

# Optimal Battery Charging Algorithm in Hybrid Systems

## Introduction

Global rising trends in energy consumption and reduced natural energy sources focus attention on optimizing efficiency in hybrid energy systems. To get higher efficiency from a hybrid solution we need to optimize the battery charging phase. Lead acid batteries are one of the most expensive parts of hybrid system and therefore it is necessary to maximize its life.

International standard IEC62509:2011 “Battery charge controllers for photovoltaic systems - Performance and functioning” was established to provide guidelines to ultimately reduce energy wastage. UNIPOWER manufactures a battery charge controller HCX Advanced that, when used with lead acid batteries in terrestrial photovoltaic systems, provide a simple system that meets these standards. Together in conjunction with IEC62093 which describes test and requirements for intended the installation application, it includes but not limited aspects such as safety, physical connection sturdiness and enclosure.

The optimal battery algorithm for exact type of cyclic battery used in hybrid system is achieved by a battery file. It is a part of configuration file used in the controller. Major battery manufacturers' recommendations for charging are individually provided and include parameters such as bulk charge rate/voltage, float voltage, equalise time/voltage, temperature compensation factor, battery optimal depth of discharge; saving any guess work by the user.

Based on battery parameters the controller calculates the charging parameters. These are exact values of battery capacity, current, time or voltage which define conditions for ending or starting one of the phases in battery charging cycle.

The HCX controller works with a status machine which automatically indicates the currently running phase of battery charging in a hybrid system.

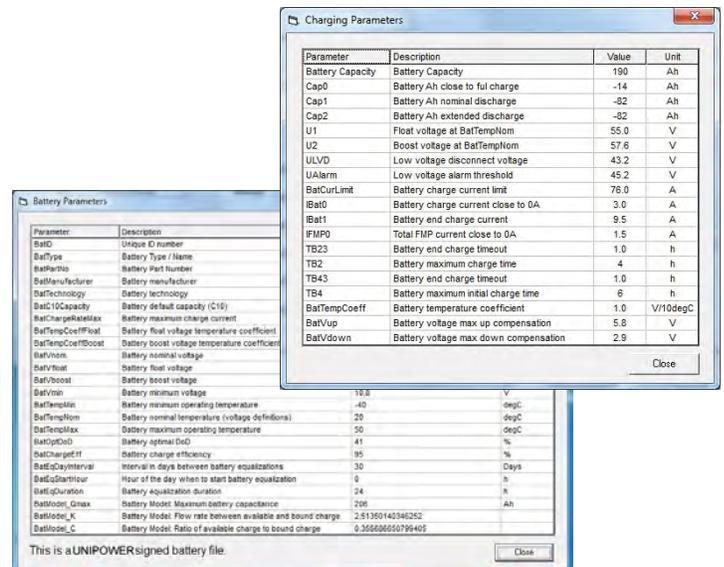
The HCX battery charge controller provides the essential function of managing battery and generator cycling, and ensuring maximum energy harvest of renewable energy sources. It collects data about battery, fuel consumption, generator status and output power

to provide complete statistics of the performance of the site. Alarm and warning notifications are indicated by front panel LEDs, and through potential free alarm contacts that allow remote signaling. External monitoring of alarms is accomplished through a USB or RS232 port using PC-based PowCom™ hybrid software. The HCX has an Ethernet port allowing control over a TCP/IP network and web based support. Alarms can be mapped via SNMP traps. To meet individual site requirements, the HCX contains a Programmable Logic System (PLS) that can be used to monitor and control specified customer requirements.

The HCX communicates internally on an RS485 bus with AC/DC and DC/DC modules based on Guardian platform. For future features expansion it is possible upgrade HCX firmware locally via the USB port or remotely via the Ethernet connection.

Site daily logs which are stored on SD card are possible to view and analyse in a graph form by Hybrid CSV Reader software.

Please see more detail of controller specifications within individual data sheets at [greencubes.com](http://greencubes.com).



The image shows two screenshots of software windows. The top window is titled "Charging Parameters" and contains a table with columns for Parameter, Description, Value, and Unit. The bottom window is titled "Battery Parameters" and contains a similar table with columns for Parameter and Description. Both windows have a "Close" button at the bottom right.

Parameter	Description	Value	Unit
Battery Capacity	Battery Capacity	190	Ah
Cap0	Battery Ah close to full charge	-14	Ah
Cap1	Battery Ah nominal discharge	-82	Ah
Cap2	Battery Ah extended discharge	-82	Ah
U1	Float voltage at BatTempNom	55.0	V
U2	Boost voltage at BatTempNom	57.6	V
ULVD	Low voltage disconnect voltage	43.2	V
UAlarm	Low voltage alarm threshold	45.2	V
BatCurLimit	Battery charge current limit	76.0	A
iBat0	Battery charge current close to 0A	3.0	A
iBat1	Battery end charge current	9.5	A
IFMPO	Total FMP current close to 0A	1.5	A
TB23	Battery end charge timeout	1.0	h
TB2	Battery maximum charge time	4	h
TB43	Battery end charge timeout	1.0	h
TB4	Battery maximum initial charge time	6	h
BatTempCoeff	Battery temperature coefficient	1.0	V/10degC
BatVup	Battery voltage max up compensation	5.8	V
BatVdown	Battery voltage max down compensation	2.9	V

## ABOUT GREEN CUBES TECHNOLOGY

Green Cubes Technology harnesses over 30 years of industry experience to ensure we design, develop and deliver solutions for the most challenging energy needs. We offer battery technology innovation, application design and performance management to drive productivity, scalability and sustainability.

Green Cubes provides complete power systems to the stationary power industry. With the addition of the Guardian and Aspiro Product lines offered under the UNIPOWER brand, these industry proven DC plant systems serve critical applications all around the world. Green Cubes offers complete power solutions including energy storage, power conversion, and seamless integration.

For more information, email [contact@greencubes.com](mailto:contact@greencubes.com) or visit [greencubes.com](http://greencubes.com)