T+TECH

TOP TECHNOLOGY IN POWER ELECTRONICS

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T-TECH Battery Chargers

Application

- **Marine**
- **Industry**
- **Office**
- **Telecommunication**
- **Retail centre**
- **Workshop**
- **Home**
- **Golf Buggy**

Features

- **Low price**
- **Designed for:**
  - **Lead Acid liquid batteries**
  - **Alkaline batteries**
  - **Sealed batteries**

Definitions and explanations of terms. ©

1. Ampere Hour Rating [Ah] Battery size measurement

This is the most common parameter used to describe the capacity of a battery. It represents the energy stored in the battery, measured by the Ampere drawn from the battery multiplied by the time (hour) it is supplied for. The measurement starts with a fully charged battery and ends when minimum single cell voltage of 1.85 V is reached. This measurement is discharge speed dependent, therefore it is standardized to 20 hours discharge rate.

2. Boost Charge (Absorption Charge**):**

- **Liquid Cell Battery**

Boost charging is a higher voltage level charge of about 2.45 V per cell, which is **temperature compensated**. This is necessary to replace the last 30% of possible stored energy of the battery. As there is a higher voltage being applied to the cells, a certain amount of water loss is unavoidable. Some water loss is a sign of an effective charging process.

- **Maintenance Free Liquid Battery**

A low maintenance, sealed battery, which uses floating liquid in the cells, a low water loss boost charge should be used. The charging current has to be reduced to a level where the generated gas can be recombined within the cell without escaping the seals. A small water loss is allowable which is designed into the battery life.

- **Dry Cell Battery**

With dry cell batteries a boost charge would be detrimental. Any accelerated water loss makes the gel cell dry out and stop the battery from functioning.

3. Charge

The energy of the battery is stored with electrons held chemically in electrodes end electrolytes. The charge stored in the battery is the number of these electrons trapped and ready to use. The electric charges are made up of electrons, therefore the quantity of the charge level is measured by the number of these electrons. The unit used for the charge measurement is the Coulomb [C] which is about 6.28×10^{18} number of electrons. The flow of these electrons (charges) is the electric **current**.

4. Charging current [A] [C]

The charging current is commonly measured in Amperes or scaled in the ratio of the battery **Ampere Hour** rating. (7.**Charging current and charging time**) In this case the value "0.1C" means the current applied to the battery is 0.1 times its Ampere hour rating, also described as 10 % of its Ampere hour rating. "1 C" represents the 200 amp on a 200 Ampere hour battery. 0.2 C would be 40 Amp on the same battery. The usual charging rate is about 0.04 to 0.2 Ampere, depending on the battery type and the charge voltage level, **float** or **boost**.

5. Cold cranking amp (CCA) [A] Battery size measurement

The fundamental job of an automotive battery is to start the engine. It rotates the starter and maintains sufficient voltage to activate the ignition system at the same time, until the engine fires and can maintains rotation by itself. By doing so, the battery gives away a lot of charge at a high current level for a short period of time. Cold weather makes it even more difficult to deliver the power. Moreover, when the engine is cold, it requires more power to turn over. CCA (cold cranking amps) simply determine how much power the battery can supply to start the car engine in cold weather.

The definition of Cold Cranking rating is: The number of amperes a lead-acid battery can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery) at 0 degrees F (-17.8 degrees C).

6. Coulometric Charging: [%] Battery efficiency measurement

Coulometric charging is the ratio of the charge "Coulombs" put into the battery to the recoverable charge during discharge.
The efficiency of sealed lead acid batteries is typically 70%, meaning that you must put 142 amp hours into the battery for every 100 amp hours you get out. This varies somewhat depending on the temperature, speed of charge, and battery type.

7. Charging current and charging time

The battery charging time depends on the starting charge level of the battery, and the charging current applied to the battery. With the normal 0.1C (10% ah **Ampere hour**) charging current a full recharge will take about 14 hours.

If a 3 stage T-TECH charger is used the charging current can be as high as 0.12C on a liquid acid battery taking about 11 hours.

If the 5 stage T-TECH charger is used, because of its close monitoring of the battery gassing, 0.2 C charging current level can be used which allows the full charge replacement within 8 hours.

If a lower current capacity charger is used on the battery, it will get charged that much slower. All T-TECH battery chargers are made to standard current levels, however if requested with the order, most of the time for no extra charge, we can tune the charger to any charging current from 50 % to 100 % of its rated maximum capacity. This can make the charger suitable specifically to your battery.

There is a limit of the minimum charging current you can apply to the battery, because the batteries which are designed for a high current use require a high charging current level too. The use of the higher current charger, rated as described before, becomes critical.

8. Cranking Amp (CA) [A] Battery size measurement

The number of amperes a lead-acid battery can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery) at 32 degrees F (0 degrees C).
CA (Cranking Amps) simply determines how much power the battery can supply to start the car engine in an average climate.

9. Current

The current in physics is the flow of charged particles electrons within the material. It is measured in Ampere which represents the number of coulomb **charge**s passed in a second. **(7.Charging current and charging time)**

10. Deep Cycle Battery

Battery which is designed to get fully discharged frequently and efficiently, as many times as possible. Deep cycle batteries are commonly used in forklifts.

11. Equalize Charge

Equalize charge is an extended time boost charge. While some cells are overcharging, others are catching up, thus equalizing the charge levels between cells. Equalizing causes water losses which is necessary to monitor. The charger may be fitted with a timer or some charge level sensor which will completely stop the charge or changes it over to float charge at completion. The necessity of the equalize charge depends on the quality of the battery. When it is new a normal boost charge is enough to do the equalization, but an older battery can develop internal leakage in some cells, therefore they may need an equalize charge fortnightly.

12. Float Charge

The charging mode when the charging voltage is limited to the level which creates minimal water loss on the battery. 2.25 to 2.3 volts/cell (at 25 degrees C) **(Temperature compensation).** Because of very low water loss at this voltage, it can be maintained on the battery for a long time. Some lead acid batteries are used in a standby condition in which they are rarely cycled, but kept constantly on float charge. On a **deep cycle battery** a float charge will replace only about 70% of its maximum possible capacity. For a full charge we have to use **Boost charge** voltage**.** Also on a **deep cycle battery** a continuous float charge will create uneven cell voltages, therefore an **equalize charge** will become necessary.

13. Gassing Charge

Gassing charge is the charging period when the battery is charged to a voltage level where the water disassociates to hydrogen and oxygen gases and deposits on the surface of the plates as they are charging.

- **Non Gassing Charge**

The non gassing charging period is when the battery charging voltage is low enough not to create gasses on the surface of the plates.

14. Lead acid battery

Is a battery relying on the chemistry of lead oxide electrodes and sulfuric acid interaction.

15. Liquid lead acid battery

Liquid lead acid battery is a term general used to describe the battery type where the electrolyte is flowing around the electrodes. In most batteries it can be topped up with water if evaporation occurs.

16. Maintenance free liquid acid battery

Battery designed for application where the electrolyte spillage has to be avoided, for example in small vessels. The breather caps are replaced with liquid trapping labyrinths or with semi permeable seals. The liquid can't therefore escape by turning the battery upside down. The charger used for these batteries has to avoid large water loss due to high voltage charge because it can not be replaced, but a fair amount of water loss is acceptable as the battery is designed to loose some over its life cycle.

17. Minimum Voltage

Anything above 2.15 volts per cell will charge a **lead acid battery**. This is the voltage of the basic chemistry, however most of the time a higher voltage is used forcing the charging reaction at a higher rate.

As the charging voltage increases it disassociates the electrolyte to Oxygen and Hydrogen gasses. This gas mixture is explosive in the right concentration therefore ventilation is critical during battery charging.

Also the higher charging voltages cause more and more water loss on the battery which has to be replaced.

18. Reserve Capacity [min.] Battery capacity measurement

The number of minutes that a new, fully charged battery, will deliver 25 Amps and maintain a terminal voltage equal to, or greater than, 1.75 volts per cell at 80 degrees F. (35.5 degrees C.)

It represents the time that the battery will operate essential accessories in case the alternator of the vehicle fails.

In other words, it is the battery's ability to sustain a minimum vehicle electrical load when a charging system failure occurs.

19. Sealed maintenance free gel-cell or dry-cell battery

These are Lead acid batteries which have no spare liquid between their cell, just enough to keep them wet, to maintain the chemical reaction. Any high voltage level **boost charge** will evaporate the small liquid inside destroying the battery.

20. Temperature Compensation

The battery chemistry of a Lead acid battery creates a **Minimum Voltage** of charging of 2.1 Volt a cell at 25 Celsius Degree. This voltage is temperature dependent. If the battery is not charged to the correct voltage level it can make a battery not charged in one extreme or create a large water loss and consequently destroy the battery on the other extreme. Most of the T-TECH Battery Chargers are fitted with automatic temperature compensations.

See: temperature compensated charger on page 10

21. Voltage

Is the measurement of electromagnetic potential between the plates of the battery cells. Represents the energy contained a charge unit by being on the cells. The unit amount of this energy difference is the Volt. The Volt value tells us how much force is in the battery terminals to discharge through the load, how much energy we will get out of a certain amount of **charge** used from the battery.

Charger's Classifications by their Operations

The basic lead acid battery chemistry is a fairly ancient invention and over the history many different charging methods have been used. The lead acid battery is generally tolerant of overcharging, which allows manufacturers to make extremely cheap chargers.
T-TECH offers a range of chargers which is economical to use from inexpensive to very sophisticated models, to give

- high charging efficiency,
- long battery life
- customized options

Here is a list of classifications for the different type of chargers used in the industry.

Unregulated Transformer-Based Chargers

These are the absolute cheapest chargers around. They consist of a transformer and a diode. For a 12 volt battery the transformer is designed to deliver 13 to 14 volts over a reasonable current range. The charging current tapers off from the low battery voltage state to the fully charged battery voltage state. At the start of a charge on a discharged battery the current can be very high, which also depends on the incoming main voltage level and on the transformer regulation. As the battery voltage increases the current tapers down.
The battery voltage with this charger rises to 15, 16, 17, even 18 volts which is too high. At these voltages the water loss is high, resulting in destruction of the battery. Unregulated chargers must not be left to trickle or **float charge** a battery, they must be disconnected when the battery is fully charged.
This type of chargers are also very sensitive to main voltage fluctuations. A small difference of main voltage would result in a large change of charging current. Because the transformer is used to control the current and voltage the chargers are typically heavy and get hot. These chargers are commonly used by bicycle and scooter manufacturers who want to keep their product price as low as possible.

Resistor Assisted Transformer Charger

This is an improved version of the transformer charger with an inclusion of a series resistance. It can give a more even current to the battery but it becomes less regulated by the battery voltage increase and the same time less sensitive to main voltage changes.

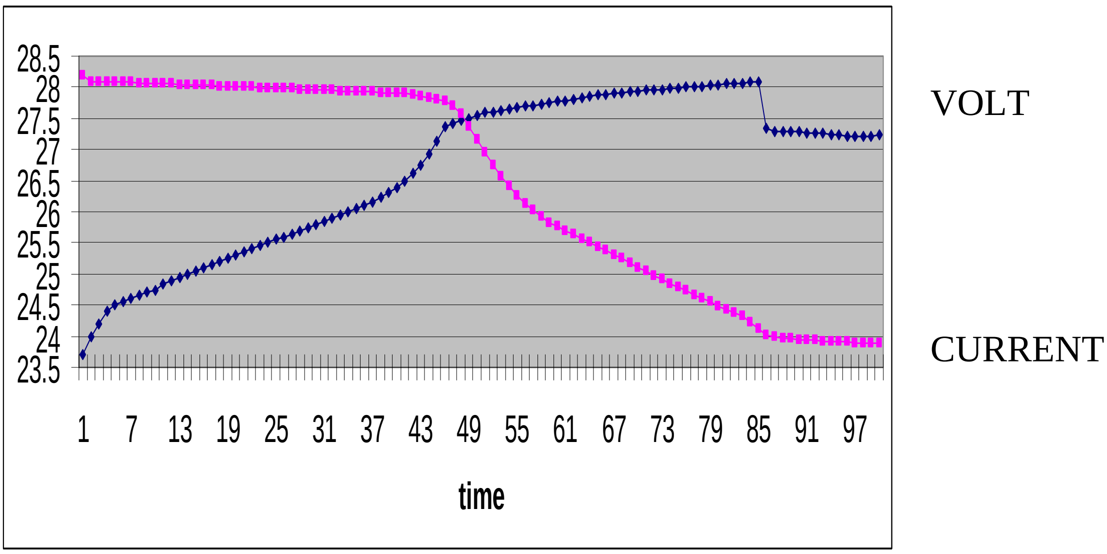
Current Regulated Charger

Using a current regulated charger, fitted with a voltage sensing switch to stop the charging, is a better, and inexpensive, alternative.
This arrangement doesn't let the voltage climb higher than the trickle charge voltage; they just simply stop charging by an internal switch.
They won't damage the battery if left on charge too long, and they don't change their charging characteristics if the line voltage should change.
There are two ways to make a current regulated charger. The first is to use a transformer and a simple voltage regulation circuit. This has the disadvantages of weight and heat, but it is a well proven and reliable technology. The second uses a modern switching power supply. These low power high frequency switchers are surprisingly cheap, efficient, and small. However at a larger charging level they still don't reach the reliability level of the transformer type chargers. The regulated transformer type chargers are utilizing diodes and SCR's for switching the power at the main line frequency. For any power, over 50 amps charging current level, the transformer charger is the only practical solutions.

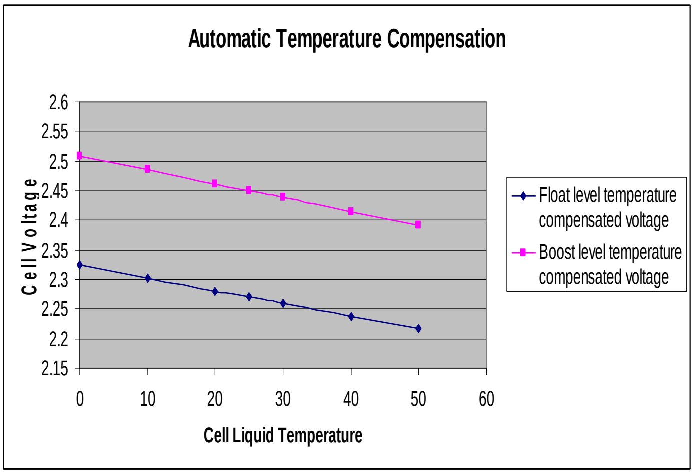
Voltage and Current Regulated Chargers

A circuit that is set to limit the maximum charge voltage, but has a current limit to control the maximum current will produce a good quality charger. This type of charger can both charge at a reasonable rate and maintain the battery at full charge without damage.

Curve of a charge current and volt with boost and float stages.



Temperature Compensated Charger



The maximum charging voltage is a function of temperature therefore a temperature compensated charger should be used where the temperature varies significantly from room temperature. T-TECH offers many different type of low-cost chargers which have temperature compensation functions.

Multiple Stage voltage and current regulated Chargers

The battery charging current has to be limited to avoid overheating of the plates during charge. Overheating can cause the buckle of the plates consequently destroying the battery. Also the water loss has to be limited during the charging. T-TECH manufacturers 3 and 5 stage chargers, which regulates the charging current to a different level in each charging phase. The current is depending on the charge level and the terminal voltage of the battery.
The T-TECH 3 stage charger, provides a **boost** and **equalize** charge which always keeps the battery fully charged while connected.
The T-TECH 5 stage charger beside the **boost** and **equalize** functions which also continuously monitors the **gassing** levels on the cells, thereby fully charging the battery in the shortest time possible while protecting it from excess gassing.

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