



## Hybrid Wind Generator Charge Controller User's Manual



**PLEASE READ THIS USER MANUAL COMPLETELY  
AND CAREFULLY PRIOR TO INSTALLATION AND  
OPERATION OF THIS PRODUCT.**

2016 Version: 2.0



## 1. Introduction

The MarineKinetix hybrid charge controller and monitor is an intelligent charge controller which has many features and capabilities. It not only can be used to control and monitor your MK4+ wind generator, but also can function as a hybrid controller, meaning it can also be used to simultaneously control and monitor a small supplemental array of solar panels up to 150W. Up to 300W is possible with an optional controller.

Because this controller is derived from a very sophisticated Wind/Solar Streetlight Controller, it also has the capability to operate as a dusk-to-dawn lighting or load timing controller. Many boaters find this useful for automatically controlling security lights, courtesy lights, anchor/mooring lights, or other small loads on a light-sensing/ time basis.

Using the latest power-electronics and an internal microprocessor, it has a very high charge efficiency, low no-load losses and built-in protection functions. It allows safe and efficient control of your generated power, while protecting and extending the life of your batteries.

While it has remarkable capabilities for hybrid wind/solar systems, it is also intended to operate as a stand-alone MK4+ wind generator controller when other sources and loads are not connected, and it will automatically and autonomously sense, monitor, and display the energy it produces.

## 2. Performance Description

### **PWM Stepless Load-Dump Mode:**

When a wind generator system is producing more power than the battery can accept, most typical marine wind generator systems simply hit a set-point, and divert all of their energy to a resistive load, and the battery stops charging completely. These crude systems haven't changed since the 70s, and simply consist of a voltage-sensitive switch and a resistive "diversion load". However, when using such a system, the battery never really gets a full charge; leaving the battery in a partial state-of-charge (PSOC), which is horrible for battery life. While the battery itself still could have accepted some of that available power (and reached a full state-of-charge), it was instead wasted completely. Even with a staged load-dump system, where there are multiple resistive elements switched sequentially, it can only be divided into five to six stages, so the effect is still some PSOC. The MK4+ charge controller uses Pulse Width Modulation (PWM) to create a step-less load-dump mode. In other words, the controller can dump residual power by dividing it into thousands of stages. So, it can still dump residual or excess power while effectively charging battery banks to a full state-of-charge. Charging batteries to their maximum capacity maintains their overall charge capacity and significantly preserves battery life.

**Constant-Current and Constant-Voltage Charge Mode:**

A charging battery normally falls into one of two states. When a battery is significantly discharged it can initially accept all the current the wind generator can supply it with. In this state, we refer to the charging profile as the “bulk” stage, or constant-current mode, of charging. When operating in the bulk phase, the battery is accepting the maximum current, which allows its terminal voltage to increase as it accepts the charge. When the battery reaches about 75% of full charge, the controller begins the “absorption” stage, or constant-voltage mode, of charging. In the absorption stage, the maximum charging voltage is now limited by the controller, and the charging current begins to naturally fall off as the battery continues to charge. The MK4+ is unique in its ability to vary the amount of energy that is supplied to the batteries in order to reach a full state-of-charge and avoid damage from overcharging.

In a sustained high-velocity wind, when the MK4+ charging current exceeds its maximum current set-point, the controller will automatically begin to brake the wind generator (slow or stop the blades) to protect the controller and the generator windings from excess current and heat. In this over-current condition, the brake will automatically remain applied for 10-15 minutes to protect the wind generator and controller from overheating. In addition, should the battery voltage exceed its over-limit shutoff voltage, the controller will automatically brake, slowing or stopping the blades. The braking mode may also be deployed manually at any time by the user by using the manual

braking function.

So, unlike typical systems, the MK4+ has 3 set-points: 1) a dump-load set point, where it begins its step-less PWM regulation and constant-voltage charging; 2) A full-charge set-point, where it recognizes a full charge, stops charging and begins 100% dump loading; 3) An over-current/over-voltage set-point, which will automatically brake the wind generator rotor, which also stops the charging.

### **Two DC Output Modes (for controlling other loads like lights, etc):**

If you do not intend to use your controller as a lighting controller, you may skip this section, but please note that when this user manual refers to “load(s)” it is referring to the loads it is controlling with this function, rather than other external loads not being controlled directly by this controller function. Note that for the light-sensitive (dusk-to-dawn) DC load control functions to work, you must also have a solar panel attached to the controller.

There are two separate DC outputs on the controller, which we reference as Output #1 and Output #2. For each of the two outputs the user can set three output control modes using the LCD and keypad buttons: 1) The dusk-to-dawn function - where the lights come on, and go off, based on ambient light level sensing from an attached PV panel); 2) Dusk-on, elapsed time off - where the off time is based on an elapsed on- time; 3) Constant on – the lights stay on for 24 hours or until the battery is low.

**LCD Display Function:**

LCD screen has status icons and alpha-numerical readouts that can display system status and parameters such as: battery voltage, wind generator voltage, PV (solar) voltage, wind generator current, PV current, wind generator power, PV power, and load current. It can also display output load control modes, time control output load shutoff hours, light control on/off voltage points, day or night indication, load status, battery over voltage/under voltage status etc.

**Wind Generator Parameter Display Screen:**

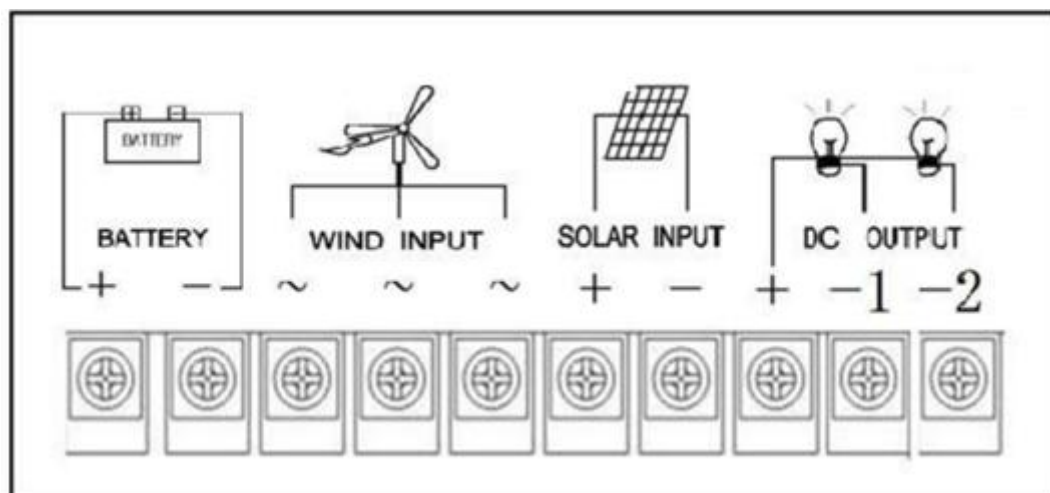
The Wind display screen provides instantaneous performance information from the connected MK4+ wind generator. Please note that the voltage information displayed on the Wind display screen is the raw AC voltage being output by the wind generator as measured across 2 of the 3 phases, and the voltage displayed will vary with the wind speed, attached loads, and RPM. The AC voltage displayed is not necessarily the DC charging voltage going to the battery, so do not worry if it looks much lower or higher than the battery voltage. The charge voltage is best displayed by looking at the battery voltage on the Battery screen.

**Protection Functions:**

The microprocessor is constantly monitoring important parameters of your system and will employ its protective functions when needed. Protection functions include: Battery over-charge protection, battery over-discharge protection, battery reverse polarity connection protection, load short circuit

protection, over-load protection, wind generator current limiting, automatic braking, PV reverse polarity connection protection, etc.

### 3. Installation



(Connection Diagram of Controller Terminals)

The user should connect and operate the system according to following procedures only after the wind generator, solar panels, and external circuit wiring is completed.

**Step 1** Check the package and then check the controller for any damage after unpacking. Do not install a damaged controller, and contact MarineKinetix or your dealer immediately.

**Step 2** Connect any external DC loads (e.g. lights) that you wish the controller to control to the “DC OUTPUT” terminals: The first load should be connected to “+” and “-1” of the “DC OUTPUT” terminals, and the second load should be connected to “+” and “-2” of the “DC OUTPUT” terminals. Max load is 10A each.

**Step 3** Connect the battery to “BATTERY” terminals with 10AWG or bigger copper cables. The controller terminals can accept a maximum wire diameter of 6mm (4 AWG). You must connect the battery to the controller before connecting the wind turbine. We also recommend that a 50A fuse or circuit breaker be placed on the positive (+) battery cable within 12” of the battery. **(Note: While the controller is fuse protected against a reverse-polarity connection, please do not connect the cables with the polarity reversed.)**

**Step 4** Connect the three (3) wind turbine output wires to the “WIND INPUT” terminals only when the wind turbine is fully stopped and tied off to prevent it from spinning.

**Step 5** Connect any solar panels to the positive wire to (+) “SOLAR INPUT” terminal, negative wire to (-) “SOLAR INPUT” terminal.

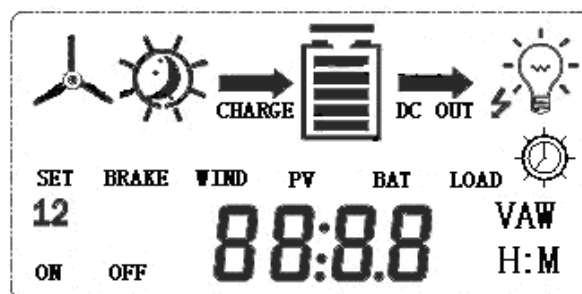
**Step 6** User can set relevant parameters and adjust load output control modes thru the LCD and the controller buttons.









**Step 7** Check whether all the connections are correct and firmly tightened.





## 4. LCD Display Instruction and Button Specification




### 4.1. LCD Display Instruction



- 1)  Wind generator symbol. The blades of this icon will appear to rotate when the wind generator is connected and making power.
- 2)  Day symbol  Night symbol (Day symbol available only if a PV panel is attached).
- 3)  battery state of charge symbol. The inner area of the icon indicates the battery power status, and the area will progressively fill with lines as the battery charges. Five horizontal lines in the display indicates that the battery is full. This symbol  will be flashing when the battery is over-discharged, and the flashing will not stop until the battery voltage recovers. Never let your batteries discharge to this level. This symbol  will be flashing when the battery is over-charged; flashing will not stop until battery voltage recovers.
- 4) The load symbol  indicates the load control status and any malfunction status.
  -  Indicates that the load has a normal output (is in an on-state),

while  indicates the load has no output (off-state).

- If the  symbol is flashing it indicates an over-load situation and the user must remove the excess load, and then press the “Esc” key to restore operation.

5)  Light-control and time-control symbol (available only if PV panel is attached). The  symbol indicates that the light-control mode is in effect, but the time-control mode is off. The  symbol indicates that the light control mode and the time-control are both in effect.

6) A “1” or a “2” displayed at the lower left corner of the display indicates that you are viewing information relative to either DC Output #1 or #2. These are the two output load “channels” available to operate external loads like lighting.

7) When “SET” is displayed, it indicates that the controller is in setting mode.

8) **88:88** Numerical display. The system parameters (volts, amps, watts, etc.) are shown via this numerical display.

9) When “ON” and a certain voltage value appear concurrently, the voltage value is the light control “ON” voltage set-point. When “ON” and “LOAD” appear concurrently, it indicates the output mode is constant on.

When “OFF” and a certain voltage value appear concurrently, the voltage value is the light control “OFF” voltage set-point. When “OFF” and a certain time value appear concurrently, then the time value indicated is the

current setting for the number of hours that shall elapse before turning off automatically.

10) If you press the “Enter” key and “Esc” key at the same time, it engages the manual brake, and the LCD will display the symbol **BRAKE**, which indicates that MK4+ wind generator is now in the braking mode. The MK4+ will stop rotating, or begin running at a very slow speed when the brake mode is engaged. If you again press the “Enter” key and “Esc” button at the same time while in manual brake mode, the **BRAKE** symbol will disappear, and the brake is released. In normal charging situations, the wind turbine will be in running mode rather than brake mode. You should always apply the brake before approaching or servicing the wind generator. If disconnecting wiring, or servicing the unit, its blades should also be securely tied off to prevent any rotation.

#### 4.2. Button Description

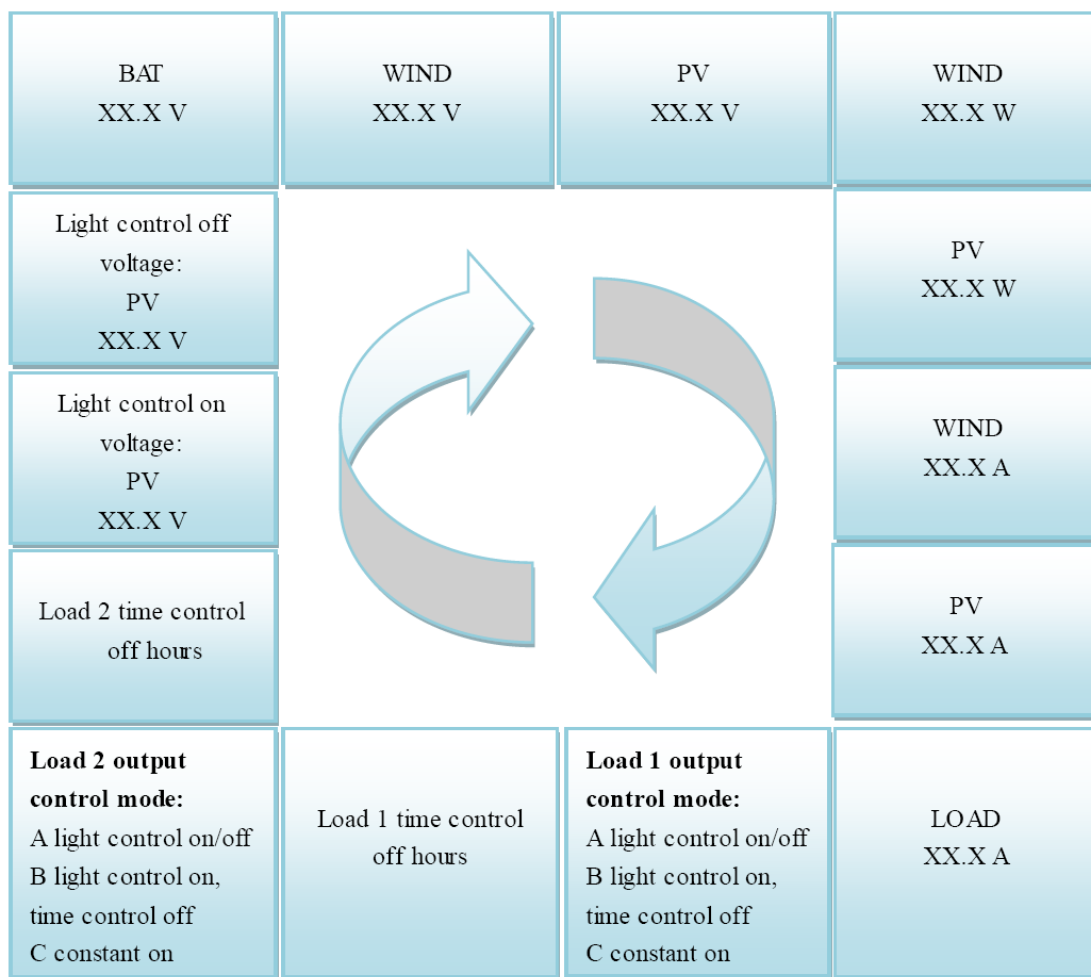


The LCD backlight will be on after pressing any button on the keypad. To save power, the backlight will automatically go out if there is no further button operation for 10 seconds.

- ✧  $\uparrow^{(+)}$ : Up/ Increase. In the browsing mode, press  $\uparrow^{(+)}$  to check the previous parameter. In the setting mode, press this button to check the next adjustable parameter or to increase the value of the current parameter.
- ✧  $\uparrow^{(-)}$ : Down/Decrease. In the browsing mode, press  $\uparrow^{(-)}$  to check the next parameter. In the setting mode, press this button to check the previous adjustable parameter or decrease the value of the current parameter.
- ✧ “**Enter**”: Set/Confirm. In the browsing mode, press “**Enter**” to access the setting window. In the setting mode, press this button to save parameters and return back to browsing window.
- ✧ “**Esc**”: Cancel/Manual reset. In setting mode, press “**Esc**” to return to browsing mode without saving the modified parameters. In browsing mode, the button is used as a manual reset key for load short circuit or over load.

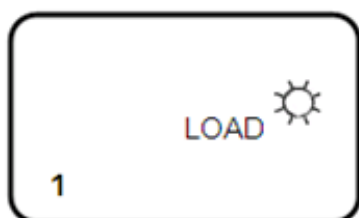
### 4.3 Parameter Browsing

- 1) When the battery is attached, and voltage is present, the LCD is in browsing mode and displays the battery voltage: XX.X V (e.g. 12.4V)
- 2) In browsing mode, the LCD will cycle through and display the following parameters (up or down) by pressing the  $\uparrow^{(+)}$  button, or the  $\downarrow^{(-)}$  button.



The LCD screen can display three output control modes as follows:

1) Dusk-to-Dawn Mode

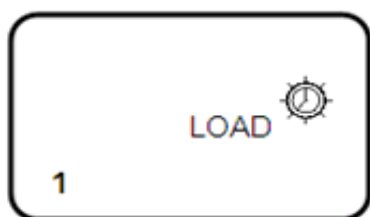


The screen shot at left indicates that the lighting control output #1 (load output) is being controlled by sunlight intensity alone (dusk-to-dawn mode).

In this control mode, the controller will automatically turn on the load (a light, for instance) at dusk, and then

automatically turn it off at dawn. It accomplishes this by sensing the voltage from the solar panel, using it like a photo-cell. The user can adjust the light control on, and light control off, voltage set-points via the LCD and the keypad push buttons.

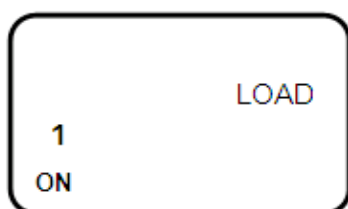
## 2) Dusk on, elapsed time off



The screen shot at left indicates that lighting control output #1 is controlled by sunlight intensity and time simultaneously. The controller will automatically turn on the lights at dusk, and

will automatically turn off the lights after the pre-set “time control off” hours have elapsed. The controller will also automatically turn off the lights should daylight appear before the pre-set number of hours have elapsed.

## 3) Constant on



The screen shot at left indicates that lighting control output #1 is in a constant-on setting. With this setting, the controller will leave the lights on

for 24 hours. In this case, the controller will also protect the battery from being over discharged, and will extinguish the lights.

#### 4.4 Parameter Setting

The user can set the lighting output #1 and #2 control modes, and parameters, by using the keypad and LCD screen. The available control options are: light control on-voltage, light control off-voltage, and time control elapsed time hour value.





When the user needs to modify any specific parameters, you will first access the appropriate browsing window by pressing the up or down keys. When you reach the specific window that you need, you will press “Enter” to access that particular window’s functionality and settings. You will see that the word “SET” will appear on the LCD screen when you have accessed the setting mode. You can then modify parameters or status by pressing the up or down keys. If you don’t wish to save the modified parameters, just press “Esc” and you will return to the browsing window without saving the modified parameters. After setting the preferred parameters, press the “Enter” key to save them and return back to the browsing window.

## 5. Technical Data

Parameters	Values
Rated Battery Voltage	12VDC (24VDC)
Maximum Wind Turbine Input Power	450W
Maximum Solar Input Power	150W (300W)
Load Dump Start Voltage	13.5V (27V)
Charge Shutoff Voltage	14.5V (29V)
Wind Turbine Brake Current	25A (13A)
Battery Over Discharge Protection Voltage	10.8V (21.6V)
Battery Over Discharge Recovery Voltage	12V (24V)
Light Control On Voltage (Factory Default )	1V (2V) - Adjustable
Light Control Off Voltage (Factory Default)	1.5V (3V) - Adjustable
Rated Output Current of Load 1 & 2	10A
Output #1 Control Mode (Factory Default)	3 User-Selectable Modes (Dusk-to-Dawn)
Output #2 Control Mode (Factory Default)	3 User-Selectable Modes (On at Dusk and off 5 hours later)
Dumplload Control Mode	PWM
Display	Backlit LCD
Quiescent Current	≤20mA
Ambient Temperature & Humidity Range	-20~+55°C/35~85%RH (No Condensation)



## 6. Troubleshooting

Problem	Possible Cause and Solution
 Symbol flashing, no charge or discharge.	Battery is over-voltage, check battery voltage, and whether the cables are well-connected. Re-connect all components.
 Symbol flashing and no output.	Battery is over-discharged or dead. Fully recharge it with a shore-base charger if the battery is fully discharged. Generator based chargers should never be used to recharge a fully depleted battery bank. This includes engine alternators.
 Symbol flashing and no output.	Your output #1 or #2 are in overload. Please check the load, and remove the extra load, then press "Esc" button to recover.
 Symbol flashing and no output.	Short-circuit. Check the all wiring, and remove the short-circuit hazard or damaged load, then press "Esc" button to recover.
No LCD display.	<ol style="list-style-type: none"> <li>1. LCD wire connection might be loose, please open controller case to check.</li> <li>2. The fuse might be burnt due to the battery reverse connection, please open controller case to check.</li> <li>3. Battery is empty or virtual connection, please check the battery voltage and examine whether the wire connection is firm or not.</li> </ol>

If your phenomenon is not included in the above descriptions, please contact MarineKinetix or your dealer for assistance.

## 7. Installation Environment



Avoid operating the apparatus under direct sunshine, blazing sun, and rainy, moist, or acid mist environments, etc.



Keep the apparatus away from flammable and explosive gas or hazard, including flame and spark.

## 8. Guarantee and Liability

### Warranty

Marinekinetix warrants your product to be free from defects in material and/or workmanship for a period of 3 years from original date of purchase. Warranty coverage is extended only to original purchaser.

If product proves defective during warranty period, Marinekinetix, at its option will:

1. Replace the controller with a new or refurbished product.
2. Correct reported problem

Customers warranty continues to be valid on repaired or replaced product from original component warranty date.

### Restrictions

This warranty covers defects in manufacturing discovered while using the product as recommended. The warranty does not apply to:

Equipment, materials, or supplies not manufactured by Marinekinetix.  
Product that has been modified or altered other than by Marinekinetix, or without prior Marinekinetix approval.  
Lightning, corrosion, or water damage  
Repairs performed by other than authorized Marinekinetix support staff  
Normal wear and tear and corrosion from exposure to the marine environment  
Acts of God; misuse, negligence, and accidents

### Disclaimer

EXCEPT FOR THE EXPRESSED WARRANTY SET FORTH ABOVE, THE MANUFACTURER DISCLAIMS ALL OTHER EXPRESSED AND IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY AND NON-INFRINGEMENT. NO OTHER WARRANTY, EXPRESSED OR IMPLIED, WHETHER OR NOT SIMILAR IN NATURE TO ANY OTHER WARRANTY PROVIDED HEREIN, SHALL EXIST WITH RESPECT TO THE PRODUCT SOLD UNDER THE PROVISIONS OF THESE TERMS AND CONDITIONS. THE MANUFACTURER EXPRESSLY DISCLAIMS ALL LIABILITY FOR BODILY INJURIES OR DEATH THAT MAY OCCUR, DIRECTLY OR INDIRECTLY, BY USE OF THE PRODUCT BY ANY PERSON. ALL OTHER WARRANTIES ARE EXPRESSLY WAIVED BY THE CUSTOMER.

