amp/hours in capacity. Any higher and you can generate too much heat and damage the battery plates and boil off the electrolyte.

In the ABSORPTION mode, the charger attempts to elevate the voltage to Voc (Voltage Over Charge) while monitoring the current. When the current decreases (tapers down) to a preset value Ioct (Current Over Charge Threshold), the charger enters the MAINTENANCE mode.

In the MAINTENANCE mode the charger will go from ZERO to Imax current while maintaining the battery at Float Voltage. The MAINTENANCE mode IS NOT a trickle mode, and the charger will issue ZERO current if the battery accepts proper charge during the first two modes. This feature allows the charger to be connected indefinitely.

Although we commonly refer to a battery as a 12V battery, meaning a battery having 6 cells at 2.0 Volts per cell totaling 12.0 Volts. The actual Lead-Acid battery voltage is in the range of 2.1V / 2.3V per cell (12.6V / 13.8V total).

In typical operation of a 1 Amp charger, the charging modes are sequential. Connect a battery to the charger first, then turn on the AC and the charger will enter the BULK mode and limit the current to a maximum of 1 Amp. As the battery accepts charge, the terminal voltage rises and when the voltage reaches 95% of Voc (13.7V), the charger enters the ABSORPTION mode where it tries to increase the battery voltage to Voc (14.4V). A VERY IMPORTANT point is that the battery voltage does NOT change abruptly. Assuming a good battery, as the voltage approaches 14.4V, the current decreases. When the current tapers down to Ioct (100 mA), usually before reaching 14.4V, the charger enters the MAINTENANCE mode. The voltage is then lowered to Vf (Float Voltage - 13.8V). There is some residual charging going on when first entering the MAINTENANCE mode but the current is well below Ioct (100 mA).

The current has to decrease to Ioct in order for the charger to enter the MAINTENANCE mode. If the load is always greater than Ioct, such as when you are powering a radio while trying to charge your battery, then you should charge the battery first without any load, allowing the charger enter the MAINTENANCE mode, then apply the load if possible.

Some QRP operators have questioned whether or not the MAINTENANCE mode will be reached. We assume that most QRP operators are human and occasionally have to attend to other functions - such as: eating, sleeping, visiting the wife / kids, etc. During which time the RIG is turned OFF (load below Ioct), allowing the charger to complete the charging sequence and enter the MAINTENANCE mode. The Smart Battery Charger does not have any timers. All decisions are based on the battery voltage & current. The charger may stay in either of the first two states as long as necessary to achieve a proper battery charge. Very large battery banks may require BULK or ABSORPTION cycles of 100+ hours or longer.

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