# BAC06S

# SOLAR BATTERY CHARGER

# USER MANUAL




SMARTGEN (ZHENGZHOU) TECHNOLOGY CO.,LTD.

Chinese trademark

SmartGen English trademark

**SmartGen —**make your generator ***smart***

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**Software Version**

| Date | Version | Content |
|---|---|---|
| 2017-07-20 | 1.0 | Original release. |
| | | |
| | | |
| | | |

# CONTENT

## 1. OVERVIEW

BAC06S solar battery charger adopts the latest switch power components and uses MPPT algorithm with perturbation incremental method, which is specially designed for charging lead-acid starting battery according to its property. It is suitable for lead-acid battery (12V/24V) long-term float charge by the sunlight.

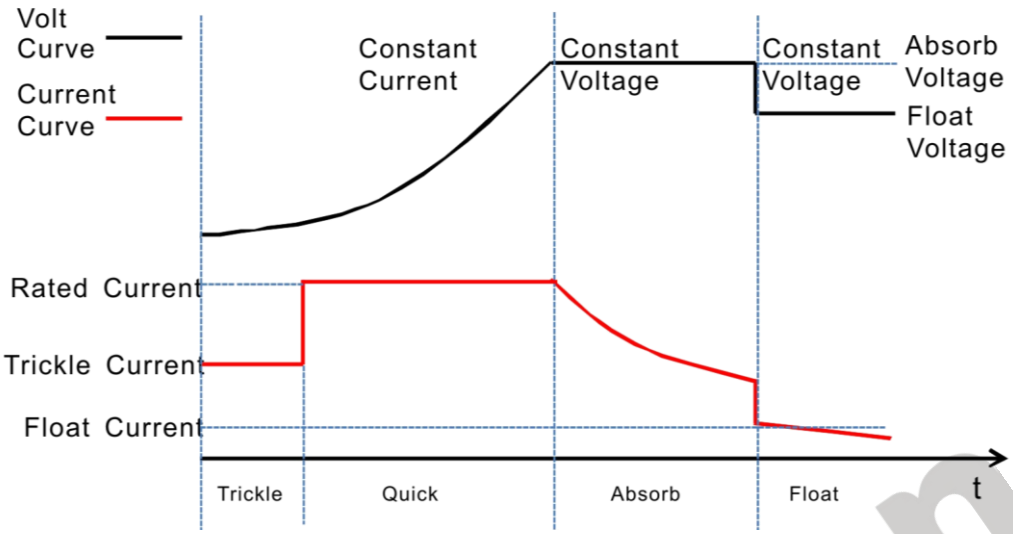
## 2. PERFORMANCE AND CHARACTERISTICS

a) Suitable for 12V/24V battery charging use, users can adjust output voltage and current as required;
b) Using step-down BACK switch power supply structure, small size, light weight and high efficiency;
c) Innovative Maximum Power Point Tracking (MPPT) technology with high tracking efficiency, and effectively improve the amount of solar power generation.
d) Excellent heat dissipation performance, natural convection air, high reliability and without noise;
e) With optional battery charging mode and CVCC mode (Power Mode);
f) 2-stage or 3-stage charging method can be choose as require, and both methods are designed for charging lead-acid battery according to its property to prevent battery overcharge and maximize the battery life;
g) With short circuit and reverse connection protection;
h) Load output port with over/under voltage and over current protections, if solar voltage is too low (night), load starts output;
i) With charge fail or battery low voltage output port;
j) RS485 communication port adopts MODBUS protocol. User can set parameters and remote monitor charging status via communication interface.

## 3. SPECIFICATION

| Category | Items | Parameter | |
|---|---|---|---|
| System | Voltage | 12V | 24V |
| Input | Max. Input Voltage | DC48V | |
| | Max. Input Power | 160W | 320W |
| | Efficiency | ⩽96% | ⩽97% |
| | MPPT Efficiency | >99% | |
| Output | Max. Output Voltage | 16V | 32V |
| | Factory Default Float Voltage | 13.8V | 27.6V |
| | Rated Charging Current | 10A | |
| | Max. Load Current | 10A | |
| Working Condition | Working Temp. | (-30~+55)°C | |
| | Storage Temp. | (-40~+85)°C | |
| | Working Humidity | 20%RH~93%RH (no condensation) | |
| Overall Structure | Weight | 0.57kg | |
| | Dimension | 143mm×96mm×55mm (L×W×H) | |

## 4. CHARGING PRINCIPLE



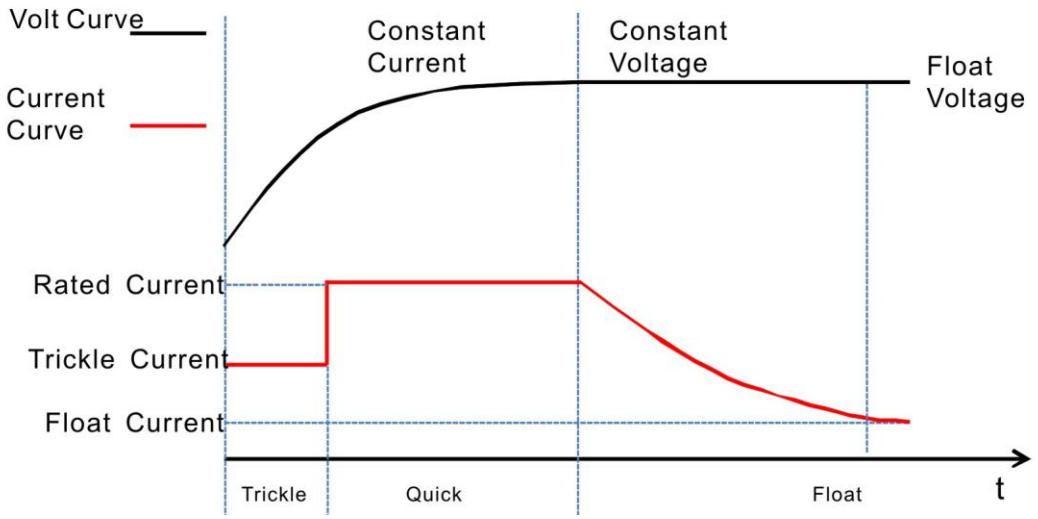

Three-stage Method

Charging is performed according to the battery charging characteristics using three-stage method.

a) The first stage is named as 'constant current': a): Trickle Charge: when the battery terminal voltage is relatively low, then the charging current is low likewise which can prevent the battery temperature is too high. b): Quick Charge: When the battery terminal voltage is relatively high, the charging current will rise to rated value. Large current charging operation leads to an increase in the electricity quantity of the battery.

b) The second stage is named as Absorption Charge: after the first stage, the battery voltage is rise to absorption charge value rapidly, and the charger voltage will keep constant. The battery terminal voltage will stabilize in the absorption charge value with the decreasing of charging current.

c) The third stage is named as Float Charge: After the above two stage, the charge is basically completed and the Float Charge is started automatically. In this stage, the charger voltage reduces to float voltage and the charger current reduces to float value. After that charging current will only neutralize the battery self-discharge. Even long-term charging cannot harm the battery, as charger can keep the battery fully charged and so guarantee long lifetime of the battery.




Two-stage Method

Charging is performed according to the battery charging characteristics using two-stage method.

a) The first stage is named as ‘constant current’: a): Trickle Charge: when the battery terminal voltage is relatively low, then the charging current is low likewise which can prevent the battery temperature is too high. b): Quick Charge: When the battery terminal voltage is relatively high, the charging current will rise to rated value. Large current charging operation leads to an increase in the electricity quantity of the battery.

b) The second stage is named as Float Charge: The charging current will decrease with the rising of battery electricity. As soon as charging current value falls below 0.3A, the battery is basically fully charged. After that charging current will only neutralize the battery self-discharge. Even long-term charging cannot harm the battery, as charger can keep the battery fully charged and so guarantee long lifetime of the battery.

## 5. PARAMETER CONFIGURATION

Basic Parameter Settings,

| No. | Items | Default | | Adjustable Range | | Description |
|---|---|---|---|---|---|---|
| | | 24V | 12V | 24V | 12V | |
| 1 | Battery Type | 2 | | (0~2) | | 0:12V ; 1:24V ; 2:Self-adaption |
| 2 | Charging Stage | 2 | | (2~3) | | 2: Two Stage; 3: Three Stage |
| 3 | Max. Rated Current | 10.0A | | Nonadjustable | | Maximum charging current |
| 4 | Rated Current | 100% | | (0~100)% | | Maximum charging current percentage |
| 5 | Absorption Charge Voltage | 28.2V | 14.1V | (20.0~32.0)V | (10.0~16.0)V | The charging voltage of “Constant Voltage” |
| 6 | Absorption Charge Time | 1 | | (0~1) | | 0: Disable; 1: Enable |
| 7 | Absorption Charge Time Setting | 1.0h | | (0.1~100)h | | The charging time of “Constant Voltage” |
| 8 | Absorption Charge Complete Current | 1 | | (0~1) | | 0: Disable; 1: Enable |
| 9 | Complete Current Setting | 0.5A | | (0.20~3.00)A | | The transition current from “Absorption Charge” transfer to “Float Charge”. |
| 10 | Float Charge Voltage | 27.6V | 13.8V | (20.0~32.0)V | (10.0~16.0)V | The voltage of “Float Charge” |
| 11 | AUTO BOOST Voltage | 25.6V | 12.8V | (20.0~32.0)V | (10.0~16.0)V | When the charger is in “Float Mode”, it enters into “Quick Charge” if the battery voltage has fallen below the set value. |
| 12 | Trickle Charge | 1 | | (0~1) | | 0: Disable; 1: Enable |
| 13 | Trickle Charge Voltage | 22.0V | 11.0V | (20.0~32.0)V | (10.0~16.0)V | The voltage of “Trickle Charge” |
| 14 | Trickle Charge Current | 50% | | (0~100)% | | Maximum charging current percentage |
| 15 | Battery Under Voltage Warn | 1 | | (0~1) | | 0: Disable; 1: Enable |
| 16 | Under Voltage Set Value | 23.0V | 11.5V | (16.0~32.0)V | (8.0~16.0)V | “Under voltage” alarm will be initiated if the |

| No. | Items | Default | | Adjustable Range | | Description |
|---|---|---|---|---|---|---|
| | | 24V | 12V | 24V | 12V | |
| | | | | | | battery voltage falls below the set value. |
| 17 | Under Voltage Delay | 120s | | (0~3600)s | | "Under voltage" alarm will be initiated if the battery voltage falls below the set value and the delay timer has expired. |
| 18 | Under Voltage Return Value | 25.0V | 12.5V | (16.0~32.0)V | (8.0~16.0)V | The transition voltage from "under voltage" transfer to "normal voltage". |
| 19 | Under Voltage Return Delay | 10s | | (0~3600)s | | "Under voltage" alarm will be removed if the battery voltage exceeds the return value and the delay timer has expired. |
| 20 | Communication Address | 10 | | 1~254 | | RS485 communication address |
| 21 | Baud Rate | 0 | | (0~2) | | 0：9600bps；<br>1：19200bps；<br>2：38400bps；<br>one stop-bit, no parity bit |

Load Parameter Settings

| No. | Items | Default | Adjustable Range | Description |
|---|---|---|---|---|
| 1 | Load Output Enabled | 1 | (0-1) | 0: Disable; 1: Enable<br>Control effectiveness of load output, if select “0”, load output port is disabled. |
| 2 | Under Volt Off Load Enabled | 1 | (0-1) | 0: Disable; 1: Enable<br>Setting whether or not to disconnect output if load under voltage. |
| 3 | Undervolt Off Load Voltage Value | 10.0V | (0-42.0)V | The minimum voltage when load disconnect. |
| 4 | Undervolt Off Load Return Value | 11.0V | (0-42.0)V | The voltage value when output restored after load under volt disconnected. |
| 5 | Undervolt Off Load Delay Value | 2.0s | (0-60.0)s | It is delay time that after load voltage falling below the setting off load value, and load disconnect after delay is expired. |
| 6 | Overvolt Off Load Enabled | 1 | (0-1) | 0: Disable; 1: Enable<br>Setting whether or not to disconnect output if load over voltage. |
| 7 | Overvolt Off Load Voltage Value | 29.0V | (0-42.0)V | The maximum voltage when load disconnect. |
| 8 | Overvolt Off Load Return Value | 28.0V | (0-42.0)V | The voltage value when output restored after load over volt disconnected. |
| 9 | Overvolt Off Load Delay | 2.0s | (0-60.0)s | It is delay time that after load voltage exceeding the setting off load value, and load disconnect after delay is expired. |
| 10 | Load Overcurrent Warning Enabled | 1 | (0-1) | 0: Disable; 1: Enable<br>Setting whether or not to initiate warning alarm if load over current. |
| 11 | Load Overcurrent Warning Current Value | 90% | (0-200)% | Load overcurrent warning value. |
| 12 | Load Overcurrent Warning Return Value | 85% | (0-200)% | After load overcurrent warning, if load current falls below the setting point, warning alarm will be cleared. |
| 13 | Load Overcurrent Warning Delay Value | 10s | (0-3600)s | It is delay time that after load current exceeding the setting overcurrent value, and overcurrent warning alarm will be initiated after delay is expired. |
| 14 | Overcurrent Off Load Current Value | 100% | (0-200)% | It is the current value when overcurrent load disconnect. |
| 15 | Overcurrent Off Load Delay Value | 1.0s | (0-60.0)s | It is delay time that after load current exceeding the setting value, and load |

| No. | Items | Default | Adjustable Range | Description |
|---|---|---|---|---|
| | | | | disconnect after delay is expired. |
| 16 | Overcurrent Off Load Action | 1 | (0-1) | 0：Always Disconnect<br>Repower-up to restore.<br>1：Restore after delay<br>Load connected again after the setting delay. |
| 17 | Overcurrent Off Load Restore Delay | 10s | (0-3600)s | Reconnecting load after preset delay. |
| 18 | Working Mode | 0 | (0-1) | 0:Battery Charging Mode<br>1:CVCC Mode<br>CVCC mode is inhibiting to choose when battery is connected to the battery output port. |
| 19 | Volt Value in CVCC Mode | 12.0V | (5.0-42.0)V | Constant voltage value in CVCC mode. |
| 20 | Current Value in CVCC Mode | 100% | (0-100)% | Constant current value in CVCC mode. |
| 21 | Min. Working Volt Off-load | 16.0V | (10.0-45.0)V | Charger starts work when input voltage exceeds the setting value. |
| 22 | Enable Load Output When Low Volt Input | 1 | (0-1) | 0: Disable; 1: Enable<br>If enable this function, load outputs when solar voltage below the level. It is used for night lighting. |
| 23 | Voltage Input When Load Output | 5.0V | (0.0-45.0)V | Load starts output when input voltage falls below the setting point. |
| 24 | Load Output Delay(Low Volt Input) | 10min | (1-600)min | Load starts output when input voltage falls below the setting point after delay is expired. |
| 25 | Volt Input When Load Disconnect | 6.0V | (0.0-45.0)V | Load output disconnect when input voltage exceeds the setting point. |
| 26 | Load Disconnect Delay(Low Voltage Input) | 10min | (1-600)min | Load disconnect when input voltage exceeds the setting point after delay is expired. |

## 6. COMMUNICATION PROTOCOL

BAC06S solar battery charger equips with RS485 port, its parameters can be configured via PC software, and group-net communication also can be realized to achieve status information of solar battery charger. Communication protocol is MODBUS RTU with default baud rate 9600bps, no parity, 1 stop-bit, and default communication address is 10 (baud rate and communication address can be modified via PC software).

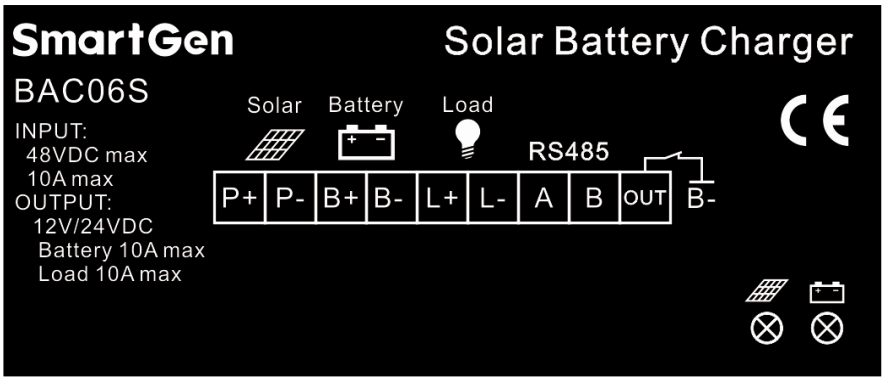
Communication protocol is as follows,

| Address | Item | Function Code | Description | Remark |
|---|---|---|---|---|
| 1000 | Reserved | 03H | | |
| 1001 | Output Current | 03H | Signed(*100) | |
| 1002 | Output Voltage | 03H | Signed (*100) | |
| 1003 | Reserved | 03H | | |
| 1004 | Reserved | 03H | | |
| 1005 | Reserved | 03H | | |
| 1006 | Charging Status | 03H | 0:Standby;<br>1:Trickle Charge;<br>2:Quick Charge;<br>3:Absorption Charge;<br>4:Float Charge | |
| 1007 | Reserved | 03H | | |
| 1008 | Reserved | 03H | | |
| 1009 | Reserved | 03H | | |
| 1010 | Reserved | 03H | | |
| 1011 | Reserved | 03H | | |
| 1012 | Reserved | 03H | | |
| 1013 | Reserved | 03H | | |
| 1014 | Reserved | 03H | | |
| 1015 | Battery Type | 03H | 0:12V<br>1:24V | |
| 1016 | Reserved | 03H | | |
| 1017 | Reserved | 03H | | |
| 1018 | Reserved | 03H | | |
| 1019 | Reserved | 03H | | |
| 1020 | Common Alarm | 03H | 0: Disable; 1: Enable | (LSB) |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Fail to Charge | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Battery Under Volt Warning | | 0: Disable; 1: Enable | |

| Address | Item | Function Code | Description | Remark |
|---|---|---|---|---|
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | （MSB） |
| 1021 | Input Voltage (no solar energy) | 03H | 0: Disable; 1: Enable | (LSB) |
| | Output (no battery) | | 0: Disable; 1: Enable | |
| | Solar Under Voltage | | 0: Disable; 1: Enable | |
| | Solar Over Voltage | | 0: Disable; 1: Enable | |
| | Load Undervolt Disconnect | | 0: Disable; 1: Enable | |
| | Load Overcurrent Disconnect | | 0: Disable; 1: Enable | |
| | Load Output Connect | | 0: Disable; 1: Enable | |
| | Load Overcurrent Warning | | 0: Disable; 1: Enable | |
| | Load Overvolt Disconnect | | 0: Disable; 1: Enable | |
| | Input Low Volt Load Connect | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | |
| | Reserved | | 0: Disable; 1: Enable | （MSB） |
| 1022 | Reserved | | | |
| 1023 | Reserved | | | |
| 1024 | Reserved | | | |
| 1025 | Reserved | | | |
| 1026 | Reserved | | | |
| 1027 | Reserved | | | |
| 1028 | Reserved | | | |
| 1029 | Reserved | | | |
| 1030 | No-load Solar Voltage | 03H | Signed(*100) | |
| 1031 | Solar Voltage | 03H | Signed (*100) | |
| 1032 | Solar Current | 03H | Signed(*100) | |
| 1033 | Load Current | 03H | Signed (*100) | |
| 1034 | Output Target Voltage | 03H | Signed(*100) | |

| Address | Item | Function Code | Description | Remark |
|---|---|---|---|---|
| 1035 | Output Target Current | 03H | Signed (*100) | |
| 1036 | Solar Power | 03H | Signed(*10) | Unit: W |
| 1037 | Output Power | 03H | Signed (*10) | Unit: W |
| 1038 | Load Power | 03H | Signed (*10) | Unit: W |
| 1039 | Solar Accumulate Energy | 03H/06H | Unsigned (*1000) | Unit: kWh |
| 1040 | | | | |
| 1041 | Output Accumulate Energy | 03H/06H | Unsigned (*1000) | Unit: kWh |
| 1042 | | | | |
| 1043 | Load Accumulate Energy | 03H/06H | Unsigned (*1000) | Unit: kWh |
| 1044 | | | | |

## 7. TERMINAL DEFINITION



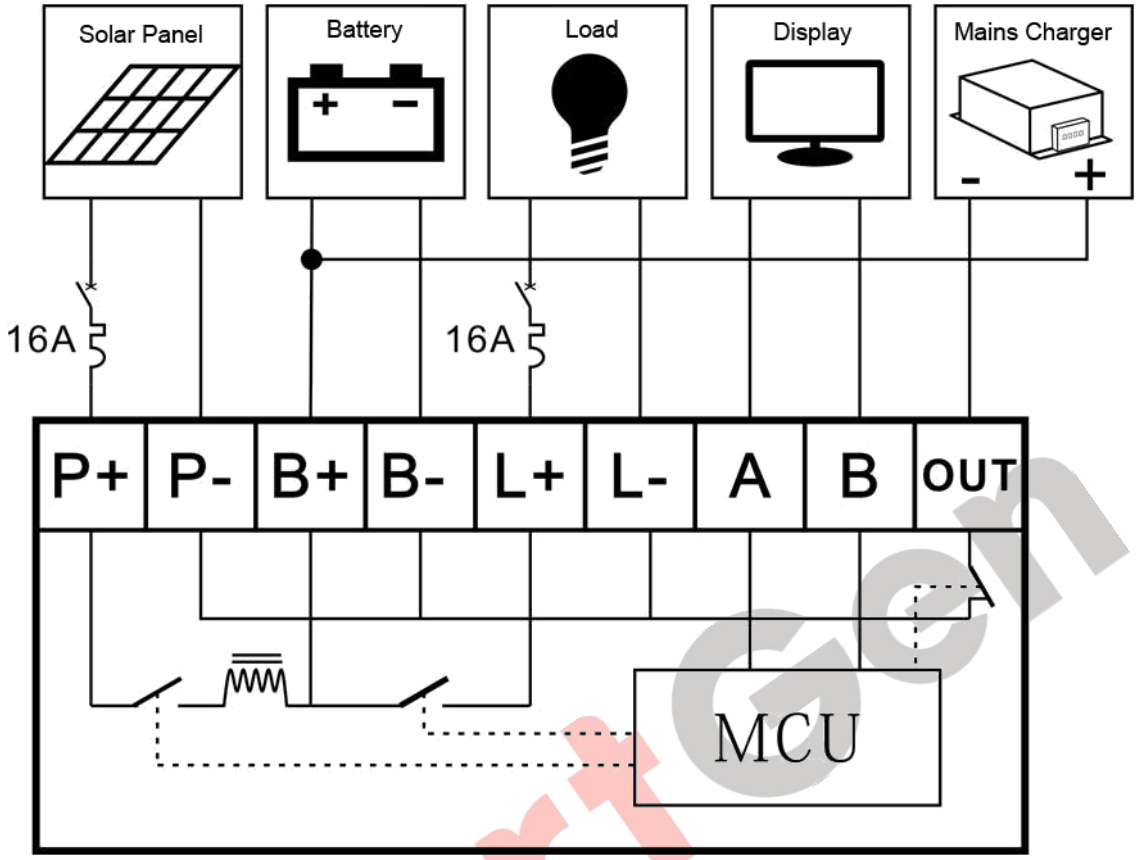

BAC06S Mask

| Terminal | Function | Description |
|---|---|---|
| P+ | Solar Power + | Connect to solar cell panel output |
| P- | Solar Power- | |
| B+ | Battery + | Connect with the battery to be charged |
| B- | Battery - | |
| L+ | Load + | Supply power to load |
| L- | Load - | |
| A | RS485 + | RS485 communication port |
| B | RS485 - | |
| OUT | Output Port | Normally closed, internal normally closed port connect with B-; It is output when charger cannot charge the battery after 60s delay expired (charge failure output); if battery under volt warning enabled, it is output only when detect battery under volt warning alarms. |
| | Solar Indicator | Indicator lights up if solar cell panel correctly connect and solar voltage exceeds 6V. If load over current, battery indicator and solar indicator flash per 0.5s. |
| | Battery Indicator | Indicator lights up if battery correctly connect to the battery and battery voltage exceeds 3V;<br>If fail to charge, battery indicator flashes per 0.5s;<br>If load over current, battery indicator and solar indicator flash per 0.5s. |

**NOTE 1: During gen-set is running, high charging current will cause voltage drop in charging line, so recommend separately connecting to battery terminal to avoid disturbance on sampling precision.**

**NOTE 2: Power connection order: connecting battery firstly and then solar panel; Power disconnection order: disconnecting solar panel firstly, and then battery. Please follow the correct sequence to connect/disconnect power and inhibit to operate energized connection cable in case of damaging the battery.**

## 8. APPLICATION




APPLICATION INSTRUCTION:

**Solar** Choose 18V or 36V solar panel, please reference solar type as below.

**Battery** Choose 12V or 24V battery (24V battery cannot be charged while using 18V solar panel).

**Load** Used for controlling lighting lamps to provide lighting in the dark, and also available for other functional load.

**Display** Connecting monitoring device to portA and portB of RS485 to display the charging status data.

**Mains Charger** Mains charger can be backup power supply for the battery, if battery volt is too low caused by the solar cells fault, heavy load, and long-term un-sufficient energy. It is avoiding the battery to over discharge. Internal of output port is normally closed point of relay, and another end of normally closed point is connecting with B-, which connect when low battery volt occurs.

## 9. SOLAR PENAL SELECTION

Solar panel type selection needs to base on conditions of the load power, battery voltage and capacity, and battery power consumption.

a) **Solar Panel Voltage Confirmation**

Firstly, according to the battery voltage to choose solar panel voltage (for 12V rechargeable battery, conventional 18V or 36V, and unconventional 16V~48V solar panels can be choose; for 24V battery, conventional 36V, and unconventional 32V~48V solar panels can be choose). No-load output voltage of solar panel cannot exceed 48V.

b) **Solar panel Power Confirmation**

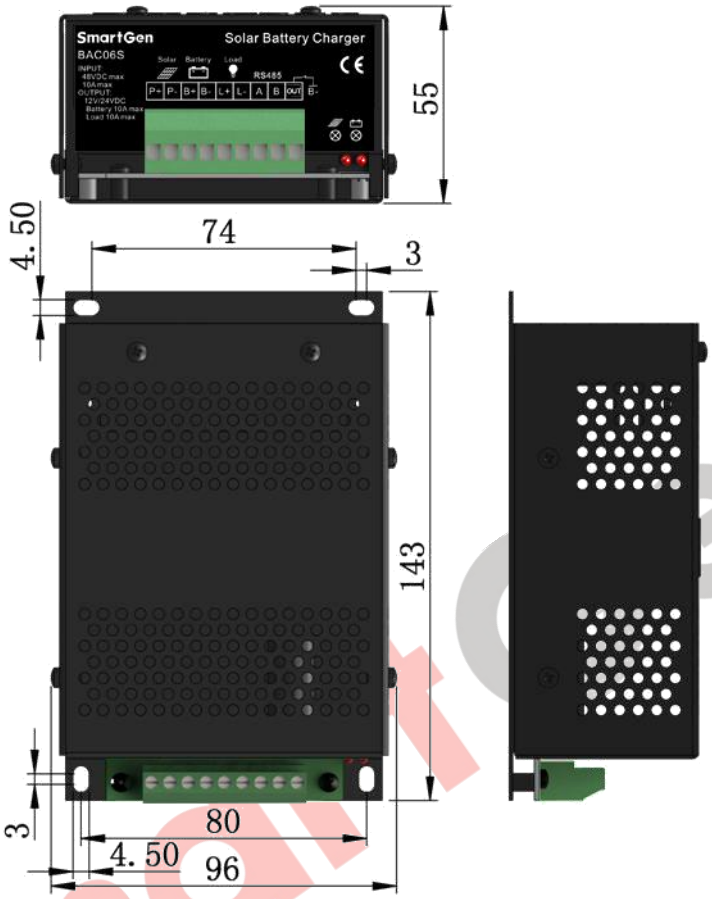
- Solar panel power > Daily power consumption (WH)/ Solar effective illumination time per day (H)/Actual utilization of solar panel power(%);
- Daily power consumption (WH)= Load power (W)* Working time (T) + Battery daily average power consumption (WH);
- Solar effective illumination time per day (usually 8 hours), if more rainy days, illumination time can be appropriately shorter.
- Actual utilization of solar panel power, which is the ratio of average daily output power of solar energy to solar penal nominal power, is commonly can be 50%. It is related to the local light intensity and installation angle, and the best mounting angle for sola panel is perpendicular to the sun. However, along with the sunlight move, light angle also changes, users can choose the best installation angle with the help of searching the internet (commonly according to the local latitude and longitude to select and optimal fixed angle).

c) **Charging Current Confirmation**

Battery charging current is always below 10% of battery capacity. Like for 100Ah battery, charging current can be set as 10A.

## 10. CASE DIMENSIONS

Unit: mm




BAC06S Mounting Dimensions

## 11. TROUBLE SHOOTING

| Troubles | Solutions |
|---|---|
| Solar indicator does not light | Check solar panel wiring connection;<br>Solar Panel failure; |
| Battery indicator does not light | Check battery connection;<br>Battery failure or battery deficit; |
| Battery indicator flashes | Check solar panel wiring connection;<br>Solar Panel failure;<br>Solar panel output voltage falls below battery voltage; |
| Both solar indicator and battery indicator flash | load over current, ramp-off the load; |
| Communication Failure | Check RS485 wiring connection;<br>Check whether the communication address and baud rate settings are consistent. |