The AdvanceTec "Burp" Pulse Charger

The history of The AdvanceTec burp Negative Pulse charging system

Since 1992 AdvanceTec has mass-produced "burp" Negative Pulse conditioning chargers at its manufacturing facilities in Miami, Florida. The burp pulse characteristic used by AdvanceTec has a much longer history. Indeed it has been used for more than 25 years in expensive charger equipment, primarily by the U.S. military.

AdvanceTec has successfully been able to capture this technology in an affordable, miniaturized version, making it available for even the most cost-sensitive products.

The major benefits of burp pulse charging

Dislodges 02 bubbles and removes plate surface charge providing:

* Maximum plate surface area for maximum charge acceptance.
* Accurate battery voltage measurements.
* Safe fast charging of a battery near its hot and cold temperature extremes.

Prevents large crystal formations on the nickel plates in new batteries, so:

* More plate surface area available for charge acceptance.
* Prevents "memory effect" and dendrite growth problems.
* Lower plate resistance and less power loss during charge and discharge.
* Can more than double the battery's useful life.

Gradually restores the crystal structure thereby reversing "memory" in used batteries:

* Each burp pulse charge produces a gradual run time increase due to less battery voltage drop while the product is operating.

By switching a battery with "memory" to an AdvanceTec charger, the severity of the memory (i.e. voltage depression knee) caused by the old charger can largely be reversed. In most instances a significant increase in the product's run time is observed with the first recharge using an AdvanceTec burp pulse charger.

AdvanceTec's burp pulse charger system is used by many progressive manufacturers worldwide for charging the batteries in their products. Many are also currently in development. AdvanceTec chargers have saved manufacturers countless engineering hours and production costs by providing a complete charging solution that is unsurpassed in performance and reliability.

Batteries -- General Characteristics
A battery's life can be defined as the number of charge/discharge cycles before it becomes damaged, unusable, fails or wears out.

1. Battery damage
The method selected for charging the battery is the most critical decision in preventing battery degradation and damage. Overcharging a battery produces heat and gas pressure stresses that degrade the battery. Batteries that are discharged too fast are also degraded by heat and pressure stresses. Under-voltage lock-out circuits can prevent battery over discharge, but this, too, contributes to memory effect problems by establishing its starting point. What happens if the charging method does not eliminate memory? The continued use of the product with an under voltage lockout circuit, over time, results in a battery that seems to charge, but does not power the product.

Use of unsophisticated charging techniques is the most common cause of NiCd and NiMH battery damage. Constant trickle charge methods for extended periods heat the battery and produce memory and dendrite crystal formations. Fast charge methods that end when overcharge is detected also heat the battery and produce memory and dendrites.

2. Unusable Batteries
NiCd and NiMH batteries with memory can actually have a near full-charge that electronic products cannot use. Memory causes a sudden voltage drop in the battery voltage. This sudden voltage drop occurs within a few minutes of power-up, and the product stops after what appears to be a complete recharge.

Dendrites form leakage paths that quickly drain a battery after a recharge. In both cases the battery can be classified as damaged, but technically it is unusable. A complete discharge to 1 volt per cell for multiple cell packs can remove the memory and dendrites, but this consumes charge/discharge life cycles of the battery. It is also very time consuming, and with further charging, the memory and dendrites will return. The AdvanceTec Burp charging method prevents their formation.

3. Battery Failures
Unsophisticated overcharge methods allow the battery to get hot before the charge is ended. Heat caused by overcharging greatly accelerates the aging process in batteries. Batteries that are overcharged time and time again fail abruptly as a stressed battery has higher power losses which produce more heat and more stress. The process is self-perpetuating and self-accelerating. Battery capacity plummets in a short amount of time. The battery will die without warning.

4. Battery Wear Out

NiCd and NiMH batteries are constructed from materials that have different coefficients of thermal expansion and different coefficients of compression. The positive and negative plates are composed of dissimilar metal compounds. The separator is a polymer (plastic) material. The electrolyte is a viscous liquid and the battery case is usually made of a plated steel alloy. Heat and pressure associated with the charging process cause mechanical stresses that cause batteries to wear out if heated plastic separators in the batteries expand more than the surrounding plate materials and the case. The soft, plastic separator is most vulnerable to the pressure that results from gas generation associated with overcharge.

The AdvanceTec Negative Pulse "Burp" Charging System

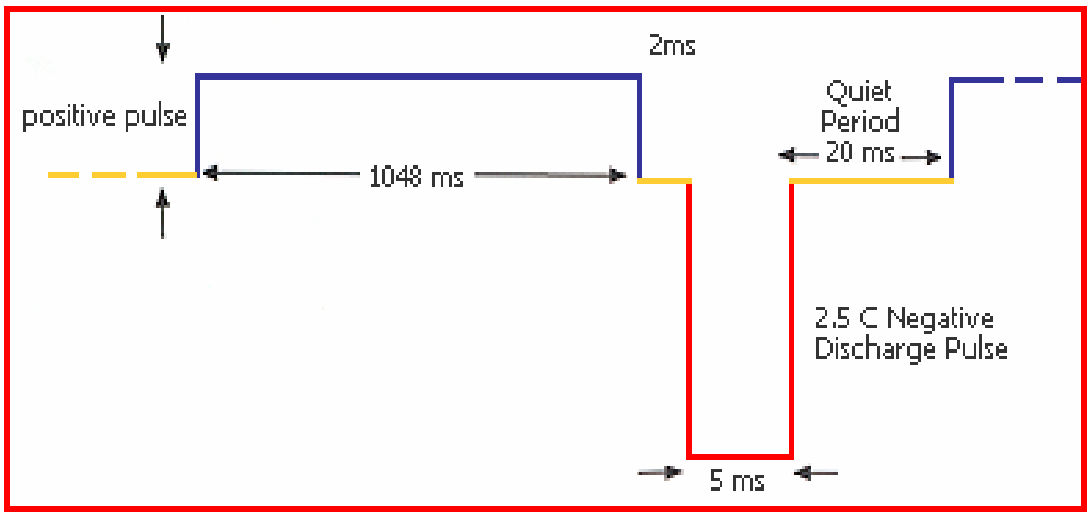
AdvanceTec burp chargers have the most advanced charging technology for providing maximum battery performance and charge/discharge cycle life.

The basic principle of the AdvanceTec Negative Pulse burp charging system combines a high-current charge with regularly spaced negative current pulses. With NiCd and NiMH cells this, in effect, burps the battery. During the application of the high-charge current, some oxygen is generated due to electrolysis of the electrolyte. The generated oxygen gas accumulates as "bubbles" attached to the cell plates, reducing the effective surface area and raising the internal impedance. This increased impedance reduces charge efficiency and causes heating during rapid charging.

When a momentary high-amplitude discharge pulse is applied, the reversal of the chemical process has a relaxing effect, burping the battery by stripping the bubbles from the cell plates. The negative pulse burp not only makes a high-current fast charge possible, but also increases the charge acceptance. Furthermore, in the case of both NiCd and NiMH cells, greater charge acceptance results in less heat generation, which in turn results in a higher charge acceptance.

The burp conditions the battery prior to the quiet time sampling period. The battery's exact charge level is calculated using the quiet window when the data is collected. Variations in NiCd and NiMH appear in the data, allowing the charging of both types.

AdvanceTec Charge Profile



Charge Termination

The AdvanceTec Negative Pulse charger uses the most sophisticated charge termination methods available in a standalone battery charging controller. Unlike other charger controllers which terminate the charge when the battery is in a state of overcharge (the most popular being the negative delta voltage method), the AdvanceTec burp charger employs Inflection Point Cut Off, which terminates the charge when the battery reaches 100% charge. This terminates the charge prior to the internal pressure rising significantly, thereby reducing the likelihood of premature battery failure due to venting. (Venting is the result of excessive internal battery pressure that causes electrolyte loss. It significantly reduces the life of the battery.) The AdvanceTec burp charger incorporates variegated measurement techniques to ensure appropriate charge termination in both NiCd and NiMH cells.

The battery voltage is measured during the quiet window immediately following the discharge pulse. The no-load voltage measured here contains less noise and is a more accurate representation of a battery's true state of charge.

In addition to the Inflection Point Cut Off method, there are six additional termination methods to ensure a safe termination of the charge including:

* Negative Derivative Termination. Unmatched cells may have a charge profile that obscures the normal inflection point. Negative Derivative Termination detects the maximum point of the charge curve and terminates the charge when the slope of the charge voltage reverses direction.

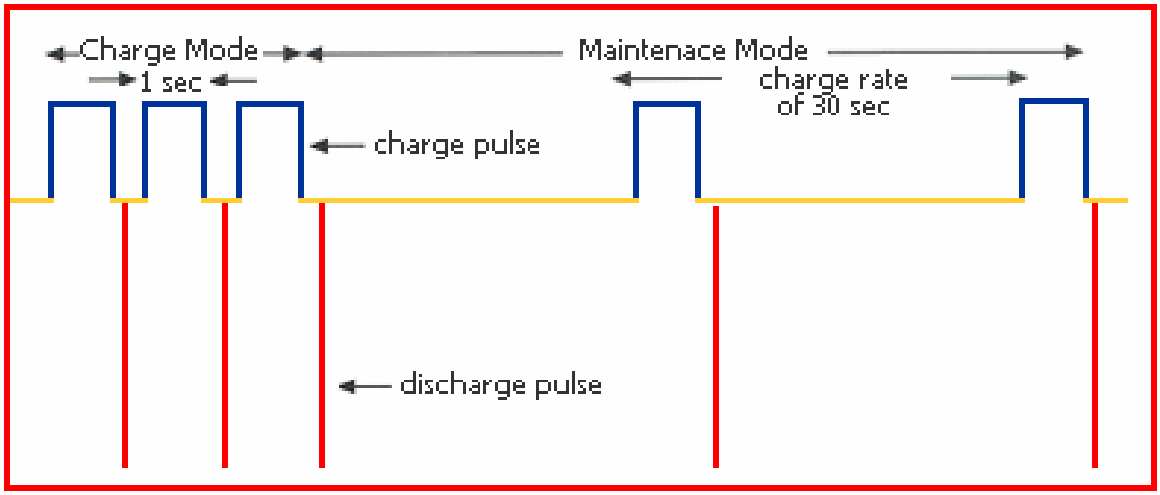
* Shorted cells or shorted contacts may be detected by observing that the charging voltage remains below a predetermined threshold during charging. The charge is terminated and the fault LED will light.

* An internal timer will terminate the charge after a predetermined period of time has elapsed.

Maintenance Mode

Upon completion of a normal charge sequence, the controller enters a maintenance mode. The purpose of this mode is to keep the battery primed at peak condition, ready for use. It is noteworthy that the maintenance charging scheme used is NOT a low-current trickle charge, as is customarily found, but the same high-current pulse used during rapid charging. The difference is that the duty has been extended, thereby applying an equivalent average maintenance charge current. The charge/discharge pulses help prevent dendrite formations and help maintain proper crystal structure of the cell plates. Dendrite formation leads to shorted cells. Improper crystals structure contributes to memory problems.

AdvanceTec Charge Profile



Independent NASA Tests

For more than two years NASA has been testing various charger methods for the Space Shuttle and Space Station application. The AdvanceTec burp charger consistently produced the highest charge with the lowest heat.

More information at http://www.advancetec.com/