



VS BN series

---Solar Charge Controller

User Manual



Model:
VS4524BN

Important Safety Instructions

Please keep this manual for future review.

This manual contains all instructions on safety, installation, and operation for VS BN series controller ("the controller" as referred to in this manual).

General Safety Information

- Read all the instructions and warnings carefully in the manual before installation.
- No user-serviceable components exist inside the controller. DO NOT disassemble or attempt to repair the controller.
- Mount the controller indoors. Avoid exposure to the components and do not allow water to enter the controller.
- Install the controller in a well-ventilated place. The controller's heat sink may become very hot during operation.
- Suggest installing appropriate external fast-acting fuses/breakers.
- Ensure to switch off all PV array connections and the battery fast-acting fuses/breakers before controller installation and adjustment.
- Power connections must remain tight to avoid excessive heating from a loose connection.



WARNING

Do not install the controller in humid, salt spray, corrosion, greasy, flammable, explosive, dust accumulative, or other severe environments.

CONTENTS

1 General Information	1
1.1 Overview	1
1.2 Characteristics	2
2 Installation Instructions	3
2.1 General Installation Notes	3
2.2 Installation and Wiring	3
3 HMI Interface	6
3.1 Button	6
3.2 Indicator	6
3.3 Operation Interface	7
4 Accessories (optional)	18
5 Others	20
5.1 Protection	20
5.2 Troubleshooting	21
5.3 Maintenance	23
6 Technical Specifications	24
Annex Mechanical Dimension Diagram	25

1 General Information

1.1 Overview

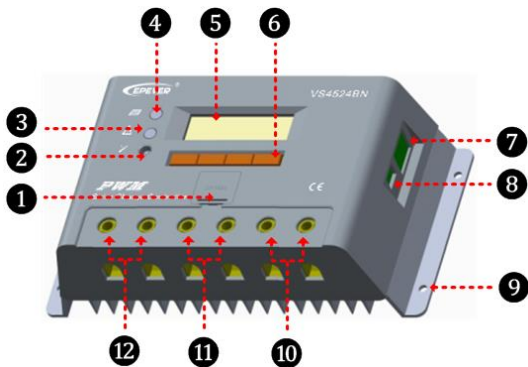
VS BN series solar charge controller adopts advanced digital control technology, LCD, and automatic operation. With the features of Pulse Width Modulation (PWM) battery charging and unique control technology, the controller will improve the long battery life efficiently. Our controller has many unique features and easy to use.

The controller could charge a battery and discharge automatically for off-grid photovoltaic (PV) systems. The charging process has been optimized for long battery life and improved system performance. The comprehensive self-diagnostics and extensive electronic protection can prevent damage against incorrect wiring or system faults.

Features:

- 12/24VDC & automatically identifying system voltage
- 3-Stage Intelligent PWM charging: Bulk, Boost/Equalize, Float
- Support 4 charging options: Sealed, Gel, Flooded, and user
- Lithium battery self-activating function
- Battery temperature compensation function
- Actual power display and record function
- The new SOC method calculates the battery capacity accurately
- Wide feasibility and recognize day or night automatically
- Several load control methods
- Hundred percent full load operation in working environment temperature range within charging & discharging
- Extensive electronic protections
- Graphical dot-matrix LCD and 4 buttons combinations as HMI (human-machine interface) for full menu and easy operation
- RS-485 ports via the open standard Modbus protocol are supported for long-distance communication and communication compatibility
- Monitoring and setting parameters via Mobile APP, PC Monitor setting software

1.2 Characteristics



①	Battery slot (battery model is CR1220-3.3V)	⑦	RS485 communication port
②	Local temperature sensor	⑧	RTS★port
③	Fault LED indicator	⑨	Mounting Hole Φ 4mm
④	Charging LED indicator	⑩	Load Terminals
⑤	LCD	⑪	Battery Terminals
⑥	Buttons	⑫	PV Terminals



★The controller charges and discharges the battery at the local temperature sensor when the remote temperature sensor doesn't connect. If the remote temperature sensor is damaged, the controller will be charging or discharging at the default temperature of 25°C.

2 Installation Instructions

2.1 General Installation Notes

- Read through the entire installation section first before beginning installation.
- Be very careful when working with batteries. Wear eye protection. Have fresh water available to wash and clean any contact with battery acid.
- Uses insulated tools and avoid placing metal objects near the batteries.
- Explosive battery gasses may be present during charging. A well-ventilation of the battery box is recommended.
- Avoid direct sunlight and do not install in locations where water can enter the controller.
- Do not install the controller in humid, salt spray, corrosion, greasy, flammable, explosive, dust accumulative, or other severe environments.
- Loose power connections and/or corroded wires may result in resistive connections that melt wire insulation, burn surrounding materials, or even cause a fire. Ensure tight connections and use cable clamps to secure cables and prevent them from swaying in mobile applications.
- Gel, Sealed, or Flooded batteries are recommended, other kinds, please refer to the battery manufacturer.
- The battery connection may be wired to one battery or a bank of batteries. The following instructions refer to a singular battery. However, it is implied that the battery connection can be made to either one battery or a group of batteries in a battery bank.
- Select the system cables according to $3.5A/mm^2$ current density.

2.2 Installation and Wiring

 WARNING	Risk of explosion! Never install the controller in a sealed enclosure with flooded batteries! Do not install in a confined area where battery gasses can accumulate.
 CAUTION	The VS BN controller requires at least 150mm of clearance above and below for proper airflow. Ventilation is highly recommended if mounted in an enclosure.

Installation Procedure:

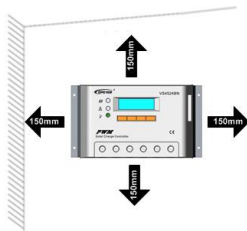


Figure 2-1 Mounting

Step 1: Determination of the installation location and heat-dissipation space

The controller shall be installed in a place with sufficient airflow through the radiators of the controller and a minimum clearance of 150 mm from the upper and lower edges of the controller to ensure natural thermal convection. Please see Figure 2-1: Mounting



CAUTION

If the controller is installed in an enclosed box, it is important to ensure reliable heat dissipation through the box.

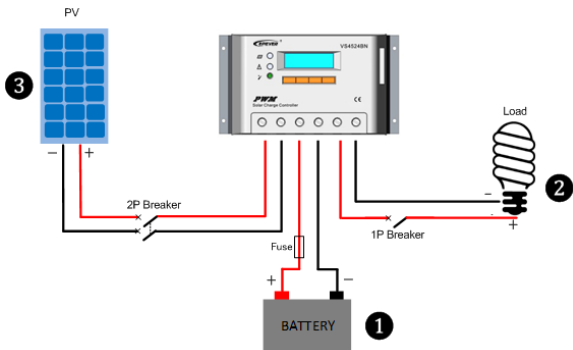





Figure 2-2 Schematic of wiring diagram

Step 2: Connect the system in the order of ① battery → ② load → ③ PV array by Figure 2-2, "Schematic Wiring Diagram" and disconnect the system in the reverse order ③ ② ①.

 WARNING	<ul style="list-style-type: none"> • Risk of explosion or fire! Never short circuit battery positive (+) and negative (-) or cables. • Risk of electric shock! Exercise caution when handling solar wiring. The solar module(s) high voltage output can cause severe shock or injury. Be careful operation when installing solar wiring.
 CAUTION	<ul style="list-style-type: none"> • While wiring the controller, do not close the circuit breaker or fast-acting fuse and ensure that the leads of "+" and "-" poles are connected correctly. • A fast-acting fuse whose current is two times the rated controller current is needed. • The controller is a common negative one. • Don't connect the loads with surge power exceeding the ratings. • Secure all wiring for mobile applications. Use cable clamps to prevent cables from swaying. Unsecured cables create loose and resistive connections, which may lead to excessive heating and fire.


Step 3: Grounding

VS BN series is a common-negative controller. All the negative terminals of the PV array, battery, and load can be grounded simultaneously, or any one of them will be grounded. However, according to the practical application, all the negative terminals of the PV array, battery, and load can also be ungrounded. However, the grounding terminal on its shell must be grounded. It can effectively shield the electromagnetic interference from the outside and prevent some electric shock to the human body.

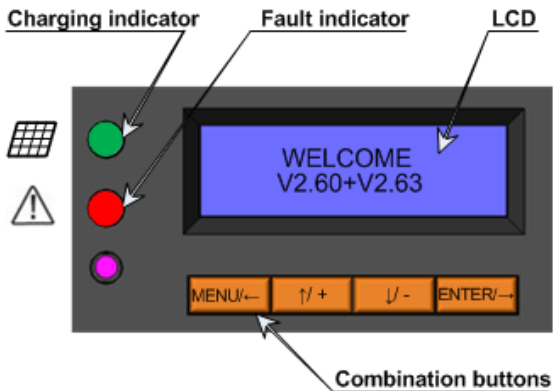
 CAUTION	<p>For common-negative systems, such as motorhomes, it is recommended to use a common-negative controller. However, if some common-positive equipment is used in the common-negative system, and the positive electrode is grounded, the controller may be damaged.</p>
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Step 4: Powered on the controller





Closing the battery fast-acting fuse will switch on the controller. Then check the battery indicator status (the controller is operating normally when the indicator is lit in green). Close the fast-acting fuse and circuit breaker of the load and PV array. Then the system will be operating in the preprogrammed mode.

 CAUTION	<p>If the controller is not operating properly or the battery indicator on the controller shows an abnormality, please refer to 5.2 "Troubleshooting."</p>
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3 HMI Interface





3.1 Button

Button		Note
	Menu	Cursor left button
	Cursor up	Number add button
	Cursor down	Number reduce button
	Enter	cursor right button

3.2 Indicator

Indicator	Color	Status	Instruction
	Green	On Solid	Charging

	Red	Flashing (6Hz)	PV: Measure Err, MOS-I Short, MOS-C Short, MOS Break <hr/> BATT: OVD, Over-Temp <hr/> LOAD: Overload, Short, MOS Short <hr/> DEVICE: Over Temp
	Green & Red	Flashing (6Hz)	BATT: Rated V Err

3.3 Operation Interface

1) Initialization Interface

When the controller is powered on, the following picture will be painted during the initialization:

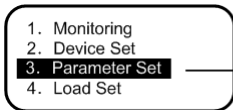


2) Main Menu Interface


After the controller is initialized, the monitoring interface will update automatically. Press



button to main menu 1 interface, which displays the following contents:

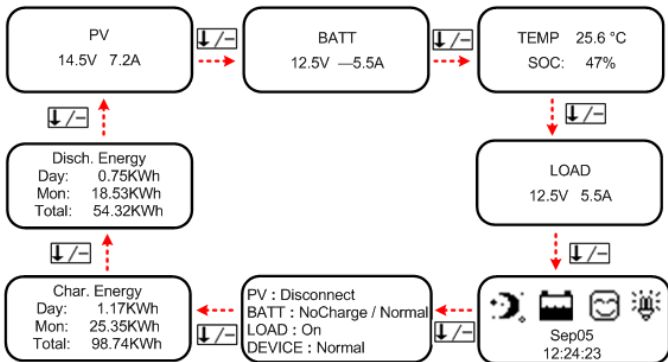


Inverse cursor showing the contents can be operated

Press  button to enter into main menu 2 and main menu 3 interface, which displays the following contents:

- 5. Rated Value**
 6. Test Mode
 7. Password
 8. Batt Mng Mode
- 9. Factory Reset**
 10. Reboot Device

3) Monitoring



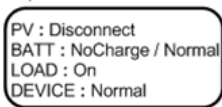
Display: Solar array voltage and current → Battery voltage and current → Battery temperature and battery SOC → Load voltage and current → Real-time clock and imaging system status → System status → Charging energy statistics → Discharging energy statistics



System status icons:

Icons	Status	Icons	Status
	Day		ON
	Night		OFF
	Charging		Normal
	Normal		UVW
	LVD		LVD

▲ Icons indicating battery charging are dynamic effects.



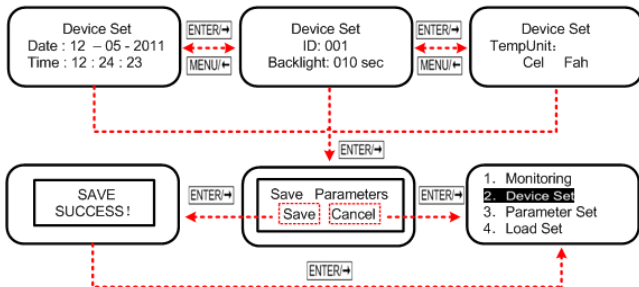
System status:

System	Status	System	Status
PV	Connect	BATT	LVD
	Measure Err★		Normal
	MOS-C Short★		Rated V Err★
	Disconnect		UVW
	MOS-I Short★		OVD★
	MOS Break★		Over Temp★
BATT	Equalize	LOAD	On

charging status	Float		Over Load★
	Boost		Off
	No Charge		Short★
DEVICE	Normal		MOS Short★
	Over Temp★		

★When fault with inverse cursor above exists for 2 minutes along without any operation, it will jump into that page automatically.

4) Device Set





Display: Date set→ID and LCD backlight time set→TempUnit set

● Device parameters

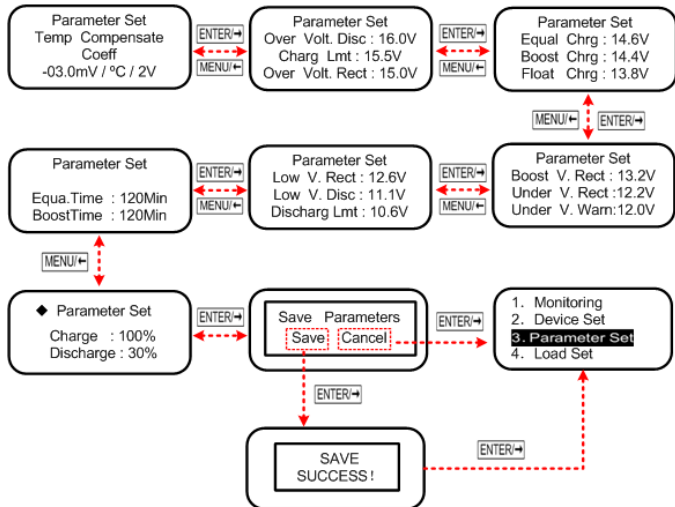
Parameter	Detail
ID	Range: 1~200
Clock	Format: dd-mm-yyyy hh-mm-ss
Password	Default: 000000

● Clear Energy

Press and hold both  and  buttons for 3 seconds to enter factory mode in the main interface. The authority code to clear Energy Log is 102206 as default. The clear operation can't be recalled, so take care!

Device Set
ID : 001
Backlight : 060sec
Energy Log : Clear

5) Parameter Set



◆ The interface will prompt only when the SOC is selected in the Batt Mng Mode.

Display: Temperature compensation coefficient → Control parameters interface 1/2/3/4/5

● Lead-acid battery parameters

The parameters are in the 12V system at 25 °C; please double the values in the 24V system.

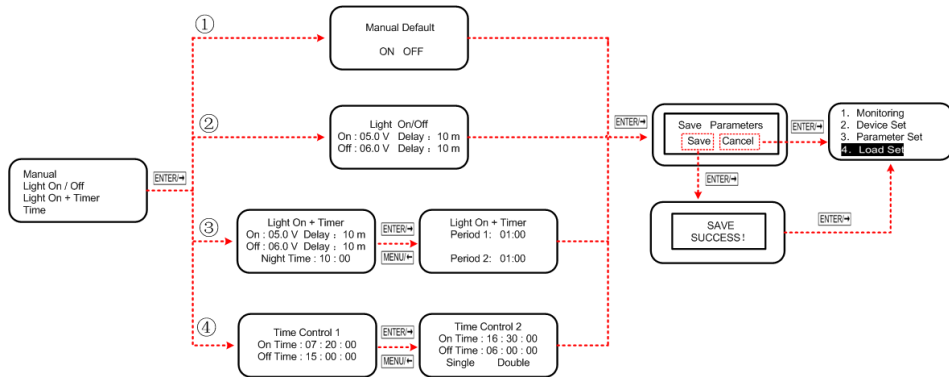
Voltage	Battery type			
	Sealed	Gel	Flooded	User
Over Voltage Disconnect Voltage	16.0V	16.0V	16.0V	9~17V
Charging Limit Voltage	15.0V	15.0V	15.0V	9~17V

Over Voltage Reconnect Voltage	15.0V	15.0V	15.0V	9~17V
Equalize Charging Voltage	14.6V	—	14.8V	9~17V
Boost Charging Voltage	14.4V	14.2V	14.6V	9~17V
Float Charging Voltage	13.8V	13.8V	13.8V	9~17V
Boost Reconnect Charging Voltage	13.2V	13.2V	13.2V	9~17V
Low Voltage Reconnect Voltage	12.6V	12.6V	12.6V	9~17V
Under Voltage Warning Reconnect Voltage	12.2V	12.2V	12.2V	9~17V
Under Voltage Warning Voltage	12.0V	12.0V	12.0V	9~17V
Low Voltage Disconnect Voltage	11.1V	11.1V	11.1V	9~17V
Discharging Limit Voltage	10.6V	10.6V	10.6V	9~17V
Equalize Duration	120 min	—	120 min	0~180 min
Boost Duration	120 min	120 min	120 min	10~180 min

Note:

- 1) When the battery type is sealed, gel, flooded, the adjusting range of equalizing duration is 0 to180 minutes, and boost duration is 10 to180 minutes.
- 2) The following rules must be observed when modifying the parameter's value in user battery type(factory default value is the same as sealed type):
 - a) Over Voltage Disconnect Voltage > Charging Limit Voltage \geq Equalize Charging Voltage \geq Boost Charging Voltage \geq Float Charging Voltage > Boost Reconnect Charging Voltage;
 - b) Over Voltage Disconnect Voltage > Over Voltage Reconnect Voltage;
 - c) Low Voltage Reconnect Voltage > Low Voltage Disconnect Voltage \geq Discharging Limit Voltage;
 - d) Under Voltage Warning Reconnect Voltage > Under Voltage Warning Voltage \geq Discharging Limit Voltage;
 - e) Boost Reconnect Charging Voltage > Low Voltage Reconnect Voltage.

6) Load Set



Display: ① Manual /② Light On/Off /③ Light On +Timer /④ Time

● Threshold voltage value

Night Time Threshold Voltage: 6V/12V,12V/24V

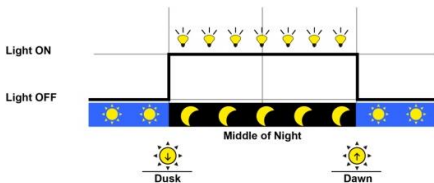
Day Time Threshold Voltage: 5V/12V,10V/24V

- Load working mode

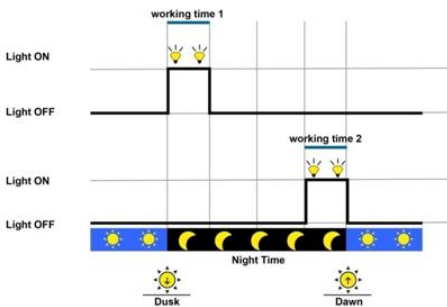
1. Manual(default)

Control ON/OFF of the load via the button or remote commands.

2. Light ON/OFF



3. Light ON +Timer



4. Time

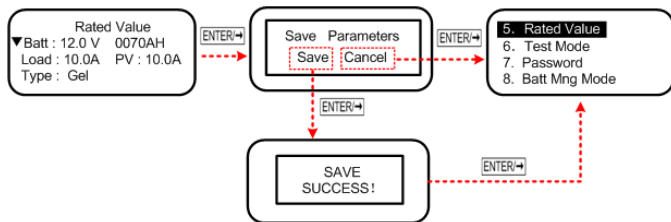
Control the load ON/OFF time by setting the real-time clock.



CAUTION

In the mode of Light ON/OFF and Light ON/Timer, the Load is turned on after 10 Min. Delay.

7) Rated Value



▼ System Nominal Voltage and Battery Rate Setting




Batt	System nominal voltage	Battery capacity range
	12V/24V/Auto	Range :0~9999AH

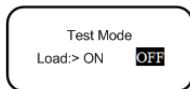
● Battery Type



Battery Type	Note
Sealed (default)	Constant value▲
GEL	Constant value▲
Flooded	Constant value▲
User	Defined by user▲

▲The parameters refer to the Lead-acid battery parameters (Parameter Set).

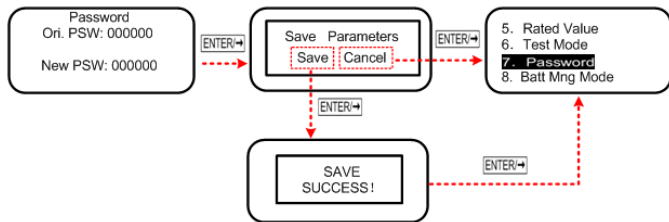
8) Test Mode

Press  or  choose the Test Mode, then press  and enter into test mode interface below:

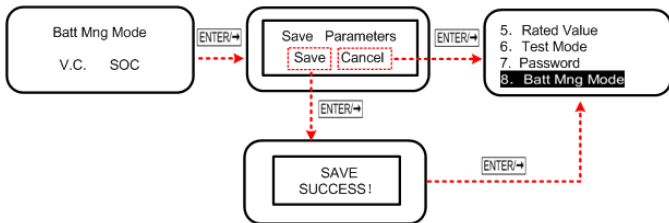


Press  or , when the inverse cursor stays ON/OFF, that is, test on or test off operations.

9) Password



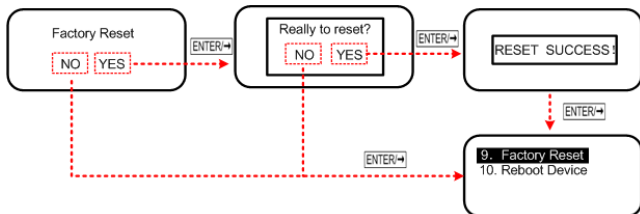
10) Batt Mng Mode



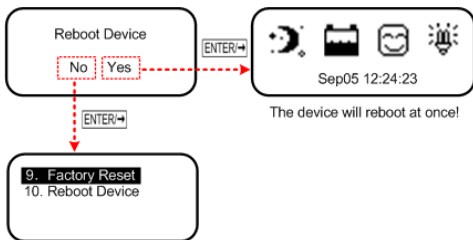
• SOC parameters

Percent of charging	100% constant value
Percent of discharging	10~80%, Low SOC reconnect is higher Low SOC disconnect than 5%







11) Factory Reset



12) Reboot Device



4 Accessories (optional)

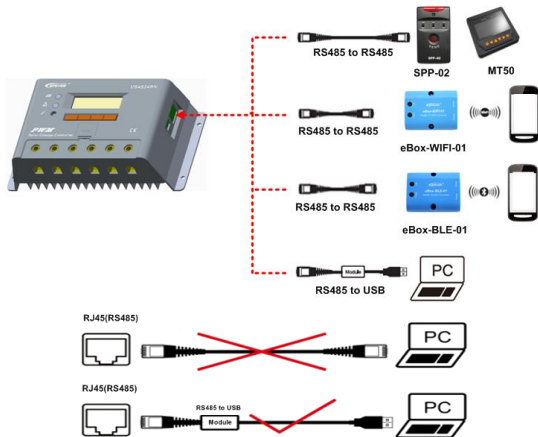
<p>Remote Temperature Sensor (RTS300R47K3.81A)</p>		<p>Acquisition of battery temperature for undertaking temperature compensation of control parameters, the standard length of the cable is 3m (length can be customized). The RTS300R47K3.81A connects to the port (8th) on the controller.</p> <p>NOTE: The temperature sensor is short-circuited or damaged. The controller will be charging or discharging at the default temperature of 25 °C.</p>
<p>USB to RS485 cable CC-USB-RS485-150U</p>		<p>USB to RS485 converter is used to monitor each controller using Solar Station PC software. The length of the cable is 1.5m. The CC-USB-RS485-150U connects to the RS485 Port on the controller.</p>
<p>RS485 to RS485 cable CC-RS485-RS485-200U</p>		<p>RS485 to RS485 converter is used to connect the accessories SPP-02, MT50, eBox-WIFI-01, eBox-BLE-01, the standard length of the cable is 3m (length can be customized).</p>
<p>Super Parameter Programmer SPP-02</p>		<p>SPP-02 can realize a one-key setting parameter operation.</p>
<p>Remote Meter MT50</p>		<p>MT50 can display various operating data and faults in the system. The information can be displayed on a backlit LCD screen. The buttons are easy to operate, and the numeric display is readable.</p>
<p>WIFI module eBox-WIFI-01</p>		<p>After the WIFI module is connected to the controller through a standard Ethernet cable (parallel cable), the operating status and related parameters can be monitored by the mobile APP software through WIFI signals.</p>

Bluetooth module
eBox-BLE-01



After the Bluetooth module is connected to the controller through a standard Ethernet cable (parallel cable), the operating status and related parameters can be monitored by the mobile APP software through Bluetooth signals.

NOTE: For setting and operation of accessory, please refer to accessory's user manual.



Do not use the standard twisted-net cable to connect the device and PC net interface, or permanent damage will occur.

5 Others

5.1 Protection

PV Short Circuit	When not in the PV charging state, the controller will not be damaged if a short-circuiting in the PV array.
PV Reverse Polarity	When the polarity of the PV array is reversed, the controller may not be damaged and can continue to operate normally after the polarity is corrected.
PV Over Voltage	When the PV voltage is higher than 60V, the controller will cut off the charging automatically. When the voltage is lower than 55V, the controller will recover charging. automatically
Charging Battery Cut Off	Disconnect the battery when the controller is charged at rated power, the controller does not be damaged
Load Overload	When the load is overloading (The overload current is ≥ 1.05 times the rated load current), the controller will automatically cut off the output. If the load reconnects automatically, it needs to be cleared by pressing the Load button restarting the controller.
Load Short Circuit	Fully protected against load wiring short-circuit (≥ 2 times rated discharge current) . After five automatic loads reconnect, the fault must be cleared by restarting the controller or pressing the switch button.
Damaged Temperature Sensor	Suppose the temperature sensor is short-circuited or damaged. In that case, the controller will be charging or discharging at the default temperature of 25°C to prevent the battery damaged from overcharging or over-discharged.
Controller Overheating	The controller can detect the temperature inside the battery. The controller stops working when its temperature exceeds 85 °C and restart to work when its temperature is below 75 °C.
TVS High Voltage Transients	The internal circuitry of the controller is designed with Transient Voltage Suppressors (TVS), which can

only protect against high-voltage surge pulses with less energy. Suppose the controller is to be used in an area with frequent lightning strikes. In that case, it is recommended to install an external surge arrester.

5.2 Troubleshooting

Faults	Possible reasons	Troubleshooting
The charging LED indicator is off during the daytime, and the monitor shows Disconnect.	PV Array Disconnection	Check that PV and battery wire connections are correct and tight.
Monitor interface PV shows Measure Err, MOS-I Short, MOS-C Short, MOS Break. Fault indicator flashing	MOS-I Or MOS-C Damage	Please restart the controller; if the fault still exists, switch off the controller immediately and contact the supplier to make maintenance.
Monitor interface BATT shows LVD.	Battery Over Discharged	The controller cuts off the output automatically and recovers when fully charged.
The charging and discharging circuit is off and monitor interface BATT shows OVD. Fault indicator flashing	Battery Over Voltage	switch off the wiring of the solar array and measure the battery's voltage, whether it is too high.
The charging and discharging circuit is off, and the BATT of the monitoring interface shows Over Temp. Fault indicator flashing	Operating Ambient Temperature(local temperature sensor) Or Battery Temperature(remote temperature sensor) Over Temperature	When operating ambient temperature or battery temperature exceeds 65°C, the controller will automatically cut off the input and output circuit. When the temperature is below 55°C, the controller will automatically reconnect the input and output circuit.

Monitor interface BATT shows Rated V Err. Charging indicator and Fault indicator flashing	System Voltage Error	Check whether the battery voltage is consistent with the system voltage set by the controller.
Discharging circuit is off, and the monitor shows Over Load. Fault indicator flashing	Load Overload★	① Please reduce the number of electric equipment. ② Restart the controller.
Discharging circuit is off, and the LOAD monitor shows Short. Fault indicator flashing	The load circuit is short	① Check carefully loads connection, clear the fault. ② Restart the controller.
The charging and discharging circuit is off, and the LOAD of the monitoring interface shows MOS-I Short, Error. Fault indicator flashing	Electronically Component Damage	Please restart the controller. If the fault still exists, cut off the charging and discharging circuit immediately and contact the supplier to make maintenance.
The charging and discharging circuit is off, and the LOAD monitor shows Over Temp. Fault indicator flashing	Controller Overheating	When the temperature of the controller exceeds 85°C, the controller will cut the input and output circuit. When it is below 75°C, the controller will automatically reconnect the input and output circuit.

★ When load power reaches 1.02-1.05 times, 1.05-1.25 times, 1.25-1.35 times, 1.35-1.5 times more than the nominal value, the controller will automatically close loads in 50 seconds, 30 seconds, 10 seconds, and 2 seconds, respectively.

5.3 Maintenance

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

- Check that the airflow and ventilation around the controller are not blocked. Clear all dirt or fragments on the heat sink.
- Check all the naked wires to ensure insulation is not damaged for serious solarization, frictional wear, dryness, insects or rats, etc. Maintain or replace the wires if necessary.
- Check and confirm that LED or LCD is consistent with the required. Pay attention to any troubleshooting or error indication. Take corrective action if necessary.
- Tighten all the terminals. Inspect for loose, broken, or burnt wire connections.
- Confirm that all the terminals have no corrosion, insulation damaged, high temperature, or burnt/discolored sign, tighten terminal screws to the suggested torque.
- Inspect for dirt, insects, and corrosion, and clear up.
- Check and confirm that the lightning arrester is in good condition. Replace a new one in time to avoid damaging the controller and even other equipment.



CAUTION

Dangerous with electric shock!

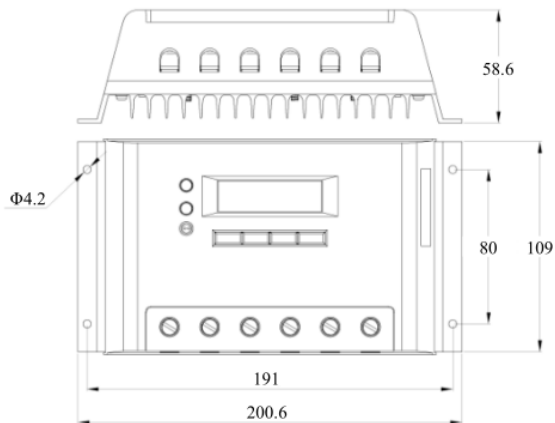
Make sure that all power source of the controller is cut off when operating above processes, make inspection or other operations!

6 Technical Specifications

Item	VS4524BN
System nominal voltage	12/24VDC Auto
Battery voltage range	9V ~32V
Max. PV open circuit voltage	60V
Rated charge current	45A
Rated discharge current	45A
Charge circuit voltage drop	≤0.69V
Discharge circuit voltage drop	≤0.17V
Battery type	Sealed / Gel / Flooded / User
Temperature compensate coefficient	-3mV/°C/2V (25°C)
Self-consumption	≤15mA/12V; ≤13mA/24V
RS485 interface	RS485(RJ45)
Remote temperature sensor interface	2P—3.81
Grounding	Negative
LCD working temperature range	-20°C~ +70°C
Environment temperature range	-25°C~ +50°C
Storage temperature range	-30°C~ +85°C
Relative humidity	≤95%,N.C.
Enclosure	IP30
Terminal	2AWG (35 mm ²)
Weight	0.64 kg

Annex Mechanical Dimension Diagram

VS4524BN (Unit: mm)



Any changes without prior notice!

Version number: 1.3

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