



SOLAR CHARGE CONTROLLER



# User Manual

User Manual\_ACO300-NBT\_OC  
CE, Rohs, ISO9001:2015  
Subject to change without notice!

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## Dear Clients,

Thanks for selecting the ACO300-NBT solar controller.

Please take the time to read this user manual, this will help you to make full use of many advantages the controller can provide your solar system.

This manual gives important recommendations for installing and using and so on. Read it carefully in your own interest and pay attention to the safety recommendations in it please.

# 1, Safety instructions and waiver of liability

## 1.1 Safety Instructions

The following symbols are used throughout this manual to indicate potentially dangerous conditions or mark important safety instructions. Please take care when meeting these symbols.



**WARNING:** Indicates a potentially dangerous condition. Use extreme caution when performing this task.



**CAUTION:** Indicates a critical procedure for safe and proper operation of the controller.



**CAUTION:**

- 1) There are no user serviceable parts inside the controller. Do not disassemble or attempt to repair the controller.
- 2) Keep children away from batteries and the charge controller.

## 1.2 Liability Exclusion

The manufacturer shall not be liable for damages, especially on the battery, caused by use other than as intended or as mentioned in this manual or if the recommendations of the battery manufacturer are neglected. The manufacturer shall not be liable if there has been service or repair carried out by any unauthorized person, unusual use, wrong installation, or bad system design.

## 2, Overview

ACO300-NBT solar controller is a fully automatic battery charger which converts power from photovoltaic(PV) array to a regulated battery voltage, widely used in yacht, RV household solar energy system and other fields.

**It comes with a number of outstanding features, such as:**

- Smart PWM technology, high efficiency
- Backlit LCD displaying system operating information and error codes
- LCD display design, read operating data and working condition easily.
- LED Bar for easy to read charge state and battery information
- 7 Battery Type Compatible Lithium-ion, LiFePO4, LTO, Gel, AGM, WET, and Calcium
- Waterproof design, suitable for indoor or outdoor use
- Support Android mobile phone APP, realize wireless monitoring function of solar controller
- Use high performance, ultra-low power consumption Bluetooth dedicated chip
- Adopt Bluetooth 4.2 and BLE technology, communication distance up to 10m
- Real-time automatic fault alarm
- External temperature sensor optional, automatic temperature compensation
- Built-in temperature sensor, when the temperature exceeds the set value, the charging current will lower down followed by the decrease of temperature, so as to control the controller' s temperature rise
- Four stages charge way: Fast, boost, equalization, float
- Withcurrent-limitingchargingmode, whenthepowerofsolarpanelis over-sized and charging current exceeds the rated current( ≤60% of rated current), the controller will lower the charging power, which enables the system to work under the rated charging current
- Perfect EMC & thermal design
- Full automatic electronic protect function

## 3, PWM Technology

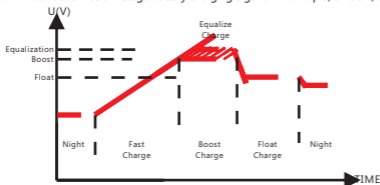
### 3.1 PWM Introduction

ACO300-NBT solar controller utilizes pulse width modulation (PWM) technology for battery charging. The characteristic of solar controller is to adjust the working voltage of solar panels intelligently, so that solar panels always work at the maximum power point of V-A characteristic curve. Battery charging is based on the current process, so controlling the current will control the battery voltage. The charging mode of PWM solar controller has three stages: boost, equalization and float charging, the battery is required to be controlled by specified voltage regulation set points for boost, Float, and Equalization charging stages.

The charge controller uses automatic duty cycle conversion, creating pulses of current to charge the battery. The duty cycle is proportional to the difference between the sensed battery voltage and the specified voltage regulation set point. Once the battery reached the specified voltage range, pulse current charging mode allows the battery to react and allows for an acceptable rate of charge for the battery level.

## 3.2 Four Charging Stages

ACO300-NBT controller has a 4-stage battery charging algorithm for rapid, efficient, and safe battery charging.



### Fast Charge

In this stage, the battery voltage has not yet reached boost voltage and 100% of available solar power is used to recharge the battery.

### Boost Charge

When the battery has recharged to the Boost voltage setpoint, constant-voltage regulation is used to prevent heating and excessive battery gassing. The Boost stage remains 120 minutes and then goes to Float Charge. Every time when the controller is powered on, if it detects neither over discharged nor overvoltage, the charging will enter into boost charging stage.

### Float Charge

After the Boost voltage stage, the controller will reduce the battery voltage to Float voltage setpoint. When the battery is fully recharged, there will be no more chemical reactions and all the charge current transmits into heat and gas at this time. Then the controller reduces the voltage to the floating stage, charging with a smaller voltage and current. It will reduce the temperature of battery and prevent the gassing, also charging the battery slightly at the same time. The purpose of Float stage is to offset the power consumption caused by self consumption and small loads in the whole system, while maintaining full battery storage capacity.

### Equalization Charge

Certain types of batteries benefit from periodic equalizing charge, which can stir the electrolyte, balance battery voltage and complete chemical reaction. Equalizing charge increases the battery voltage, higher than the standard complement voltage, which gasifies the battery electrolyte. If it detects that the battery is being over discharged, the solar controller will automatically turn the battery to equalization charging stage, and the equalization charging will be 120minutes. Equalizing charge and boost charge are not carried out constantly in a full charge process to avoid too much gas precipitation or overheating of battery.



Only for WET or Calcium batteries drained below 12.1V will automatically run this stage and bring the internal cells as an equal state and fully complement the loss of capacity. Lithium-ion, LiFePO<sub>4</sub>, LTO, Gel and AGM do not undergo this stage.



### **WARNING: Risk of explosion!**

Equalizing flooded battery can produce explosive gases, so well ventilation of battery box is necessary.



**WARNING: Incorrect battery type setting may damage your battery.**

### 3.3 Charging Voltage

Battery Type	AGM	GEL	WET	Calcium	LiFePO4	Li-ion	LTO
Fast Voltage	9.0V~14.0V, Current = Rated Charge Current						
Boost Voltage *1	14.4V	14.1V	14.7V	14.9V	14.4V	12.6V	14.0V
Equalization Voltage *2	N/A	N/A	15.0V	15.0V	N/A	N/A	N/A
Float Voltage	13.6V	13.6V	13.6V	13.6V	N/A	N/A	N/A
Under Voltage Recharging	12.5V	12.5V	12.5V	12.5V	14.2V	12.4V	13.8V
Low Voltage Disconnect	11.0V	10.8V	11.0V	11.0V	10.4V	9.0V	10.0V
Over Voltage Protection	15.8V	15.8V	15.8V	15.8V	14.6V	12.8V	14.2V

\*1. For LiFePO4, Li-ion and LTO battery, the constant voltage time is 1 Hour.

For AGM, GEL, WET and Calcium battery, the maximum constant voltage time is 2 Hours,

If charging current < 0.5A and holds for 1min, the charging state will end.

\*2. Only WET and Calcium batteries have equalization charging stage, 2 hours maximum.

Conditions for entering the equalization charging stage: If the battery voltage discharge below 12.1V or without equalization charging stage for 30 days.

✍ **The Bluetooth setting parameters are consistent with the parameters corresponding to the battery type in the table above, and the LCD screen displays the battery type. Otherwise, the battery type is not displayed.**

## 4, Optional Component

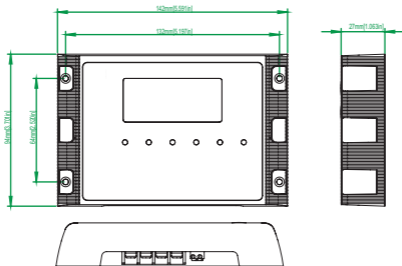
The ACO300-NBT solar controller is shipped with a temperature sensor of length 80mm. If you need other components you need to purchase separately.

### Temperature Sensor

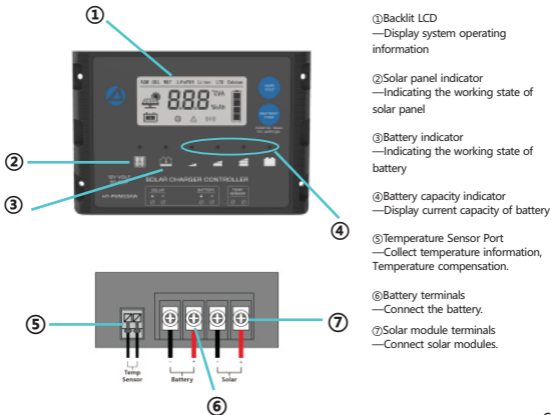
Measures the temperature at the battery and uses this data for very accurate temperature compensation. The sensor is supplied with a 3m cable length that connects to the charge controller. The temperature sensor connected via interface 6.

If the external temperature sensor is not connected or damaged, the internal temperature will be used for temperature compensation during charging.

## 5, Dimensions(mm)



## 6, Structure



## 7, Installation



**CAUTION:** Please read all instructions and precautions in the manual before installing!  
To protect the Battery and the Solar Panel, we strongly recommend that you place an inline fuse on the positive wire on both the "Solar" and "Battery" Circuits. 40A fuse for 20A controller; 30A fuse for 15A controller, 20A fuse for 10A controller (As close to the Battery /Panel as possible)

### 7.1 Installation Notes

(1)The solar charge controller may only be used in PV systems in accordance with this user manual and the specifications of other modules manufacturers. No energy source other than a solar generator may be connected to the solar charge controller.

(2)Before wiring installation and adjustment of controller, Always disconnect the solar modules and insurance or circuit breaker of battery terminal.

(3)Only to comply with the range of the battery charge controller.

(4)Batteries store a large amount of energy, never short circuit a battery under all circumstances. We strongly recommend connecting a fuse directly to the battery to avoid any short circuit at the battery wiring.

(5)Batteries can produce flammable gases. Avoid making sparks, using fire or any naked flame. Make sure that the battery room is ventilated.

(6)Uses insulated tools and avoid placing metal objects near the batteries.

(7)Be very careful when working with batteries. Wear eye protection. Have fresh water available to wash and clean any contact with battery acid.

(8)Avoid touching or short circuiting wires or terminals. Be aware that the voltages on special terminals or wires can be as much as twice the battery voltage. Use isolated tools, stand on dry ground, and keep your hands dry.

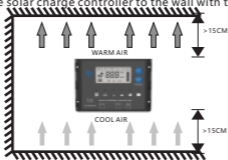
(9)Refer to the technical specifications for max wire sizes on the controller and for the maximum amperage going through wires.

(10)After installation check that all connections are tight line, avoid heat accumulation caused by virtual access danger.

### 7.2 Mounting Location Requirements

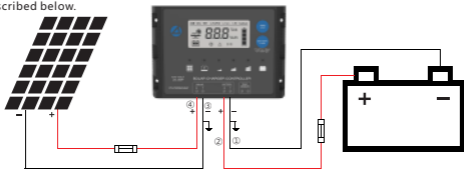
Do not subject the solar charge controller to direct sunshine or other sources of heat. Protect the solar charge controller from dirt and moisture. Mount upright on the wall on a non-flammable substrate. Maintain a minimum clearance of 15cm below and around the device to ensure unhindered air circulation. Mount the solar charge controller as close as possible to the batteries.

Mark the position of the solar charge controller fastening holes on the wall, drill 2 holes and insert dowels, fasten the solar charge controller to the wall with the cable openings facing downwards.



### 7.3 Connection

Solar PV modules create current whenever light strikes them. The current created varies with the light intensity, but even in the case of low levels of light, full voltage is given by the modules. So, protect the solar modules from incident light during installation. Never touch uninsulated cable ends, use only insulated tools, and make sure that the wire diameter is in accordance with the expected currents of solar charge controller. Connections must always be made in the sequence described below.



**WARNING:** Risk of electric shock! Exercise caution when handling solar wiring. The solar PV array can produce open-circuit voltages in excess of 100V when in sunlight. Pay more attention to it.



**WARNING:** Risk of explosion! Once the battery's positive and negative terminals or leads that connect to the two terminals get short-circuited, a fire or explosion will occur. Always be careful in operation.



Fusing is a recommendation in PV systems to provide a safety measure for connections going from panel to controller and controller to battery. Remember to always use the recommended wire gauge sized based on the PV system and the controller.

Cable total length one-way distance	<3m	3m~6m
Cable wires(AWG)	14~12AWG	12~10AWG

The wire size is only for reference. If there is a long distance between the PV array and the controller or between the controller and the battery, larger wires can be used to reduce the voltage drop and improve performance.

#### 1st step: Connect the battery

Connect the battery connection cable with the correct polarity to the battery terminals on the solar charge controller (with the battery symbol). If the polarity is correct, the LCD on the controller will begin to show.

#### 2nd step: Connect the solar module

Ensure that the solar module is protected from incident light. Ensure that the solar module does not exceed the maximum permissible input current. Connect the solar module connection cable to the correct polarity of the solar terminals on the solar charge controller (with the solar module symbol).

#### 3rd step: Final work

Tighten all cables connected to the controller and remove all the debris around the controller (leaving a space of approx. 15 cm).

## 7.4 Grounding

Be aware that the negative terminals of controller are connected together and therefore have the same electrical potential. If any grounding is required, always do this on the negative wires.

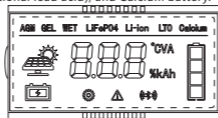


**CAUTION:** For common-negative system, such as motorhome, it is recommended to use a common-negative controller; but if in the common-negative system, some common-positive equipment are used, and the positive electrode is grounded, the controller may be damaged.

## 8, Operation

### 8.1 LCD Display

Please check your battery manufacturer's specifications to select correct battery type. The unit provides eight ( 8 ) battery types for selections: Lead crystal, Lithium-ion, LiFePO4, LTO, Gel, AGM, WET (conventional lead acid), and Calcium battery.
















#### 8.1.1 Status Description

Icon	Status
	Daytime
	Battery connected
	Battery capacity
12.8 V	Battery voltage
10.0 A	Charging current
25 °C	Temperature
99 %	Battery state of charge(in %)
200 Ah	The total charge ampere hours
AGM GEL WET LiFePO4 LI-ion LTO Calcium	Battery type
	Bluetooth function
	Bluetooth connected
	Setting icon(Not used)
	Fault indication, see 8.1.2

The total charge ampere hours are off after power failure.

## 8.1.2 Fault indication

Status	Icon	Description
Battery Low Voltage	 E1 	Battery level shows empty, fault icon display, Battery icon flashes, the LCD screen displays E1.
Battery Over Voltage	 E2 	Battery level shows full, fault icon display, Battery icon flashes, the LCD screen displays E2.
Over Temperature	 E3 	Fault icon display, icon °C flashes, the LCD screen displays E3.
PV Over Current	 E4	Fault icon display, the LCD screen displays E4.
Battery Over Voltage (No solar connection)	 E5 	When there is no solar connection, battery level shows full, battery icon flashes, the LCD screen displays E5.
PV Over Voltage	 E6 	PV level shows high, PV icon display, the LCD screen displays E6.
All icons light up		1. The system does not recognize the correct voltage, the full icon lights up. 2. If the battery type is set to a non-lithium battery system, all ICONS on the screen light up when only PV is connected but no battery is connected.
All icons light off		If the controller is not powered, the screen does not display.

## 8.2 Key function





### 8.2.1 Static display

Long press the "BATTERY TYPE" key to enter the battery setting mode, and short press the "BATTERY TYPE" key to enter the switching mode. Short press the "AMP/VOLT" key to enter the acknowledged mode. If you do not press the "BATTERY TYPE" key when the battery type flashes, the selected battery type will not be saved.



**WARNING:** Incorrect battery type setting may damage your battery. Please check your battery manufacturer's specifications when selecting battery type.

### 8.3 Bluetooth

If the solar charge controller has this icon , it means that the controller has Bluetooth communication function. If the Android phone is connected successfully, this icon  will be displayed.

AGM, GEL, Liquid and Lithium four battery types can be set via Bluetooth mobile phone APP, and the charge voltage can be set.

**Please refer to Bluetooth APP instructions for detailed operation of mobile APP.**

#### 8.3.1 Charging Voltage Parameters(Liquid, GEL, AGM)

When choosing Liquid, GEL or AGM for battery type, the parameters of boost, equalization and float charge voltage can be set by mobile phone APP. The range of parameters is as follows. The following voltage parameters are 25°C/12V system parameters.

Charging stage	Boost	Equalization	Float
Charging Voltage Range	14.0~14.8V	14.0~15.0V	13.0~14.5V
Default charging voltage	14.5V	14.8V	13.7V

#### 8.3.2 Charging Voltage Parameters(Lithium)

When choosing lithium battery type, the overcharge target and overcharge recovery voltage of lithium battery can be set by mobile phone APP.

Lithium overcharge target(CVT) voltage range: 10.0-17.0V

Lithium overcharge recovery(CVR) voltage setting range: 9.2-16.8V



**(Overcharge Recovery Voltage+1.5V)≥Lithium Overcharge Protection Voltage≥(Overcharge Recovery Voltage+0.2V)**  
**Mobile App does not support parameters beyond this range.**



**Warning: The required accuracy of BMS shall be at least 0.2V. If the deviation is higher than 0.2V, the manufacturer will assume no liability for any system malfunction caused by this.**

## 8.4 LED Display












Solar LED   Battery LED  



 Battery Capacity LED  
Soc1 Soc2 Soc3 Soc4

LED	Status	Function
Solar LED (Red)	On	Solar panel is correctly connected, but not charged
	Flash(0.2s/0.2s)	Charging
	Off	Night
Battery LED (Blue)	On	Battery is normal
	Flash(0.2s/0.2s)	Over temperature
Battery Capacity LED (Red, yellow, Green, Green)	Soc1 Flash(0.2s/0.2s, Red)	Low voltage protection
	Soc4 Flash(0.2s/0.2s, Green)	Over voltage protection
	Soc1 On	Battery capacity < 20%
	Soc2 On	20% < Battery capacity < 50%
	Soc3 On	50% < Battery capacity < 90%
	Soc4 On	Battery capacity > 90%

# 9, Protection, Troubleshooting and maintenance

## 9.1 Troubleshooting

Faults	Reason	Troubleshooting
 E1 	Battery Low Voltage	Charging battery.
 E2 	Battery Over Voltage	Check if other sources overcharge the battery. If not, controller is damaged.
 E3 	Over Temperature	After the temperature decreases, the controller will work normally.
 E4	PV Over Current	Check whether the solar panel power exceeds the maximum power limitation. If yes, change the solar panel.
 E5 	Battery Over Voltage (No solar connection)	Check if other sources overcharge the battery. If not, controller is damaged.
 E6 	PV Over Voltage	Check whether the solar panel voltage exceeds the maximum voltage limit. If yes, change the solar panel.

	All icons light up	1.Please check whether the battery voltage is within the correct voltage range, and try to increase or reduce the battery voltage. 2.For a non-lithium battery system, all ICONS will be displayed when only PV is connected. Check whether the battery is properly connected.
	All icons light off	Please ensure that the battery voltage is greater than 3V, and check that all cables are installed correctly, otherwise the controller will not work.

## 9.2 Protection

Protection	Description
PV Over Current	When the charging current of the PV array exceeds the controller' s rated current, it will be charged at the rated current.
PV Short Circuit	When PV short circuit occurs, the controller will stop charging. Remove it to start normal operation.
PV Reverse Polarity	Fully protection against PV reverse polarity, no damage to the controller. Correct the connection to start normal operation.
Night Reverse Charging	Prevents the battery from discharging to the PV array at night.
Battery Reverse Polarity	Fully protection against battery reverse polarity, no damage to the controller. Correct the connection to start normal operation.
Battery Over voltage	If there are other energy sources to charge the battery, the battery voltage may exceeds the rated data, the controller will stop charging to protect the battery from overcharging damage.
Battery Over discharge	When battery voltage drops to the setting voltage point of Low Voltage Disconnect ,the controller will alarm.
Over Temperature Protection	The controller detects the internal temperature through internal sensor, when the temperature exceeds the setting value, the charging current will lower down followed by the decrease of temperature, so as to control the controller' s temperature rise, when the internal temperature exceeds the setting over temperature protection threshold, the controller stops working and restores after the temperature is lowered.

## 9.3 Maintenance

The following inspections and maintenance tasks are recommended at least two times per year for best performance.

- Make sure no block on air-flow around the controller. Clear up any dirt and fragments on radiator.
- Check all the naked wires to make sure insulation is not damaged. Repair or replace some wires if necessary.
- Tighten all the terminals. Inspect for loose, broken, or burnt wire connections.
- Check and confirm that LCD is consistent with required. Pay attention to any troubleshooting or error indication .Take corrective action if necessary.
- Confirm that all the system components are ground connected tightly and correctly.
- Confirm that all the terminals have no corrosion, insulation damaged, high temperature or burnt/discolored sign, tighten terminal screws to the suggested torque.
- Check for dirt, nesting insects and corrosion. If so, clear up in time.

## 10, Technical Data

### 10.1 Electrical Parameters

Item	ACO300-NBT
System Voltage	12V
Max Charging Power	300W
Max volt on Bat. Terminal	20V
Max volt on PV Terminal	25V
Temp. Compensation	-4.17mV/K per cell (Boost, Equalization), -3.33mV/K per cell (Float)
Self consumption	<10mA
Communication	Bluetooth
Grounding	Common Negative
Dimensions	142 * 94 * 27mm
Weight	217g
Mounting	Vertical Wall Mounting
Mounting dimensions	132 * 64mm
Mounting hole size	φ4mm
Maximum Terminals Wire Size	10AWG(4mm <sup>2</sup> )
Ambient temperature	-20 ~ +55°C
Storage temperature	-25 ~ +80°C
Ambient humidity	0 ~ 100%RH
Protection degree	IP65
Max Altitude	4000m
Electrical Protection and Feature	Spark-free Protection. Reverse polarity solar and battery connection. Reverse current from battery to solar panel protection at night Over temperature protection with derating charging current Transient overvoltage protection at solar input and battery output protects against surge voltage

## 10.2 Charging Parameters

### 10.2.1 Default battery Parameters

Battery Type	AGM	GEL	WET	Calcium	LiFePO4	Li-ion	LTO
Fast Voltage	9.0V~14.0V, Current = Rated Charge Current						
Boost Voltage *1	14.4V	14.1V	14.7V	14.9V	14.4V	12.6V	14.0V
Equalization Voltage *2	N/A	N/A	15.0V	15.0V	N/A	N/A	N/A
Float Voltage	13.6V	13.6V	13.6V	13.6V	N/A	N/A	N/A
Under Voltage Recharging	12.5V	12.5V	12.5V	12.5V	14.2V	12.4V	13.8V
Low Voltage Disconnect	11.0V	10.8V	11.0V	11.0V	10.4V	9.0V	10.0V
Over Voltage Protection	15.8V	15.8V	15.8V	15.8V	14.6V	12.8V	14.2V

### 10.2.2 Battery Parameters can be set

Battery Type	AGM	GEL	Liquid	Lithium
Fast Voltage	9.0V~14.0V, Current = Rated Charge Current			
Boost Voltage *1	14.0~14.8V	14.0~14.8V	14.0~14.8V	10.0~17.0V
Equalization Voltage *2	N/A	N/A	14.0~15.0V	N/A
Float Voltage	13.0~14.5V	13.0~14.5V	13.0~14.5V	N/A
Under Voltage Recharging	12.5V	12.5V	12.5V	9.2~16.8V
Low Voltage Disconnect	10.8~11.8V	10.8~11.8V	10.8~11.8V	8.0~15.0V
Over Voltage Protection	15.8V	15.8V	15.8V	10.2~17.2V

\*1. For LiFePO4, Li-ion, LTO and Lithium battery, the constant voltage time is 1 Hour.  
For Liquid, AGM, GEL, WET and Calcium battery, the maximum constant voltage time is 2 Hours,  
If charging current < 0.5A and holds for 1min, the charging state will end.

\*2. Only Liquid, WET and Calcium batteries have equalization charging stage, 2 hours maximum.  
Conditions for entering the equalization charging stage: If the battery voltage discharge below 12.1V or without equalization charging stage for 30 days.

\*3. This parameters are in the 12V system at 25°C.