

# Charge Controllers

## What is a Charge Controller?

A charge controller is a device that regulates the state of charge of a battery bank



# Functions of Charge Controller

Charge controllers perform the following functions:

- Charging batteries safely, quickly and completely
- Protecting batteries from deep discharge, if the charge controller has a load controller function included
- Protects the battery from overcharging
- Prevents reverse current from the battery to solar panels
- Prevents unwanted discharge of the battery bank

# Types of Charge controllers

Charge controllers are classified based on their voltage and ampere rating. There are two types of charge controllers

1. Pulse Width Modulation (PWM)
2. Maximum Power Point Tracking (MPPT)

# Types of charge controllers

## Pulse Width Modulation (PWM)

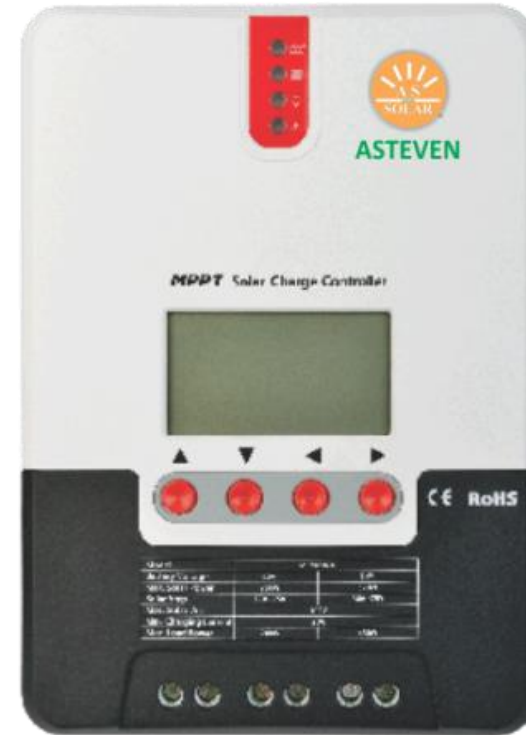
- The most common type of controller
- Operate using the basic ON/OFF switching to regulate the charging voltage
- They match the solar array voltage to the voltage required to charge the battery bank depending on the state of charge of the battery



# Types of charge controllers

## Maximum Power Point Tracking (MPPT)

- Also referred to as maximum power point tracker
- Mostly used in systems larger than 1kWp
- It works by scanning and locating the characteristic I-V curve of the PV array and determines the **maximum power point**
- It is more expensive than PWM
- It generally increases the energy output of the PV modules by up to 30%



# Which is best?

## PWM

- Smaller systems
- Voltage pulled down to battery voltage(Nominal voltage of array matches battery bank)

## MPPT

- Larger systems, extra % of power worth the extra money
- Converts input voltage to battery voltage(Mismatched nominal voltage)
- Increases current when voltage drop
- More expensive than PWM

# Charge Controller Comparison

100W 12V PANEL  
18V<sub>mp</sub> 5.56A

## PWM

- Low battery
  - $11V \times 5.56A = 61W$
- High battery
  - $14V \times 5.56A = 78W$

## MPPT

- Low battery
  - $18V \div 11V = 1.6:1$
  - $1.6 \times 5.56A = 8.9A$
  - $11V \times 8.9A = 97.8W$
- High battery
  - $18V \div 14V = 1.28:1$
  - $1.28 \times 5.56A = 7.1A$
  - $14V \times 7.1A = 99.4W$

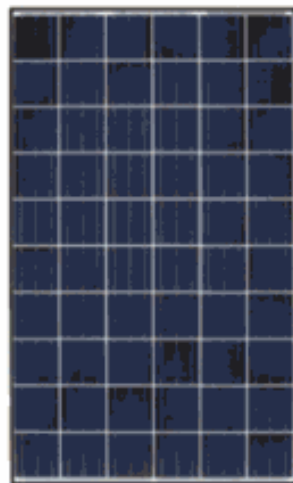
12V Solar Panel -> 12V PWM Charge Controller -> 12V Battery Bank



18Vmp, 8A  
Into Charge Controller

14V , 8A  
Into Battery bank

20V Solar Panel -> MPPT Charge Controller -> 12V Battery Bank



32Vmp, 9A  
Into Charge Controller

14V, 20A  
Into Battery Bank



# Charge Controller: features

Optional features:

- Display
  - LED readout
  - LED Indicator
  - Remote LCD
- Low voltage disconnect(LVD)
- Remote monitoring
- Temperature sensing and compensation
- Diversion load control
- Lighting control – i.e. dusk to dawn

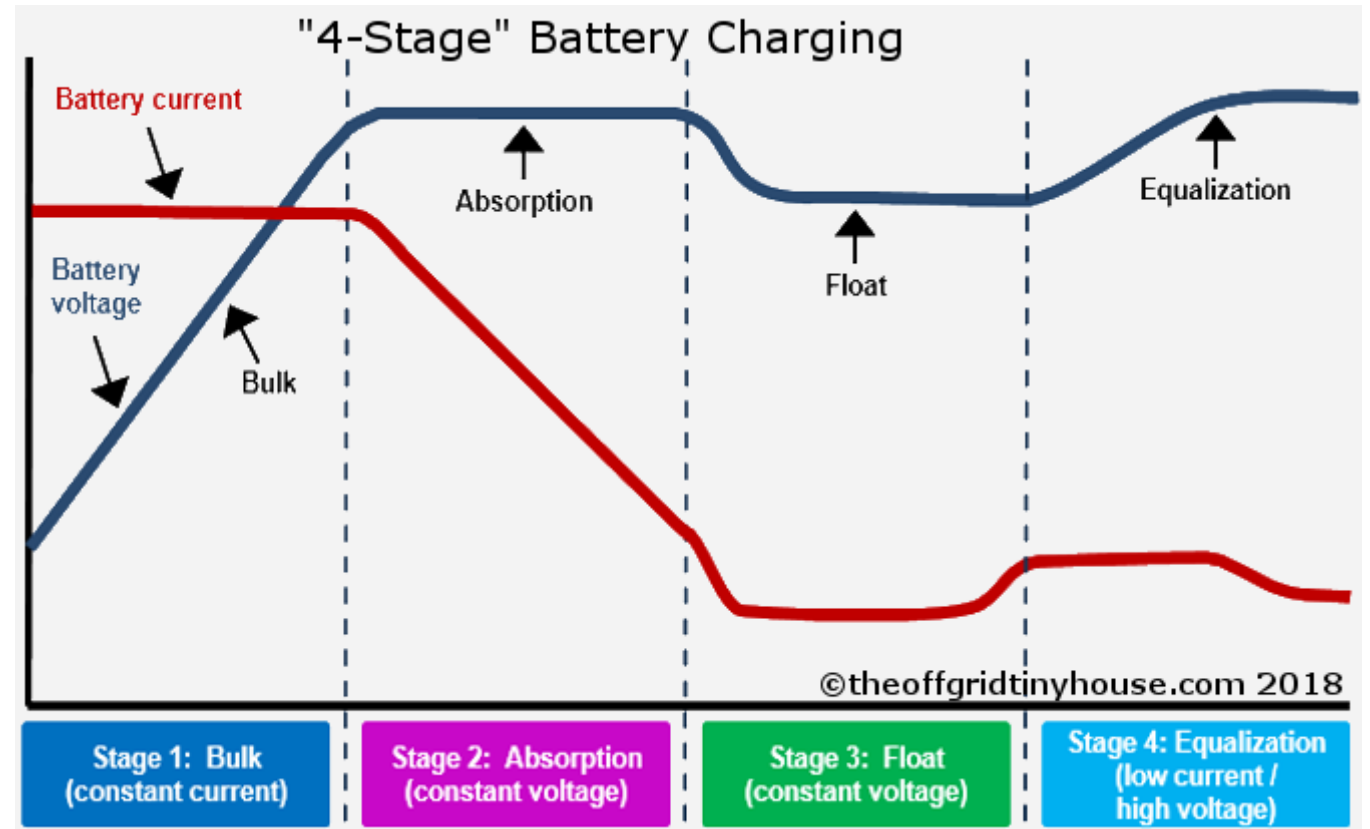
# Choosing the Correct Charge Controller

- Selecting an efficient and properly designed charge controller is key to longevity and efficiency of your entire battery based PV system.
- By optimizing the power coming from the solar modules, you will get that much closer to offset the use of traditional grid power or another source of energy.
- In addition will be protecting your battery bank and thereby protect yourself from unforeseen and needless replacement costs.
- Your solar charge controller is an item worth investing in and researching as you design your system.
- You will need to choose an option that is scalable and appropriate for your power needs, as well as you make sure you have ample battery storage for the solar modules you have selected to install
- Solar charge controllers are rated and sized by the solar module array current and system voltage. Most common are 12, 24 and 48-volt controller

# Stages of charging in a charge controller

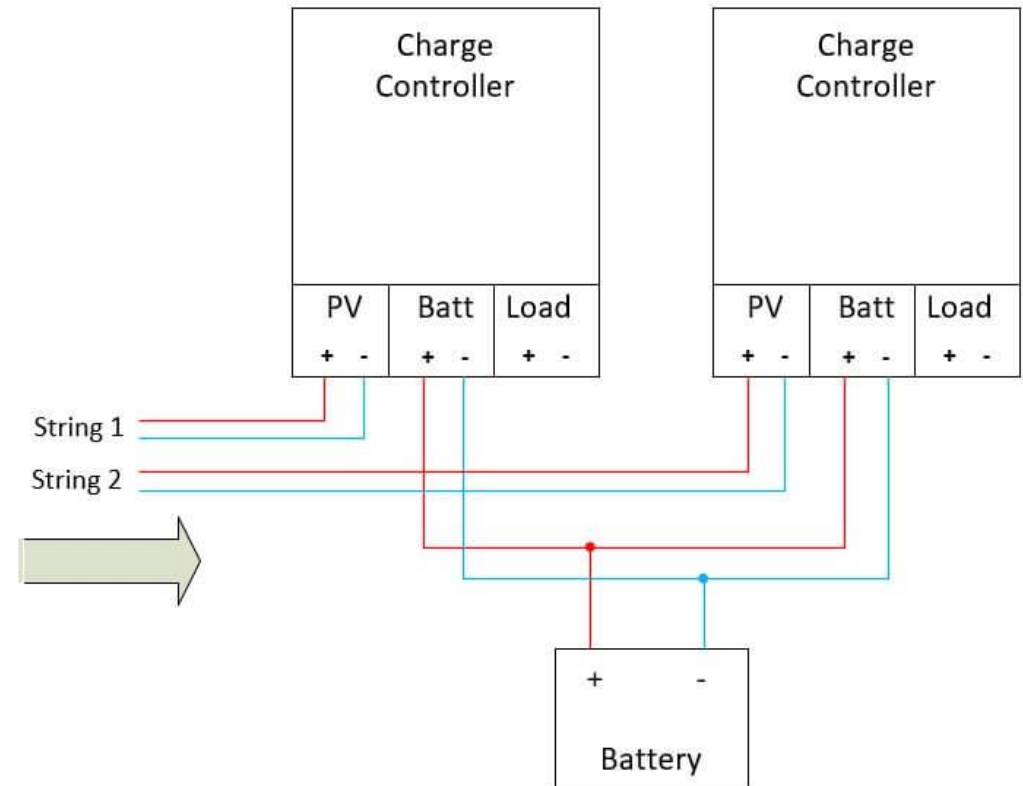
There are four stages of charging in a charge controller

- Bulk charging
- Absorption charging
- Float charging
- \*Equalization



# Can you use more than one charge controller?

- You can use multiple charge controllers with one battery bank in situations where a single charge controller is not large enough to handle the output of your solar panel array.
- However, we do recommend using the same type of charge controllers if you are using more than one
- So, if you have one MPPT charge controller, all your charge controller must be MPPT.
- Additionally, make sure all your controllers have the same battery setting input.



# Specification of charge controllers available in the market

## PWM

- 10A 12V/24 PWM Charge controller
- 20A 12V/24 PWM Charge controller
- 30A 12V/24 PWM Charge controller
- 30A 12V/24V/36V/48V PWM Charge Controller
- 45A 12V/24V PWM Charge Controller
- 40A 48V PWM Charge Controller
- 50A 48V PWM Charge Controller
- 60A 12V/24V PWM Charge Controller
- 60A 48V PWM Charge Controller
- 60A 12V/24V/36V/48V PWM Charge Controller

## MPPT

- 30A 12V/24 MPPT Charge controller
- 50A 12V/24V MPPT Charge Controller
- 60A 12V/24V/36V/48V MPPT Charge Controller
- 60A 12V/24V/36V/48V MPPT Charge Controller
- 70A 12V/24V MPPT Charge Controller
- 80A 12V/24V/36V/48V/60V MPPT Charge Controller
- 100A 12V/24V/36V/48V MPPT Charge Controller
- 100A 96V MPPT Charge Controller

# Using PWM Vs. MPPT

