SmartGen

ideas for power

HES7120-PV

HYBRID ENERGY CONTROLLER

USER MANUAL

SMARTGEN (ZHENGZHOU) TECHNOLOGY CO.，LTD

CONTENT

PREFACE

 Chinese trademark

 English trademark

SmartGen — make your generator *smart*

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Table 1　Software Version

Date	Version	Note
2020-05-20	1.0	Original release.

Table 2   Symbol Illustration

Symbol	Illustration
⚠️NOTE	Implies or indicate operator to operate rightly.
⚠️CAUTION	Indicates wrong operation may lead to impair apparatus.
☠️HAZARD	Indicates wrong operation may lead to death, critical personal harm or serious property loss.

1 OVERVIEW

HES7120-PV Hybrid Energy Controller can be used for solar energy control system with inverter. It can control the closing and opening of circuit breaker and the starting and stopping of the inverter, as well as the output power. According to the system application, it can be set to a variety of modes, including fixed power, busbar control power and inverter control power, etc., which can display all data and status of solar PV power generation. The controller integrates digitization, intelligentialize and networked technology, and adopts LCD, which can display Chinese, English and other languages, with simple and reliable operation.

HES7120-PV Hybrid Energy Controller adopts 32-bit microprocessor technology, realizing the functions of precise measurement, fixed value adjustment, timing and threshold setting of various parameters. Most parameters can be adjusted from the front panel of the controller, and all parameters can be adjusted by PC via USB or network interface. Its compact structure, simple connection and high reliability can be widely used in hybrid energy control system.

2 PERFORMANCE AND CHARACTERISTICS

Main features are as follow:

━132x64 LCD with backlit, and selectable language interface (Chinese, English, and other languages) that can be chosen on site, which is convenient for debugging personnel commissioning.

━With network communication interface, by which "4 remote functions" (remote control, remote measuring, remote communication and remote regulation) can be realized through MODBUS protocol.

━Suitable for 3-phase 4-wire, 3-phase 3-wire, single phase 2-wire, and 2-phase 3-wire power systems with voltage 120/240V and frequency 50/60Hz.

━Sampling and displaying 3-phase voltage, 3-phase current, frequency and power parameter of busbar/PV power generator.

Busbar

Line voltage	Uab, Ubc, Uca
Phase voltage	Ua, Ub, Uc
Frequency	Hz
Phase sequence	

Busbar Power

Current	Ia, Ib, Ic
Divided phase and total active power	P
Reactive power	Q
Apparent power	S
Power factor	PF

PV

Line voltage	Uab, Ubc, Uca
Phase voltage	Ua, Ub, Uc
Frequency	Hz
Phase sequence	

PV Power

Current	Ia, Ib, Ic
Active power	P
Reactive power	Q
Apparent power	S
Power factor	PF

PV Accumulated Total Generating Power

Unit：A

Unit：kW

Unit：kvar

Unit：kVA

Unit：kWh、kvarh、kVAh

— The busbar has the functions of over and under voltage, over and under frequency, loss of phase, reverse phase sequence, over power, reverse power and voltage imbalance. PV has the functions of over and under voltage, over and under frequency, loss of phase, reverse phase sequence and voltage imbalance.

— Voltage, current and power display of up to 4 solar panel channels can be set.

— Sampling up to 3 solar panel temperatures and 3 solar irradiance to calculate the maximum capacity of PV.

— A variety of temperature, pressure, liquid level, power transmitter, light radiation sensor curves can be used directly, and sensor curves can be customized, among which programmable 2 and programmable 4 can be connected to resistance, voltage or current type sensors.

— Busbar power can be achieved by current transformer, power transmitter and communication.

— With variety of protocols RS485 interface and can communicate with various inverters with RS485 interface.

— With automatic closing and start function, automatic soft loading and soft unloading function.

— With minimum load power setting of the busbar to prevent reverse power transmission to the busbar.

— With up to 6-way busbar power, and calculates the total load power of busbar in real time according to the state of input port.

— Control and protection functions: realize automatic start/stop of PV power generation inverter, closing and opening of breaker switch, perfect fault display protection and other functions.

— Three active power control modes (fixed power, busbar control power, inverter control).

— Four reactive power control modes (fixed power, busbar control power, power factor, inverter control).

— Parameter setting function: allows the user to change and set its parameters, which will not be lost when the system is powered off. Most parameters can be adjusted from the front panel of the controller, and all parameters can be adjusted by PC through USB or network interface.

— The power supply has a wide range of DC (8-35) V, which can adapt to different power supply voltage environments.

— With event log and real-time clock.

— Data recording function of busbar voltage, busbar frequency, busbar current, busbar power, PV generation voltage, PV generation frequency, PV current, PV power, sensor, etc. one minute before stop fault (can be set), with a maximum of 5 records; maximum records are 5.

— With accumulation, user A, user B accumulation (running time, start times, power).

— A rubber sealing ring is designed between the shell and the control panel, and the waterproof performance can reach IP65.

— The controller is fixed with metal clips.

— Modular structure design, pluggable terminal block, embedded installation mode, compact structure, convenient installation.

3 SPECIFICATION

Table 3 Performance Parameters

Items	Contents
Working Voltage	Range: DC8V-DC35V continuous power supply, DC reverse connection protection Resolution: 0.1V Accuracy: 1%
Whole Power Consumption	<4W (standby ≤2W)
AC Voltage	Phase voltage Range: AC15V - AC360V (ph-N) Resolution: 1V Accuracy: 1%
	Line voltage Range: AC30V - AC620V (ph-ph) Resolution: 1V Accuracy: 1%
AC Frequency	Range: 5Hz - 75Hz Resolution: 0.1Hz Accuracy: 0.1Hz
Alternating Current	Rated: 5A Range: 0A - 10A Resolution: 0.1A Accuracy: 1%
Analog Sensor	Resistance input Range: 0 - 6000Ω Resolution: 0.1 Accuracy: 1Ω(below 300Ω)
	Voltage input Range: 0 - 5V Resolution: 0.001V Accuracy: 1%
	Current input Range: 0 - 20mA Resolution: 0.01mA Accuracy: 1%
The Digital Output Port 1	16A DC28V passive output (relay output)
The Digital Output Port 2	16A DC28V passive output (relay output)
The Digital Output Port 3	7A DC28V DC power supply output (relay output)

The Digital Output Port 4	8A AC250V passive output (relay output)
The Digital Output Port 5	16A AC250V passive output (relay output)
The Digital Output Port 6	16A AC250V passive output (relay output)
The Digital Output Port 7	7A DC28V DC power supply output (relay output)
The Digital Output Port 8	7A DC28V DC power supply output (relay output)
The Digital Output Port 1-7	Low on threshold voltage 1.2V, maximum input voltage 60V
RS485 Interface	Isolation, half duplex, default 9600 baud rate, maximum communication distance 1000M
USB	Self-adaption 10/100Mbit
EMC/CE Certification	EN 61326-1:2013
Vibration	5 - 8 Hz: ±7.5 mm 8 - 500 Hz: 2 g IEC 60068-2-6
Impact	50g, 11 ms, half sine, complete the impact test from three directions. Each test has 18 shocks in total IEC 60068-2-27
Collision	25g, 16 ms, half sine IEC 60255-21-2
Safety Requirements	According to EN 61010-1 installation category (over voltage category) III, 300V, pollution level 2, altitude 3000m
Case Dimension	209 mm x 167 mm x 45 mm
Panel Cutout	186mm x 141mm
Working Conditions	Temperature: (-25~+70)°C; Humidity: (20~93)%
Storage Condition	Temperature: (-30~+80)°C
Protection Level	Front panel: IP65, when a waterproof rubber ring is added between the controller and the control panel Rear panel: IP20
Insulating Intensity	Apply AC2.2kV voltage between high voltage terminal and low voltage terminal and the leakage current is not more than 3mA within 1min.
Weight	0.67kg

4 OPERATION

4.1 KEY FUNCTION

Table 4 Key Function Descriptions

Icon	Key	Description
O	Stop/ Reset	Shut down the inverter and stop the PV from generating electricity in Auto/Manual mode; Remove the alarm in stop mode; Press for 3 seconds or over and panel indicators can be tested (lamp test); Press again in stop process and genset shall stop immediately.
I	Start	Turn on the inverter and make PV generate power in manual mode.
	Manual	Set the module to manual mode.
@	Auto	Set the module to auto mode.
	Close	Control breaker close in manual mode.
	Open	Control breaker open in manual mode.
✿/OK	Set/Confirm	Enter menu list page; Move cursor in parameter setting and confirm the set information.
▲	Up/Increase	Scrolls the screen up; Shift cursor up or increase the set value in parameter setting.
▼	Down/Decrease	Scrolls the screen down; Shift cursor down or decrease the set value in parameter setting.
⌂/↩	Home/Return	Return to home page in main interface; Return to last interface in parameter setting; Press for 3 seconds or over, trip alarm can be reset.

⚠ **NOTE:** press any key to mute alarms in main screen.

4.2 CONTROLLER PANEL
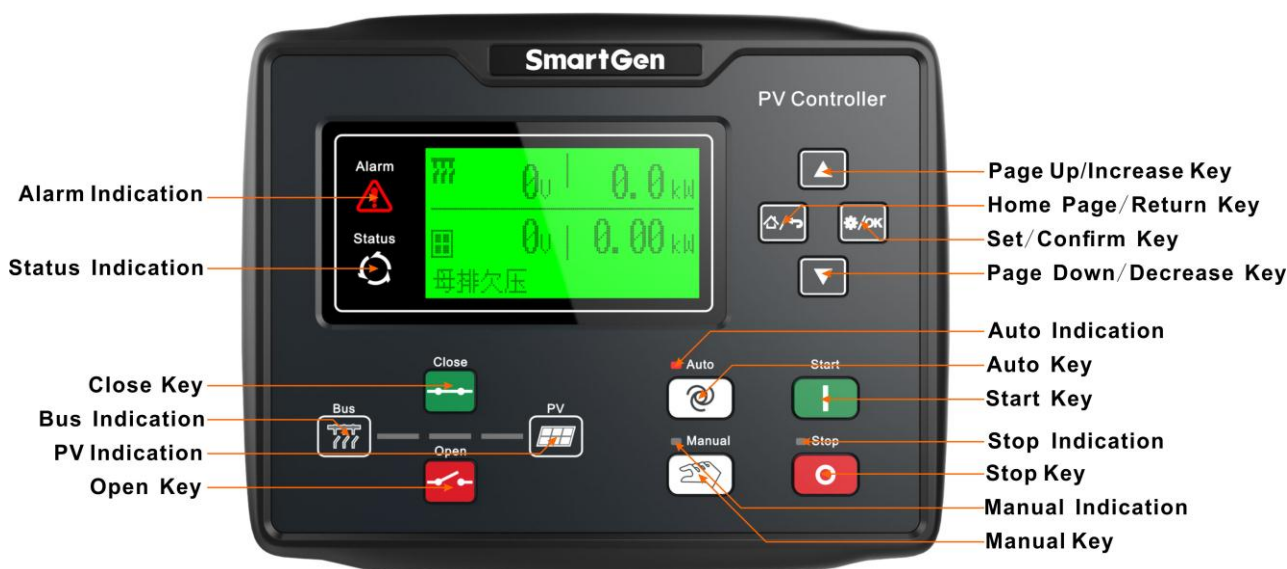
Fig.1 HES7120-PV Front Panel

⚠NOTE: Illustration for part indicators.

Table 5 Alarm Indicator Description

Alarm Type	Alarm Indicators
Warning alarm	slowly flashing (once per second)
Trip alarm	slowly flashing (once per second)
Shutdown alarm	fast flashing (5 times per second)
Trip and stop alarm	fast flashing (5 times per second)
Indicator	off

⚠**NOTES**:

a) Status Indicators: illuminate always after startup and before shutdown; extinguished during other periods.

b) PV Indicator: illuminates always PV generator is normal; flashes when PV generator is abnormal; extinguished when PV generator is standby.

4.3 MAIN DISPLAY

The main display is divided into main interface, data interface, status interface and alarm interface,

⌂/↩ is used to return to the main interface and ▲ ▼ is used to turn the screen.

   a) Two display modes can be set in the main interface:
      - A large font display includes the following contents: busbar voltage, busbar power, PV voltage, PV power, the bottom line shows one of the states.
      - A multi-line display includes the following: busbar voltage, busbar frequency, busbar power, PV voltage, PV frequency, PV power, total load active power, total load reactive power, power supply voltage, controller time. The bottom line shows one of the states.
   b) Data interface includes the following contents:
      - Busbar two screens: phase voltage, line voltage, frequency, phase sequence, voltage imbalance percentage, current, active power, reactive power, apparent power, power

factor.

- PV two screens: phase voltage, line voltage, frequency, phase sequence, voltage imbalance percentage, current, active power, reactive power, apparent power, power factor, maximum capacity.
- Solar panel one screen: voltage, current, power of the maximum four channels.
- Sensor data three screens: programmable analog 1, programmable analog 2, programmable analog 3, programmable analog 4, programmable analog 5, battery voltage, controller time.
- Total accumulative data one screen: accumulative running time, accumulative starting times, accumulative active power, reactive power, apparent electric energy.
- The accumulative data one screen: the running time, the electric energy, the average power and the historical power.
- User A accumulative data one screen: accumulative running time, accumulative startup times, accumulative active power.
- User B accumulative data one screen: accumulative running time, accumulative startup times, accumulative active power.
- Output active and reactive power percentage one screen: the current active power percentage of the busbar, the current reactive power percentage of the busbar, the current active power percentage of PV, the target reactive power percentage of PV, the target reactive power percentage of PV, the current power factor of PV, and the target power factor of PV.

c) Status interface includes the following contents:

Status one screen: system mode, automatic start/stop delay, busbar status, system PV working status, circuit breaker switching status.

d) Alarm interface includes the following contents:

The specific alarm contents of stop alarm, trip alarm, trip without stop alarm and warning alarm.

⚠**NOTE:** Illustration for power factor display

P is the active power

Q is reactive power
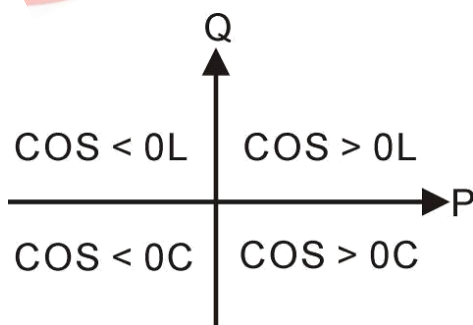
Table 6   Power Factor Description

Power Factor	Condition	Active Power	Reactive Power	Remark
COS>0L	P>0、Q>0	Input	Input	The load is resistance sensibility
COS>0C	P>0、Q<0	Input	Output	The load is resistive and capacitive
COS<0L	P<0、Q>0	Output	Input	The load is equivalent to an underexcited PV generator
COS<0C	P<0、Q<0	Output	Output	The load is equivalent to an overexcited PV generator

⚠NOTES:

a)   Input active power: PV generation or busbar transmission to load.

b)   Output active power: load to PV generation or busbar transmission.

c)   Input reactive power: PV generation or busbar sending reactive power to load.

d)   Output reactive power: Load sends reactive power to PV generation or busbar.

4.4   USER MENU AND PARAMETER SETTING

4.4.1   MENU

After the controller is turned on, press the button to enter the parameter setting menu, which includes:

Parameter settings

Language selection

Event log

Controller information

Date and time setting

Clear user A accumulative data

Clear user A accumulative data

4.4.2   CONTROLLER PARAMETER SETTING

When the password is entered, then you can enter "00318" to set all parameter items. When the default password (00318) is changed, the same password as the controller is required to set parameters through PC software. When more items need to be set or the password is forgotten, such as voltage and current calibration, please contact the manufacturer.

★ Busbar settings

★ Timer settings

★ PV settings

★ PV control settings

★ Switch settings

★ Analog sensor settings

★ The digital input port settings

★ Relay output port settings

★ Module setting

★ Network settings

Example:

Return Busbar setting **Timer setting** PV setting PV control setting	Table 1： ▲ ▼ is used to change what needs to be set, ✿/OK is used to enter settings (Table 2), △/� is used to exit the settings.

Return Start delay **Stop delay** Warming up time Start time	Table 2： ▲ ▼ is used to change what needs to be set, ✿/OK is used to enter settings (Table 2), △/�befback to last step(Table 1).

Stop delay 000005s	Table 3： ✿/OKis used to enter settings (Table), ▲ ▼ △/�befback to last step(Table 2).

Stop delay 000005s	Table 4： ▲ ▼is used to change the value on the cursor, ✿/OKis used to change the cursor position to the right or to the far right to determine settings (Table 3)，△/�befexit the settings

⚠️**NOTES:**

a)   Please modify the internal parameters of the controller in standby state (such as programmable input, output port configuration, various delays, etc.); otherwise, alarm shutdown or other abnormal phenomena may occur.

b)   The excessively high threshold must be greater than the excessively low threshold; for example, the overvoltage threshold must be greater than the undervoltage threshold; otherwise, both overpressure and undervoltage will occur.

c)   The overfrequency threshold must be greater than the underfrequency threshold, otherwise both overfrequency and underfrequency will occur.

d)   When setting the alarm, please set the return value correctly, otherwise the alarm will not work normally. When setting too high warning, the return value should be less than the set value; When setting too low warning, the return value should be greater than the set value.

e)   When starting successfully, the PV generator frequency should be set as low as possible so that the starter can quickly separate when starting successfully.

f)   The programmable input port 1-7 cannot be set to the same item, otherwise the correct function cannot appear, and the programmable input outlet 1-8 can be set to the same item.

4.4.3   LANGUAGE SELECTION

The display language of this selection interface is simplified Chinese, English and others; other languages are English by default.

4.4.4   EVENT LOG

You can query up to 999 event logs

4.4.5 CONTROLLER INFORMATION

a) This interface can display controller development information, such as software version, hardware version and release date.

b) Press ▲ to display the digital input and output states.

c) Press ▼ to display the startup interface.

4.4.6 DATA AND TIME SETTING

Calibrate the date and time of the controller with this setting.

4.4.7 CLEAR USER A ACCUMULATIVE DATA

All accumulated data (running time, startup times, power) of User A can be cleared through this item.

4.4.8 CLEAR USER B ACCUMULATIVE DATA

All accumulated data (running time, startup times, power) of User B can be cleared through this item.

4.5 AUTO START/STOP OPERATION

4.5.1 ILLUSTRATION

Press ℗ and the indicator beside is illuminated, meaning PV generation is in Auto Start mode.

4.5.2 AUTO START SEQUENCE

HES7120-PV starting conditions: the remote starting input port is valid or the bus is normal.

a) When the busbar returns to normal, it will enter the "Busbar Voltage Normal Delay". After confirming the busbar is normal, the busbar status indicator will light up and enter the "Start Delay", Or enter "Start Delay" when the input of remote power on is valid.

b) The status page of LCD shows the countdown of "Start Delay".

c) After the start delay is over, preheat relay output (if configured), and the status page of LCD shows "Preheat Delay XX S".

d) After the startup delay, simultaneously close the relay output (if configured). Closing is completed after the closing feedback is effective (if configured). Otherwise, if the closing feedback is invalid, the status page of LCD will display "waiting for PV closing" and the alarm page of LCD will display the alarm of switch fault;

e) After the preheating delay is over, the controller enters "starting" and issues start instructions to the inverter via RS485. If the controller does not receive the start instruction in the "starting" delay, then enter the "Power-on failure", and the LCD Alarm page will display the power fall alarm. If the controller receives the start instruction effectively within the "staring" delay, it will enter "starting wait" immediately until the inverter work normally.

f) If the controller does not receive the normal operation instruction of the inverter after the "Power-on waiting" delay, enter "Power-on failure", and the LCD alarm page shows the alarm of power-on failure;

g) If the controller receives the normal operation instruction of the inverter at the end of the

"power-on waiting" delay, the controller will immediately enter the "normal operation" state, and then soft load to the target active power/reactive power percentage obtained according to the power control mode to complete the whole boot process.

4.5.3 AUTO STOP SEQUENCE

a) HES7120-PV during normal operation of PV power generation, if the alarm set by the busbar is only a warning or an indicating alarm, if the busbar is abnormal (over voltage, under voltage, over frequency, under frequency, phase loss, and inverse phase), it will enter into "busbar abnormal delay". The status page of LCD shows the countdown. Or when the input of remote power on fails, "stop delay" will start. If the alarm set by busbar or PV has the alarm of shutdown, trip shutdown and trip non shutdown, the PV power generation closing relay will be disconnected and the controller will enter the shutdown sequence after the alarm is sent, and the opening will be completed after the closing feedback is invalid (if configured), otherwise, if the closing feedback is still valid, the LCD status page will display "waiting for PV to open", and the LCD Alarm page will display the switch fault alarm.

b) After the shutdown delay, soft unloading will be started. When the unloading reaches the set unloading value, the controller will enter the "shutdown cooling" delay (if configured), and the PV will start to open (refer to B for the opening step).

c) After the "shutdown and heat dissipation" delay, the controller will enter the "on-going shutdown" mode, and send the shutdown command to the inverter through RS485. If the controller does not receive the valid shutdown command within the "on-going shutdown" delay, it will enter the "shutdown failure" mode, and the LCD Alarm page will display the shutdown failure alarm. If the controller receives the valid shutdown command within the "on-going shutdown" delay, it will immediately Enter "stop waiting" and wait for the inverter to stop working.

d) If the controller does not receive the inverter stop command after the "stop waiting" delay, enter "stop failure", and the LCD Alarm page displays the stop failure alarm.

e) If receiving the inverter stop working command, enter PV standby state.

4.5.4 MANUAL START/STOP OPERATION

a) HES7120-PV：Press ✍, the controller enters "manual mode" and the manual mode indicator lights up. In this mode, press ⟍⟋firstly，PV generation switch close, press 【 I 】,then PV generation start. Automatically judge the successful start, automatically rise to high speed operation. (See 4.5.2 automatic starting sequence for the process, c~g)。

b) Manual Stop: press 【 O 】, the running PV can be shut down and switched on. (See 4.5.3 automatic stop sequence for process, b~e).

5 PROTECTION

5.1 WARNING ALARM

When controller detects the warning alarms, it only issues alarm and does not stop the genset. Alarm is not issued until the alarm is enabled and the action type is selected

Table 7 Warning Alarm Types

No.	Type	Description
1	Busbar Over Voltage	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, under frequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a warning signal.
2	Busbar Under Voltage	
3	Busbar Over Frequency	
4	Busbar Under Frequency	
5	Busbar Reverse Power	When the controller detects that the absolute value of busbar power value (power is negative) ≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a warning signal.
6	Busbar Over Power	When the controller detects that the power value of the busbar (power is positive)≥ the set threshold value, the alarm is enabled and the action type is selected, the controller will send out a warning signal.
7	Busbar Reverse Phase	When the controller detects the loss of busbar phase, the controller will send out a warning signal when the alarm is enabled.
8	Busbar Loss of Phase	When the controller detects the reverse phase sequence of the busbar and the alarm is enabled, the controller sends out a warning signal.
9	Busbar Unbalanced Voltage	When the controller detects that the voltage unbalance percentage of the busbar ≥ the set threshold value, and the alarm is enabled and the action type is selected, the controller will send out a warning signal.
10	PV Over Voltage 1	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, under frequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a warning signal.
11	PV Under Voltage 1	
12	PV Over Frequency 1	
13	PV Under Frequency 1	

No.	Type	Description
14	PV Unbalanced Voltage	When the controller detects the voltage imbalance percentage of PV generation ≥ set threshold, alarm enabling and the action type chooses warning, the controller sends a warning signal.
15	PV Reverse Phase Sequence	When the controller detects the reverse phase sequence of PV power generation, and the alarm is enabled, the controller will send out a warning signal.
16	PV Loss of Phase	When the controller detects the loss of phase of PV power generation and the alarm is enabled, the controller will send out a warning signal.
17	PV Reverse Power	When the controller detects that the absolute value of PV power value (power is negative)≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a warning signal.
18	PV Over Power	When the controller detects that the power value of PV power generation (power is positive)≥ the set threshold value, the alarm is enabled and the action type is selected, the controller will send out a warning signal.
19	PV Over Voltage 2	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, under frequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a warning signal.
20	PV Under Voltage 2	
21	PV Over Frequency 2	
22	PV Under Frequency 2	
23	Programmable Sensor 1 Open Circuit	When the controller detects the sensor open circuit or the data value≥ (high alarm value) or ≤ (low alarm value) the set threshold value, and the alarm is enabled and the action type is selected, the controller will send out a warning signal.
24	Programmable 1 High 1 Alarm	
25	Programmable 1 Low 1 Alarm	
26	Programmable 1 High 2 Alarm	
27	Programmable Sensor 2 Open Circuit	
28	Programmable 2 High 1 Alarm	
29	Programmable 2 Low 1 Alarm	
30	Programmable 2 High 2 Alarm	
31	Programmable Sensor 3 Open Circuit	
32	Programmable 3 High 1 Alarm	
33	Programmable 3 Low 1 Alarm	
34	Programmable 3 High 2 Alarm	
35	Programmable Sensor 4 Open Circuit	

No.	Type	Description
36	Programmable 4 High 1 Alarm	
37	Programmable 4 Low 1 Alarm	
38	Programmable 4 High 2 Alarm	
39	Programmable Sensor 5 Open Circuit	
40	Programmable 5 High 1 Alarm	
41	Programmable 5 Low 1 Alarm	
42	Programmable 5 High 2 Alarm	
43	Programmable 1 Low 2 Alarm	
44	Programmable 2 Low 2 Alarm	
45	Programmable 3 Low 2 Alarm	
46	Programmable 4 Low 2 Alarm	
47	Programmable 5 Low 2 Alarm	
48	Power Supply Over Voltage	When the controller detects that the power supply voltage ≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a warning signal.
49	Power Supply Under Voltage	When the controller detects that the power supply voltage ≤ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a warning signal.
50	Switch Failure	When the controller detects the switch closing / opening failure and feedback line disconnection, (the switch state is inconsistent with the switch feedback state), the controller will send out a warning signal.
51	Stop Failure	When the controller detects the stop failure, the controller will send out a warning signal.
52	Start Failure	When the controller detects start failure, the controller will send out a warning signal.
53	Unload Failure	When the PV power generation needs to be opened and soft unloaded, if the current active power value can not reach the opening value within the set time, the controller will send out a warning signal.
54	Input Port 1 Alarm	When the switch input port is configured as "0: user defined", and the action type is selected as warning, and it is valid within the effective range, the controller will send out the corresponding input port warning signal.
55	Input Port 2 Alarm	
56	Input Port 3 Alarm	
57	Input Port 4 Alarm	
58	Input Port 5 Alarm	
59	Input Port 6 Alarm	
60	Input Port 7 Alarm	
61	Inverter Communication Failure	When the controller detects that the inverter communication data cannot be received within the set time, and the action type is selected, the controller sends out a warning signal.

No.	Type	Description
62	Inverter Alarm	When the controller and the inverter communicate normally, the controller will send out the warning signal when receiving the inverter warning alarm.

5.2 SHUTDOWN ALARM

When controller detects shutdown alarms, it will send signals to stop the generator and the corresponding alarm information will be displayed on LCD. When the alarm is enabled and the action type is selected as shutdown, the shutdown alarm will be sent out.

Table 8 Shutdown Alarms Types

No.	Type	Description
1	Busbar Over Voltage	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, underfrequency alarm, etc.) the set threshold value, the alarm is enabled and the action type is selected, the controller will send out a shutdown signal.
2	Busbar Under Voltage	
3	Busbar Over Frequency	
4	Busbar Under Frequency	
5	Busbar Reverse Power	When the controller detects that the absolute value of busbar power value (power is negative) ≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a shutdown signal.
6	Busbar Over Power	When the controller detects that the power value of the busbar (power is positive) ≥ the set threshold value, the alarm is enabled and the action type is selected, the controller will send out a shutdown signal.
7	Busbar Unbalanced Voltage	When the controller detects that the voltage unbalance percentage of the busbar ≥ the set threshold value, and the alarm is enabled and the action type is selected, the controller will send out a shutdown signal.
8	PV Over Voltage 1	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, underfrequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a shutdown signal.
9	PV Under Voltage 1	
10	PV Over Frequency 1	
11	PV Under Frequency 1	
12	PV Unbalanced Voltage	When the controller detects the voltage imbalance percentage of PV generation ≥ set threshold, alarm enabling and the action type chooses warning, the controller sends a shutdown signal.
13	PV Reverse Power	When the controller detects that the absolute value

No.	Type	Description
		of PV power value (power is negative) ≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a shutdown signal.
14	PV Over Power	When the controller detects that the power value of PV power generation (power is positive) ≥ the set threshold value, the alarm is enabled and the action type is selected, the controller will send out a shutdown signal.
15	PV Over Voltage 2	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, underfrequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a shutdown signal.
16	PV Under Voltage 2	
17	PV Over Frequency 2	
18	PV Under Frequency 2	
19	Programmable Sensor 1 Open Circuit	When the controller detects the sensor open circuit or the data value ≥ (high alarm value) or ≤ (low alarm value) the set threshold value, and the alarm is enabled and the action type is selected, the controller will send out a shutdown signal.
20	Programmable 1 High 1 Alarm	
21	Programmable 1 Low 1 Alarm	
22	Programmable 1 High 2 Alarm	
23	Programmable Sensor 2 Open Circuit	
24	Programmable 2 High 1 Alarm	
25	Programmable 2 Low 1 Alarm	
26	Programmable 2 High 2 Alarm	
27	Programmable Sensor 3 Open Circuit	
28	Programmable 3 High 1 Alarm	
29	Programmable 3 Low 1 Alarm	
30	Programmable 3 High 2 Alarm	
31	Programmable Sensor 4 Open Circuit	
32	Programmable 4 High 1 Alarm	
33	Programmable 4 Low 1 Alarm	
34	Programmable 4 High 2 Alarm	
35	Programmable Sensor 5 Open Circuit	
36	Programmable 5 High 1 Alarm	
37	Programmable 5 Low 1 Alarm	
38	Programmable 5 High 2 Alarm	
39	Programmable 1 Low 2 Alarm	
40	Programmable 2 Low 2 Alarm	
41	Programmable 3 Low 2 Alarm	
42	Programmable 4 Low 2 Alarm	

No.	Type	Description
43	Programmable 5 Low 2 Alarm	
44	Power Supply Over Voltage	When the controller detects that the power supply voltage≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a shutdown signal.
45	Power Supply Under Voltage	When the controller detects that the power supply voltage ≤ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a shutdown signal.
46	Input Port 1 Alarm	When the switch input port is configured as "0: user defined", and the action type is selected as warning, and it is valid within the effective range, the controller will send out the corresponding input port shutdown signal
47	Input Port 2 Alarm	
48	Input Port 3 Alarm	
49	Input Port 4 Alarm	
50	Input Port 5 Alarm	
51	Input Port 6 Alarm	
52	Input Port 7 Alarm	
53	Inverter Communication Failure	When the controller detects that the inverter communication data cannot be received within the set time, and the action type is selected, the controller will send out a shutdown signal.
54	Inverter Alarm	When the controller and the inverter communicate normally, the controller will send out the shutdown signal when receiving the inverter shutdown alarm.

5.3 TRIP AND STOP ALARM

When controller detects trip and stop alarms, it will immediately disconnect the generator close signals and genset shall stop after high-speed cooling. When the alarm is enabled and the action type is selected as trip stop, the trip stop alarm will send out.

Table 9 Trip and Stop Alarms

No.	Type	Description
1	Busbar Over Voltage	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, underfrequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip and stop signal.
2	Busbar Under Voltage	
3	Busbar Over Frequency	
4	Busbar Under Frequency	
5	Busbar Reverse Power	When the controller detects that the absolute value of busbar power value (power is negative) ≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a trip and stop signal.

No.	Type	Description
6	Busbar Over Power	When the controller detects that the power value of the busbar (power is positive)≥ the set threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip and stop signal.
7	Busbar Unbalanced Voltage	When the controller detects that the voltage unbalance percentage of the busbar ≥ the set threshold value, and the alarm is enabled and the action type is selected, the controller will send out a trip and stop signal.
8	PV Over Voltage 1	When the controller detects the corresponding data value ≥ (overvoltage, over frequency alarm, etc.) or ≤ (under voltage, under frequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip and stop signal.
9	PV Under Voltage 1	
10	PV Over Frequency 1	
11	PV Under Frequency 1	
12	PV Unbalanced Voltage	When the controller detects the voltage imbalance percentage of PV generation ≥ set threshold, alarm enabling and the action type chooses warning, the controller sends a trip and stop signal.
13	PV Reverse Power	When the controller detects that the absolute value of PV power value (power is negative)≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a trip and stop signal.
14	PV Over Power	When the controller detects that the power value of PV power generation (power is positive)≥ the set threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip and stop signal.
15	PV Over Voltage 2	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, underfrequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip and stop signal.
16	PV Under Voltage 2	
17	PV Over Frequency 2	
18	PV Under Frequency 2	
19	Programmable Sensor 1 Open Circuit	When the controller detects the sensor open circuit or the data value ≥ (high alarm value) or ≤ (low alarm value) the set threshold value, and the alarm is enabled and the action type is selected, the controller will send out a trip and stop signal.
20	Programmable 1 High 1 Alarm	
21	Programmable 1 Low 1 Alarm	
22	Programmable 1 High 2 Alarm	
23	Programmable Sensor 2 Open Circuit	

No.	Type	Description
24	Programmable 2 High 1 Alarm	
25	Programmable 2 Low 1 alarm	
26	Programmable 2 High 2 Alarm	
27	Programmable Sensor 3 Open Circuit	
28	Programmable 3 High 1 Alarm	
29	Programmable 3 Low 1 Alarm	
30	Programmable 3 High 2 Alarm	
31	Programmable Sensor 4 Open Circuit	
32	Programmable 4 High 1 Alarm	
33	Programmable 4 Low 1 Alarm	
34	Programmable 4 High 2 Alarm	
35	Programmable Sensor 5 Open Circuit	
36	Programmable 5 High 1 Alarm	
37	Programmable 5 Low 1 Alarm	
38	Programmable 5 High 2 Alarm	
39	Programmable 1 Low 2 Alarm	
40	Programmable 2 Low 2 Alarm	
41	Programmable 3 Low 2 Alarm	
42	Programmable 4 Low 2 Alarm	
43	Programmable 5 Low 2 Alarm	
44	Power Supply Over Voltage	When the controller detects that the power supply voltage≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a trip and stop signal.
45	Power Supply Under Voltage	When the controller detects that the power supply voltage ≤ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a trip and stop signal.
46	Input Port 1 Alarm	When the switch input port is configured as "0: user defined", and the action type is selected as warning, and it is valid within the effective range, the controller will send out the corresponding input port trip and stop signal
47	Input Port 2 Alarm	
48	Input Port 3 Alarm	
49	Input Port 4 Alarm	
50	Input Port 5 Alarm	
51	Input Port 6 Alarm	
52	Input Port 7 Alarm	
53	Inverter Communication Failure	When the controller detects that the inverter communication data cannot be received within the set time, and the action type is selected, the controller will send out a trip and stop signal.

5.4 TRIP ALARM

When controller detects trip alarms, it will immediately disconnect the generator close signals but PV generation does not stop. When the alarm is enabled and the action type is selected to trip, the trip alarm will be sent out

Table 10 Trip Alarms

No.	Type	Description
1	Busbar Over Voltage	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, underfrequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip signal.
2	Busbar Under Voltage	
3	Busbar Over Frequency	
4	Busbar Under Frequency	
5	Busbar Reverse Power	When the controller detects that the absolute value of busbar power value (power is negative) ≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a trip signal.
6	Busbar Over Power	When the controller detects that the power value of the busbar (power is positive)≥ the set threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip and stop signal.
7	Busbar Unbalanced Voltage	When the controller detects that the voltage unbalance percentage of the busbar ≥ the set threshold value, and the alarm is enabled and the action type is selected, the controller will send out a trip signal.
8	PV Over Voltage 1	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, underfrequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip signal.
9	PV Under Voltage 1	
10	PV Over Frequency 1	
11	PV Under Frequency 1	
12	PV Unbalanced Voltage	When the controller detects the voltage imbalance percentage of PV generation ≥ set threshold, alarm enabling and the action type chooses warning, the controller will send out a trip signal.
13	PV Reverse Power	When the controller detects that the absolute value of PV power value (power is negative)≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a trip signal.

No.	Type	Description
14	PV Over Power	When the controller detects that the power value of PV power generation (power is positive)≥ the set threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip signal.
15	PV Over Voltage 2	When the controller detects the corresponding data value ≥ (overvoltage, overfrequency alarm, etc.) or ≤ (undervoltage, underfrequency alarm, etc.) the threshold value, the alarm is enabled and the action type is selected, the controller will send out a trip signal.
16	PV Under Voltage 2	
17	PV Over Frequency 2	
18	PV Under Frequency 2	
19	Programmable Sensor 1 Open Circuit	When the controller detects the sensor open circuit or the data value ≥ (high alarm value) or ≤ (low alarm value) the set threshold value, and the alarm is enabled and the action type is selected, the controller will send out a trip signal.
20	Programmable 1 High 1 Alarm	
21	Programmable 1 Low 1 Alarm	
22	Programmable 1 High 2 Alarm	
23	Programmable Sensor 2 Open Circuit	
24	Programmable 2 High 1 Alarm	
25	Programmable 2 Low 1 alarm	
26	Programmable 2 High 2 Alarm	
27	Programmable Sensor 3 Open Circuit	
28	Programmable 3 High 1 Alarm	
28	Programmable 3 Low 1 Alarm	
30	Programmable 3 High 2 Alarm	
31	Programmable Sensor 4 Open Circuit	
32	Programmable 4 High 1 Alarm	
33	Programmable 4 Low 1 Alarm	
34	Programmable 4 High 2 Alarm	
35	Programmable Sensor 5 Open Circuit	
36	Programmable 5 High 1 Alarm	
37	Programmable 5 Low 1 Alarm	
38	Programmable 5 High 2 Alarm	
39	Programmable 1 Low 2 Alarm	
40	Programmable 2 Low 2 Alarm	
41	Programmable 3 Low 2 Alarm	
42	Programmable 4 Low 2 Alarm	
43	Programmable 5 Low 2 Alarm	

No.	Type	Description
44	Power Supply Over Voltage	When the controller detects that the power supply voltage≥ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a trip signal.
45	Power Supply Under Voltage	When the controller detects that the power supply voltage ≤ the set threshold value, the alarm is enabled and the action type is selected to warn, the controller will send out a trip signal.
46	Input Port 1 Alarm	When the switch input port is configured as "0: user defined", and the action type is selected as warning, and it is valid within the effective range, the controller will send out the corresponding input port trip signal
47	Input Port 2 Alarm	
48	Input Port 3 Alarm	
49	Input Port 4 Alarm	
50	Input Port 5 Alarm	
51	Input Port 6 Alarm	
52	Input Port 7 Alarm	
53	Inverter Communication Failure	When the controller detects that the inverter communication data cannot be received within the set time, and the action type is selected, the controller will send out a trip signal.

6 WIRING CONNECTION

6.1 HES7120-PV CONTROLLER REAR PANEL
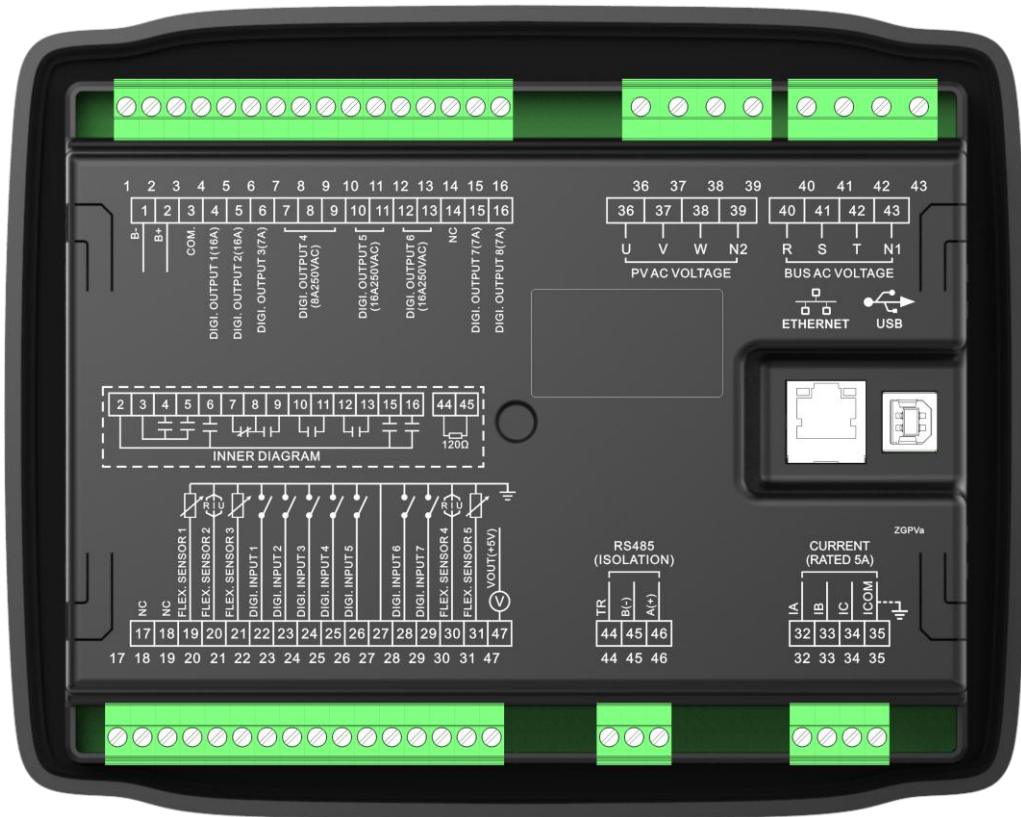
Fig.2 Rear Panel

Table 11 Terminal Wiring Connection

No.	Function	Cable Size	Remarks		
1	B-	2.5mm^2	Connected with negative of starter battery.		
2	B+	2.5mm^2	Connected with positive of starter battery. If wire length is over 30m, it's better to double wires in parallel. Max. 20A fuse is recommended.		
3	COM	2.5mm^2	Connect with B+.		
4	Programmable Relay Output Port 1	2.5mm^2	B+ is supplied by Terminal 3, rated 16A.		
5	Programmable Relay Output port 2	2.5mm^2	B+ is supplied by Terminal 3, rated 16A. Connect with starting coil of starter.		
6	Programmable Relay Output Port 3	1.5mm^2	B+ is supplied by Terminal 2, rated 7A.	For items please see Table 13.	
7	Programmable Relay Output Port 4	1.5 mm^2	NC output, rated 8A.		
8			Relay common port.		
9			NO output, rated 8A.		
10	Programmable Relay Output Port 5	2.5 mm^2	Relay NO volt free contact, rated 16A, volt free contact output.		
11					
12	Programmable Relay Output Port 6	2.5 mm^2			
13					
14	NC	Please hang it up if there is not this terminal.			
15	Programmable Relay Output Port 7	1.5 mm^2	B+ is supplied by Terminal 2, rated 7A	For items please see Table 13.	
16	Programmable Relay Output Port 8	1.5 mm^2			
17	NC	Please hang it up if there is not this terminal.			
18	NC				
19	Programmable Sensor 1	Connect temperature or pressure or liquid level or power transmitter or irradiance sensor	For items please see Table 15.		
20	Programmable Sensor 2				
21	Programmable Sensor 3				
22	Programmable Input Port 1	1.0mm^2	Ground connected is active (B-)	For items please see Table 14.	
23	Programmable Input Port 2	1.0mm^2	Ground connected is active (B-)		
24	Programmable Input Port 3	1.0mm^2	Ground connected is active (B-)		
25	Programmable Input Port 4	1.0mm^2	Ground connected is active (B-)		
26	Programmable Input Port 5	1.0mm^2	Ground connected is active (B-)		
27	Sensor Common Port	Sensor common port, battery negative electrode has been connected inside controller.			
28	Programmable Input Port 6	1.0mm^2	Ground connected is active (B-)	For items please	

No.	Function	Cable Size	Remarks	
29	Programmable Input Port 7	1.0mm^2	Ground connected is active (B-)	see Table 14.
30	Programmable Sensor 4	Connect temperature or pressure or liquid level or power transmitter or irradiance sensor.		For items please see Table 15.
31	Programmable Sensor 5			
32	CT A-phase Monitoring Input	1.5mm^2	Outside connected to secondary coil of CT (5A rated).	
33	CT B-phase Monitoring Input	1.5mm^2	Outside connected to secondary coil of CT (5A rated).	
34	CTC-phase Monitoring Input	1.5mm^2	Outside connected to secondary coil of CT (5A rated).	
35	CT Common Port	1.5mm^2	Details to see the following installation description.	
36	Gen U-phase Voltage Monitoring Input	1.0mm^2	Connected to U-phase output of genset (2A fuse recommended).	
37	Gen V-phase Voltage Monitoring Input	1.0mm^2	Connected to V-phase output of genset (2A fuse recommended).	
38	Gen W-phase Voltage Monitoring Input	1.0mm^2	Connected to W-phase output of genset (2A fuse recommended).	
39	Gen N2-line Input	1.0mm^2	Connected to N-line output of genset.	
40	Busbar R-phase Voltage Monitoring Input	1.0mm^2	Connected to R-phase of mains (2A fuse recommended).	
41	Busbar S-phase voltage monitoring input	1.0mm^2	Connected to S-phase of mains (2A fuse recommended).	
42	Busbar T-phase voltage monitoring input	1.0mm^2	Connected to T-phase of mains (2A fuse recommended).	
43	Busbar N1-line Input	1.0mm^2	Connected to N-line of busbar.	
44	RS485 common	0.5mm^2	120Ω shielding wire is recommended with single end ground connected.	
45	RS485-	0.5mm^2		
46	RS485+	0.5mm^2		
47	VOUT(+5V)	0.5mm^2	Output DC +5V.	

⚠**NOTE:** USB ports in controller rear panel are programmable parameter ports, and users can directly configure the controller on PC.

⚠**NOTE:** ETHERNET ports in controller rear panel are programmable parameter ports, and users can directly monitor controller on PC.

6.2 CONTENTS AND SCOPES OF PARAMETERS

Table 12 Parameter Settings and Scope

No.	Items	Range	Default	Description
Busbar Setting				
1	AC System	(0-3)	0	0：3P4W； 1：3P3W； 2：2P3W； 3：1P2W。
2	Rated Voltage	(30-30000)V	230	Provide standard for judging busbar over/under voltage or not; if voltage transformer is applied, this value is the primary voltage of transformer.
3	Rated Frequency	(10.0-75.0)Hz	50.0	Provide standard for judging busbar over/under frequency or not.
4	Normal Time	(0-3600)s	10	The time from busbar abnormal to normal.
5	Abnormal Time	(0-3600)s	5	The time from busbar normal to abnormal.
6	Voltage Transformer (PT)	(0-1)	0	0: Disabled; 1: Enabled
		(30-30000)V	100	Primary voltage
		(30-1000)V	100	Secondary voltage
7	Over Voltage	(0-1)	1	0: Disabled; 1: Enabled
		(0-200.0)%	120.0	The setting value is rated voltage percentage
		(0-200.0)%	116.0	The return value is rated voltage percentage
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
8	Under Voltage	(0-1)	1	0: Disabled; 1: Enabled
		(0-200.0)%	80.0	The setting value is rated voltage percentage
		(0-200.0)%	84.0	The return value is rated voltage percentage
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
9	Over Frequency	(0-1)	0	0: Disabled; 1: Enabled
		(0-200.0)%	114.0	The setting value is rated frequency percentage
		(0-200.0)%	110.0	The return value is rated frequency percentage
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
10	Under Frequency	(0-1)	0	0: Disabled; 1: Enabled
		(0-200.0)%	90.0	The setting value is rated frequency percentage

No.	Items	Range	Default	Description
		(0-200.0)%	94.0	The return value is rated frequency percentage
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
11	Loss of Phase	(0-1)	1	0: Disabled; 1: Enabled
12	Reverse Phase	(0-1)	1	
13	Transformation Ratio of Current Transformer	(5-6000)/5	500	Transformation ratio of external current transformer
14	Selection of Busbar Active Power Input	(0-6)	0	0: current transformer; 1: sensor 1; 2: sensor 2; 3: Sensor 3; 4: sensor 4; 5: sensor 5; 6: Communication
15	Selection of Busbar Reactive Power Input	(0-6)	0	
16	Rated Active Power	(0-6000)kW	276	provide a reference for the judgment of bus reverse power over power or active power percentage.
17	Rated Reactive Power	(0-6000)kW	210	provide a reference for the judgment of busbar reactive power percentage.
18	Reverse Power	(0-1)	0	0: Disabled; 1: Enabled
		(0-200.0)%	10.0	The setting value is rated active power percentage
		(0-200.0)%	5.0	The return value is rated active power percentage
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
19	Over Power	(0-1)	0	0: Disabled; 1: Enabled
		(0-200.0)%	110.0	The setting value is rated active power percentage
		(0-200.0)%	105.0	The return value is rated active power percentage
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
20	Unbalanced Voltage	(0-1)	0	0: Disabled; 1: Enabled
		(0-200.0)%	10.0	The setting value is unbalanced voltage percentage
		(0-200.0)%	5.0	The return value is unbalanced voltage percentage
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
Timer Setting				
1	Start Delay	(0-3600)s	1	Time between busbar normal or remote start signal is active and genset start.

No.	Items	Range	Default	Description
2	Return Delay	(0-3600)s	1	Time between buabar abnormal or remote start signal is deactivated and genset stop.
3	Preheat Delay	(0-3600)s	0	Warm up time before power on.
4	Start Time	(0-60)s	2	Time to send power on command to inverter.
5	Wait Start Time	(0-3600)s	60	Waiting time for the inverter to work normally.
6	Stop Cooling Time	(0-3600)s	0	Cooling time required before shutdown after PV power generation unloading.
7	Stop Time	(0-3600)s	2	Time to send shutdown command to inverter.
8	Wait Stop Time	(0-3600)s	60	Waiting time for the inverter to stop working.
PV Setting				
1	Inverter Model	(0-49)	0	Inverter model selection
2	Communication Address of Inverter	(1-250)	1	RS485 communication address of inverter
3	Inverter Communication Failure Delay	(0-3600)s	5	After delaying this setting value, the alarm communication fails
4	Inverter Communication Failure Action	(0-4)	0	Alarm action type of communication failure
5	DC Channel of Inverter	(1-4)	2	Number of solar panel to inverter interfaces
6	Rated Voltage	(30-30000)V	230	It provides a reference for judging over-voltage and under voltage of PV power generation. If a voltage transformer is used, this value is the primary voltage of the transformer.
7	Rated Frequency	(10.0-75.0) Hz	50.0	It provides reference for over frequency, under frequency and on load frequency judgment.
8	Voltage Transformer Setting	(0-1)	0	0: Disabled; 1: Enabled
				Primary voltage
				Secondary voltage
9	PV Overvoltage 1	(30-30000)V	100	0: Disabled; 1: Enabled
		(30-1000)V	100	The setting value is rated voltage percentage
		(0-1)	1	The return value is rated voltage percentage
		(0-200.0)%	120.0	Delay value
		(0-200.0)%	118.0	Action type
10	PV Under Voltage 1	(0-3600)s	3	0: Disabled; 1: Enabled
		(0-4)	1	The setting value is rated voltage percentage

No.	Items	Range	Default	Description
		(0-1)	1	The return value is rated voltage percentage
		(0-200.0)%	80.0	Delay value
		(0-200.0)%	82.0	Action type
11	PV Over Frequency 1	(0-3600)s	3	0: Disabled; 1: Enabled
		(0-4)	1	The setting value is rated frequency percentage
		(0-1)	1	The return value is rated frequency percentage
		(0-200.0)%	114.0	Delay value
		(0-200.0)%	112.0	Action type
12	PV Under Frequency 1	(0-3600)s	3	0: Disabled; 1: Enabled
		(0-4)	1	The setting value is rated frequency percentage
		(0-1)	1	The return value is rated frequency percentage
		(0-200.0)%	80.0	Delay value
		(0-200.0)%	82.0	Action type
13	PV Over voltage 2	(0-3600)s	3	0: Disabled; 1: Enabled
		(0-4)	1	The setting value is rated voltage percentage
		(0-1)	1	The return value is rated voltage percentage
		(0-200.0)%	110.0	Delay value
		(0-200.0)%	108.0	Action type
14	PV Under Voltage 2	(0-3600)s	5	0: Disabled; 1: Enabled
		(0-4)	0	The setting value is rated voltage percentage
		(0-1)	1	The return value is rated voltage percentage
		(0-200.0)%	84.0	Delay value
		(0-200.0)%	86.0	Action type
15	PV Over Frequency 2	(0-3600)s	5	0: Disabled; 1: Enabled
		(0-4)	0	The setting value is rated frequency percentage
		(0-1)	1	The return value is rated frequency percentage
		(0-200.0)%	110.0	Delay value
		(0-200.0)%	108.0	Action type
16	PV Under Frequency 2	(0-3600)s	5	0: Disabled; 1: Enabled
		(0-4)	0	The setting value is rated frequency percentage
		(0-1)	1	The return value is rated frequency percentage
		(0-200.0)%	84.0	Delay value

No.	Items	Range	Default	Description
		(0-200.0)%	86.0	Action type
17	Loss of Phase	(0-3600)s	5	0: Disabled; 1: Enabled
18	Reverse Phase	(0-4)	0	
19	Unbalanced Voltage	(0-1)	1	0: Disabled; 1: Enabled
		(0-1)	1	The setting value is unbalanced voltage percentage
		(0-1)	0	The return value is unbalanced voltage percentage
		(0-200.0)%	10.0	Delay value
		(0-200.0)%	5.0	Action type
PV Control Setting				
1	Rated Active Power	(0-6000.0)kW	276.0	Provide a basis for judging PV active power percentage.
2	Rated Reactive Power	(0-6000.0)kW	210.0	Provide a basis for judging PV reactive power percentage.
3	Active Power Control Mode	(0-2)	0	0: Fixed power 1: Busbar control power 2: Inverter control
4	Reactive Power Control Mode	(0-3)	0	0: Fixed power 1: Busbar control power 2: Power factor control 3: Inverter control
5	Fixed Active Power Percentage	(0-100.0)%	60.0	
6	Fixed Reactive Power Percentage	(0-100.0)%	60.0	
7	Fixed Power Factor	(0-1.00)	0.80	
8	Minimum Load Percentage of Busbar	(-200.0-200.0)%	30.0	Prevent reverse power transmission to the busbar, resulting in the bus reverse work.
9	Busbar Divided Into 1 Power Percentage	(-200.0-200.0)%	10.0	If the busbar is divided into six inputs at most, it can be considered as six gensets. When one input is valid and the power of genset is valid, all gensets will be switched on and loaded. If several input ports are effective, several gensets will be loaded. According to the configured busbar percentage N power percentage, the accumulated sum is the minimum load percentage of the current bus bar to prevent reverse power transmission to the bus bar It is the opposite work of the bus. Note: if this function is used, the bus minimum load percentage function will be invalid.
10	Busbar Divided Into 2 Power Percentage	(-200.0-200.0)%	10.0	
11	Busbar Divided Into 3 Power Percentages	(-200.0-200.0)%	10.0	
12	Busbar Divided Into 4 Power Percentages	(-200.0-200.0)%	10.0	
13	Busbar Divided Into 5 Power Percentage	(-200.0-200.0)%	10.0	
14	Busbar Divided Into 6 Power Percentages	(-200.0-200.0)%	10.0	

No.	Items	Range	Default	Description
15	Loading Slope	(0.0-100.0) % /s	3.0	When the loading slope delay point is reached, the loading slope delay time is suspended, and the target power percentage increases.
16	Loading Slope Delay Point	(0.1-50.0)%	10.0	
17	Loading Slope Delay	(0-30)s	0	
18	Unloading Slope	(0.0-100.0) % /s	3.0	Decrease the target power slope by the percentage of power to be unloaded.
19	Percentage of Active Power Regulation Limit	(0-100.0)%	10.0	Limit active / reactive power regulation. If the difference between the current power percentage and the target power percentage is greater than this setting value, the maximum output is limited according to this setting.
20	Reactive Power Regulation Limit Percentage	(0-100.0)%	10.0	
21	PV Unloading Open	(0-1)	1	PV unloading opening enable, 0: not enabled; 1: enabled. If this function is enabled, it will be opened when unloading fails; On the contrary, it will not open when unloading fails.
		(0-100.0)%	10.0	Active power percentage of unloading opening
		(0-3600)s	60	Unloading failure alarm delay value. PV unload failure alarm is always valid.
22	Solar Panel Temperature 1 Input Selection	(0-6)	0	0: not enabled 1: Sensor 1 2: Sensor 2 3: Sensor 3 4: Sensor 4 5: Sensor 5 6: Communication
23	Solar Panel Temperature 2 Input Selection	(0-6)	0	
24	Solar Panel Temperature 3 Input Selection	(0-6)	0	
25	Light Irradiance 1 Input Selection	(0-6)	0	
26	Light Irradiance 2 Input Selection	(0-6)	0	
27	Light Irradiance 3 Input Selection	(0-6)	0	
28	Solar Panel Temperature 1 Power Curve			Curve setting X - corresponding temperature or irradiance

No.	Items	Range	Default	Description
29	Solar Panel Temperature 2 Power Curve			Y - corresponding power percentage
30	Solar Panel Temperature 3 Power Curve			
31	Power Curve of Light Irradiance 1			
32	Power Curve of Light Irradiance 2			
33	Power Curve of Light Irradiance 3			
34	Solar Panel Temperature 1 Power Ratio	(0-100.0)%	20.0	The cumulative sum of (power percentage of each sensor * power percentage of each sensor) is the percentage of PV maximum capacity
35	Solar Panel Temperature 2 Power Ratio	(0-100.0)%	15.0	
36	Solar Panel Temperature 3 Power Ratio	(0-100.0)%	15.0	
37	Light Irradiance 1 Power Ratio	(0-100.0)%	20.0	
38	Light Irradiance 2 Power Ratio	(0-100.0)%	15.0	
39	Light Irradiance 3 Power Ratio	(0-100.0)%	15.0	
Switch Setting				
1	Close Delay	(0-20.0)s	5.0	Pulse width of PV close and generator close; 0 stands for constant output.
2	Open Delay	(0-20.0)s	3.0	Pulse width of PV generator open.
3	Open Detection Enabled	(0-1)	0	0: Disabled; 1: Enabled
Analog Sensor Setting				
Programmable 1 Sensor				
1	Sensor Selection	(0-5)	0	0:Disabled; 1: temperature sensor; 2: pressure sensor; 3: liquid level sensor; 4: power transmitter; 5: irradiance sensor.
2	Curve Type	(0-15)	0	Refer to table 15
3	Open Circuit Action	(0-4)	0	Open circuit alarm action type
4	Over 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	100	Setting value
		(-100-1000)%	90	Return value
		(0-3600)s	5	Delay value

No.	Items	Range	Default	Description
		(0-4)	1	Action type
5	Under 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	10	Setting value
		(-100-1000)%	20	Return value
		(0-3600)s	5	Delay value
		(0-4)	1	Action type
6	Over 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	90	Setting value
		(-100-1000)%	80	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
7	Under 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	20	Setting value
		(-100-1000)%	30	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
8	Customized Curve			
Programmable 2 Sensor				
1	Sensor Selection	(0-5)	0	0:Disabled; 1: temperature sensor; 2: pressure sensor; 3: liquid level sensor; 4: power transmitter; 5: irradiance sensor.
2	Curve Type	(0-15)	0	Refer to table 15
3	Open Circuit Action	(0-4)	0	Open circuit alarm action type
4	Over 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	100	Setting value
		(-100-1000)%	90	Return value
		(0-3600)s	5	Delay value
		(0-4)	1	Action type
5	Under 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	10	Setting value
		(-100-1000)%	20	Return value
		(0-3600)s	5	Delay value
		(0-4)	1	Action type
6	Over 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	90	Setting value
		(-100-1000)%	80	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
7	Under 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	20	Setting value
		(-100-1000)%	30	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type

No.	Items	Range	Default	Description
8	Customized Curve			
Programmable 3 Sensor				
1	Sensor Selection	(0-5)	0	0:Disabled; 1: temperature sensor; 2: pressure sensor; 3: liquid level sensor; 4: power transmitter; 5: irradiance sensor.
2	Curve Type	(0-15)	0	Refer to table 15
3	Open Circuit Action	(0-4)	0	Open circuit alarm action type
4	Over 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	100	Setting value
		(-100-1000)%	90	Return value
		(0-3600)s	5	Delay value
		(0-4)	1	Action type
5	Under 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	10	Setting value
		(-100-1000)%	20	Return value
		(0-3600)s	5	Delay value
		(0-4)	1	Action type
6	Over 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	90	Setting value
		(-100-1000)%	80	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
7	Under 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	20	Setting value
		(-100-1000)%	30	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
8	Customized Curve			
Programmable 4 Sensor				
1	Sensor Selection	(0-5)	0	0:Disabled; 1: temperature sensor; 2: pressure sensor; 3: liquid level sensor; 4: power transmitter; 5: irradiance sensor.
2	Curve Type	(0-15)	0	Refer to table 15
3	Open Circuit Action	(0-4)	0	Open circuit alarm action type
4	Over 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	100	Setting value
		(-100-1000)%	90	Return value
		(0-3600)s	5	Delay value
		(0-4)	1	Action type
5	Under 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	10	Setting value
		(-100-1000)%	20	Return value

No.	Items	Range	Default	Description
		(0-3600)s	5	Delay value
		(0-4)	1	Action type
6	Over 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	90	Setting value
		(-100-1000)%	80	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
7	Under 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	20	Setting value
		(-100-1000)%	30	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
8	Customized Curve			
Programmable 5 Sensor				
1	Sensor Selection	(0-5)	0	0:Disabled; 1: temperature sensor; 2: pressure sensor; 3: liquid level sensor; 4: power transmitter; 5: irradiance sensor.
2	Curve Type	(0-15)	0	Refer to table 15
3	Open Circuit Action	(0-4)	0	Open circuit alarm action type
4	Over 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	100	Setting value
		(-100-1000)%	90	Return value
		(0-3600)s	5	Delay value
		(0-4)	1	Action type
5	Under 1	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	10	Setting value
		(-100-1000)%	20	Return value
		(0-3600)s	5	Delay value
		(0-4)	1	Action type
6	Over 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	90	Setting value
		(-100-1000)%	80	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
7	Under 2	(0-1)	0	0: Disabled; 1: Enabled
		(-100-1000)%	20	Setting value
		(-100-1000)%	30	Return value
		(0-3600)s	5	Delay value
		(0-4)	0	Action type
8	Customized Curve			
Digital Input Port Setting				
Digital Input 1				

No.	Items	Range	Default	Description
1	Content Setting	(0-50)	28	Remote start (on-load). For details please see table 14.
2	Active Type	(0-1)	0	0: Close; 1: Open
Digital Input 2				
1	Content Setting	(0-50)	0	User-defined. For details please see table 14.
2	Active Type	(0-1)	0	0: Close; 1: Open
3	Active Range	(0-3)	0	0: From safety on delay; 1: From crank; 2: Always; 3:Never
4	Active Action	(0-4)	0	0: Warning; 1: Shutdown; 2: Trip and Stop; 3: Trip; 4: Indication.
5	Active Delay	(0-20.0)s	2.0	Time from detecting input port is active to confirmation.
6	Description			LCD displays corresponding content when input port is active.
Digital Input 3				
1	Content Setting	(0-50)	0	User-defined. For details please see table 14.
2	Active Type	(0-1)	0	0: Close; 1: Open
3	Active Range	(0-3)	0	0: From safety on delay; 1: From crank; 2: Always; 3:Never
4	Active Action	(0-4)	0	0: Warning; 1: Shutdown; 2: Trip and Stop; 3: Trip; 4: Indication.
5	Active Delay	(0-20.0)s	2.0	Time from detecting input port is active to confirmation.
6	Description			LCD displays corresponding content when input port is active.
Digital Input 4				
1	Content Setting	(0-50)	0	User-defined. For details please see table 14.
2	Active Type	(0-1)	0	0: Close; 1: Open
3	Active Range	(0-3)	0	0: From safety on delay; 1: From crank; 2: Always; 3:Never
4	Active Action	(0-4)	0	0: Warning; 1: Shutdown; 2: Trip and Stop; 3: Trip; 4: Indication.
5	Active Delay	(0-20.0)s	2.0	Time from detecting input port is active to confirmation.
6	Description			LCD displays corresponding content when input port is active.
Digital Input 5				
1	Content Setting	(0-50)	0	User-defined. For details please see table 14.
2	Active Type	(0-1)	0	0: Close; 1: Open
3	Active Range	(0-3)	0	0: From safety on delay; 1: From crank; 2: Always; 3:Never

No.	Items	Range	Default	Description
4	Active Action	(0-4)	0	0: Warning; 1: Shutdown; 2: Trip and Stop; 3: Trip; 4: Indication.
5	Active Delay	(0-20.0)s	2.0	Time from detecting input port is active to confirmation.
6	Description			LCD displays corresponding content when input port is active.
Digital Input 6				
1	Content Setting	(0-50)	0	User-defined. For details please see table 14.
2	Active Type	(0-1)	0	0: Close; 1: Open
3	Active Range	(0-3)	0	0: From safety on delay; 1: From crank; 2: Always; 3:Never
4	Active Action	(0-4)	0	0: Warning; 1: Shutdown; 2: Trip and Stop; 3: Trip; 4: Indication.
5	Active Delay	(0-20.0)s	2.0	Time from detecting input port is active to confirmation.
6	Description			LCD displays corresponding content when input port is active.
Digital Input 7				
1	Content Setting	(0-50)	0	User-defined. For details please see table 14.
2	Active Type	(0-1)	0	0: Close; 1: Open
3	Active Range	(0-3)	0	0: From safety on delay; 1: From crank; 2: Always; 3:Never
4	Active Action	(0-4)	0	0: Warning; 1: Shutdown; 2: Trip and Stop; 3: Trip; 4: Indication.
5	Active Delay	(0-20.0)s	2.0	Time from detecting input port is active to confirmation.
6	Description			LCD displays corresponding content when input port is active.
Relay Output Setting				
Relay Output 1				
1	Content Setting	(0-239)	0	Not use For details please see table 13.
2	Output Type	(0-1)	0	0: Normally open; 1: Normally close.
Relay Output 2				
1	Content Setting	(0-239)	0	Not use For details please see table 13.
2	Output Type	(0-1)	0	0: Normally open; 1: Normally close.
Relay Output 3				
1	Content Setting	(0-239)	0	Not use For details please see table 13.
2	Output Type	(0-1)	0	0: Normally open; 1: Normally close.
Relay Output 4				
1	Content Setting	(0-239)	0	Not use For details please see table 13.
2	Output Type	(0-1)	0	0: Normally open; 1: Normally close.

No.	Items	Range	Default	Description
Relay Output 5				
1	Content Setting	(0-239)	0	Not use For details please see table 13.
2	Output Type	(0-1)	0	0: Normally open; 1: Normally close.
Relay Output 6				
1	Content Setting	(0-239)	0	Not use For details please see table 13.
2	Output Type	(0-1)	0	0: Normally open; 1: Normally close.
Relay Output 7				
1	Content Setting	(0-239)	0	Not use For details please see table 13.
2	Output Type	(0-1)	0	0: Normally open; 1: Normally close.
Relay Output 8				
1	Content Setting	(0-239)	0	Not use For details please see table 13.
2	Output Type	(0-1)	0	0: Normally open; 1: Normally close.
Module Setting				
1	Power On Mode	(0-2)	0	0: Stop Mode; 1: Manual Mode; 2: Auto Mode
		(0-1)	0	Home display parameters 0:4 parameter 1:8 parameter
2	Slave ID	(1-254)	1	Controller address in remote monitoring status.
		(0-1)	(0-1)0	Pressure display unit 0: psi or 1: Bar
3	Language	(0-2)	0	0: Simplified Chinese; 1: English; 2: Other
		(0-3600) s	300	LCD on time, when 0, the LCD is always on
4	Password	(0-65535)	00318	This password is used to enter advanced parameter setting.
5	Date and Time			Set controller date and time
6	Startup Interface	(0-1)	0	0: Disabled; 1: Enabled
		(0-3600)s	10	Display time of power on interface when the controller is powered on again
7	Inverter Communication	(0-3)	2	0:2400 1:4800 2:9600 3:19200
		(0-1)	0	0: 2 bit stop bit; 1: 1 bit stop bit.
8	Alarm Data Recording Interval	(0-60.0)s	1	Record interval of 60 recorded data in each alarm data analysis record
9	Rated Voltage of Power Supply	(0-60)V	24.0	

No.	Items	Range	Default	Description
10	Over Voltage of Power Supply	(0-1)	1	0: Disabled; 1: Enabled
		(0-200.0)%	120.0	The setting value is a percentage of the rated supply voltage
		(0-200.0)%	115.0	The return value is a percentage of the rated supply voltage
		(0-3600)s	60	Delay value
		(0-4)	0	Action type
11	Under Voltage of Power Supply	(0-1)	1	0: Disabled; 1: Enabled
		(0-200.0)%	85.0	The setting value is a percentage of the rated supply voltage
		(0-200.0)%	90.0	The return value is a percentage of the rated supply voltage
		(0-3600)s	60	Delay value
		(0-4)	0	Action type
Network Setting				
1	Enable to Network Communication	(0-1)	0	0: Disabled; 1: Enabled
2	Enable to Obtain IP Address Automatically	(0-1)	0	0: Disabled; 1: Enabled; obtain IP address automatically
3	IP Address	(0-255)	192.168.0.100	All changes to the Ethernet settings (such as IP address, subnet mask, etc.) will not take effect until the controller is powered on again.
4	Subnet Mask	(0-255)	255.255.255.0	
5	Default Gateway	(0-255)	192.168.0.2	
6	DNS Address	(0-255)	211.138.24.66	
7	MAC Address	(0-255)		
8	Enable to TCP Modbus	(0-1)	0	0: Disabled; 1: Enabled
9	Enable to Cloud Monitoring Communication	(0-1)	0	0: Disabled; 1: Enabled
Cloud Server Setting				
1	Site Name	(0-65535)		20 Chinese characters or letters or numbers
2	URL Server	(0-65535)	www.monitoryun.com	
3	Server Port	(0-65535)	91	
4	Module Password	(0-65535)	123456	16 characters
5	Set Longitude	(-180-180)°	113.33	Unit controller location, altitude information; need to be manually input.
6	Set Latitude	(-90-90)°	34.48	
7	Altitude	(-9999.9-9999.9)	100.0	

No.	Items	Range	Default	Description
8	Historical Data Interval	(0-3600)s	10	
9	Real Time Data Interval	(1-20)s	5	

6.3 DEFINED CONTENT OF PROGRAMMABLE OUTPUT PORTS 1-6

Table 13 Programmable Output Ports 1-6

No.	Type	Description
0	Not Used	
1-6	Reserved	
7	Custom Combined 1	For details about function description please see the following content.
8	Custom Combined 2	
9	Custom Combined 3	
10	Custom Combined 4	
11	Custom Combined 5	
12	Custom Combined 6	
13	Forbid Busbar Power ATS Conversion	If the busbar power supply has two or more independent power sources and cannot be connected to the grid, if the PV is working, the output of this output port can not switch the busbar power supply.
14	Reserved	
15	Sound Alarm	When the "external connection" of the alarm can be programmed, the alarm can be disabled and the output can be disabled.
16	Remote Communication Control	The output port is controlled by communication (PC).
17	PV Closing Output	The PV generator switch can be controlled to close.
18	Opening Output	It can control the opening of PV generator switch.
19	Power on Successfully Output	PV power on after the normal operation output
20	PV Power Generation Normal Output	Activated when PV power generation is normal.
21	Effective PV Power Generation	Activated when during normal operation and high-speed heat dissipation of PV generator.
22	Normal Output of Busbar	Activated when the busbar is normal.
23	Reserved	
24	Public Alarm	Activated when busbar and PV power generation public warning.
25	Common Trip Shutdown Alarm	Activated when the public trip and stop alarm.
26	Public Shutdown Alarm	Activated when public shutdown alarm.
27	Public Trip Alarm	Activated when the public trip does not stop alarm, it will act.
28	Public Warning	Activated when the public warning alarm is given.
29	Reserved	

No.	Type	Description
30	Too High the Power Supply Voltage	Activated when the power supply voltage is too high to alarm.
31	Too Low the Power Supply Voltage	Activated when the power supply voltage is too low to alarm.
32	Reserved	
33	Reserved	
34	Reserved	
35	Digital Input 1 Active	Activated when input port 1 is active.
36	Digital Input 2 Active	Activated when input port 2 is active.
37	Digital Input 3 Active	Activated when input port 3 is active.
38	Digital Input 4 Active	Activated when input port 4 is active.
39	Digital Input 5 Active	Activated when input port 5 is active.
40	Digital Input 6 Active	Activated when input port 6 is active.
41	Digital Input 7 Active	Activated when input port 7 is active.
42-65	Reserved	
66	Power on failure alarm	Activated when crank disconnect signal is detected.
67	Shutdown failure warning	Activated when generator is OK.
68	PV Over Freq Warning 1	Activated when PV power generation over frequency setting value is 1.
69	PV Over Freq Shutdown 2	Activated when PV power generation over frequency setting value is 2.
70	PV Over Voltage Warning 1	Activated when PV power generation overvoltage setting value is 1.
71	PV Over Volt Shutdown 2	Activated when PV power generation overvoltage setting value is 2.
72	PV Under Frequency Warning 1	Activated when PV power generation under frequency setting value 1.
73	PV Under Frequency Shutdown 2	Activated when PV power generation under frequency setting value 2.
74	PV Under Voltage Warning 1	Activated when PV power generation under voltage set value 1
75	PV Under Voltage Shutdown 2	Activated when PV power generation under voltage set value 2
76	PV Loss of Phase	Activated when PV power generation loss phase.
77	PV Reverse Phase	Activated when PV power generation acts in reverse phase sequence.
78	PV Unbalanced voltage	Activated when PV voltage is unbalanced.
79	Reserved	
80	Reserved	
81	Reserved	
82	Reserved	
83	PV Over Current	Activated when PV over current (inverter communication

No.	Type	Description
		acquisition alarm)
84	Reserved	
85	Busbar No Power	Activated when busbar no Power
86	Busbar Over Frequency	Activated when busbar over Frequency
87	Busbar Over Voltage	Activated when busbar over Voltage
88	Busbar Under Frequency	Activated when busbar under frequency
89	Busbar Under Voltage	Activated when busbar under voltage
90	Busbar Phase Sequence Error	Activated when busbar phase sequence error
91	Busbar Phase Loss	Activated when busbar phase loss
92	Busbar Over Current	Activated when busbar over current
93	Busbar Reverse Power	Activated when busbar reverse power
94	Busbar Over Power	Activated when busbar over power
95	Unbalanced Busbar voltage	Activated when Busbar voltage is unbalance
96	Reserved	
97	Reserved	
98	Reserved	
99	Sensor 1 High 1 Alarm	
100	Sensor 1 Low 1 Alarm	
101	Sensor 1 High 2 Alarm	
102	Sensor 1 Low 2 Alarm	
103	Sensor 1 Open Circuit Alarm	
104	Sensor 2 High 1 Alarm	
105	Sensor 2 Low 1 Alarm	
106	Sensor 2 High 2 Alarm	
107	Sensor 2 Low 2 Alarm	Sensor high 1 alarm is the action when the sensor value is higher than the set value of over alarm 1
108	Sensor 2 Open Circuit Alarm	
109	Sensor 3 High 1 Alarm	Sensor low 1 alarm is the action when the sensor value is lower than the set value of low alarm 1
110	Sensor 3 Low 1 Alarm	
111	Sensor 3 High 2 Alarm	Sensor high 2 alarm acts when the sensor value is higher than the set value of over alarm 2
112	Sensor 3 Low 2 Alarm	
113	Sensor 3 Open Circuit Alarm	Sensor low 2 alarm is the action when the sensor value is lower than the set value of low alarm 2
114	Sensor 4 High 1 Alarm	
115	Sensor 4 Low 1 Alarm	Sensor open circuit alarm is the action of sensor open circuit
116	Sensor 4 High 2 Alarm	
117	Sensor 4 Low 2 Alarm	
118	Sensor 4 Open Circuit Alarm	
119	Sensor 5 High 1 Alarm	
120	Sensor 5 Low 1 Alarm	
121	Sensor 5 High 2 Alarm	
122	Sensor 5 Low 2 Alarm	
123	Sensor 5 Open Circuit Alarm	
124	Reserved	
125	Reserved	

No.	Type	Description
126	Reserved	
127	Reserved	
128	Shutdown Mode of System	Activated when the system is in shutdown mode.
129	Manual Mode of System	Activated when the system is in manual mode.
130	Reserved	
131	Automatic Mode of System	Activated when the system is in automatic mode.
132	PV Power Load Indication	Activated when PV power load indicated.
133-239	Reserved	

6.3.1 CUSTOMIZED COMBINATION OUTPUT

Defined combination output is composed by 3 parts, condition output S1 or S2 and condition output S3.
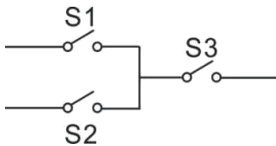
S1 or S2 is TRUE, while S3 is TRUE, defined combination output is outputting;

S1 and S2 are FALSE, or S3 is FALSE, defined combination output is not outputting.

⚠NOTE: S1, S2, S3 can be set as any contents except for "defined combination output" in the output setting.

⚠NOTE: 3 parts of defined combination output (S1, S2, and S3) couldn't include or recursively include themselves.

Example,

Contents of probably condition output S1: output port 1 is active;

Close when probably condition output S1 is active /inactive: close when active (disconnect when inactive);

Contents of probably condition output S2, output port 2 is active;

Close when probably condition output S2 is active /inactive: close when active (disconnect when inactive);

Contents of probably condition output S3: output port 3 is active;

Close when probably condition output S3 is active /inactive: close when active (disconnect when inactive);

When input port 1 active or input port 2 active, if input port 3 is active, Defined combination output is outputting; If input port 3 inactive, Defined combination output is not outputting;

When input port 1 inactive and input port 2 inactive, whatever input port 3 is active or not, Defined combination output is not outputting.

6.4 DEFINED CONTENTS OF DIGITAL INPUT PORTS 1~7

Table 14 Digital Inputs 1~7 (Ground connected is active (B-))

No.	Items	Description
0	User Configured	Users can define contents as bellow: Indication: only display without warning and shutdown. Warning: only warning without shutdown. Shutdown: alarm and shutdown immediately. Trip and stop: alarm, generator ramp-off load and stop after high-speed cooling. Trip: alarm, generator ramp-off load but not stop. Inactive: input doesn't work. Always active: input detects all the time. Active from startup: start detecting at the beginning of startup. Active from safety on: detecting after safety on.
1	Reserved	
2	Alarm Mute	When input is active, "Audible Alarm" output is inhibited.
3	Reset Alarm	When input is active, shutdown alarms and trip alarms can be reset.
4	Reserved	
5	Lamp Test	When input is active, all LED indicators are light.
6	Panel Lock	When input is active, all buttons on the panel are inactive except for ▲ ▼ ✳/OK ⌂/↩, and 🔒 displays on the right side of the first line of LCD status page.
7	Reserved	
8	Reserved	Under speed, under frequency and under voltage are not protected in this mode.
9	Inhibit Auto Stop	After generator is normal running in auto mode, when input is active, PV generation auto stop function is inhibited.
10	Inhibit Auto Start	After input is active in auto mode, PV generation auto start is inhibited.
11	Reserved	
12	Reserved	
13	PV Closing State Input	Connecting the auxiliary point on the PV circuit breaker switch..
14	Inhibit PV Load	When the input is valid, the PV power generation will inhibit to switch on.
15	Reserved	Connecting the auxiliary contactor of mains loading switch.
16	Reserved	When input is active, mains will inhibit to close.
17	Auto Mode Input	When input is active, controller will enter into auto mode, and all buttons on the panel are inactive except for ▲ ▼ ✳/OK ⌂/↩, and 🔒 displays on the right side of the first line of LCD status page.
18	Auto Mode Invalid	When input is active, controller will not work in auto mode,

No.	Items	Description
		key and "Simulate Auto Mode" key are unavailable.
19	Reserved	
20	Reserved	
21	Inhibit Alarm Shutdown	All shutdown alarms are inhibited except for emergency stop (sometimes called War Mode or Override Mode)
22	Instrument Mode	All outputs are inhibited in this mode.
23	Reserved	
24	Reserved	
25	Reserved	
26	Reserved	
27	Reserved	
28	Remote Start	In the automatic mode, when the input is valid, PV can be switched on automatically to generate power with load. When the input is invalid, PV power generation can be automatically stopped and opened.
29	Reserved	
30	Aux Manual Start	When input is active in manual mode, PV generation will be started automatically. When input is inactive, PV generation will be stopped automatically.
31	Reserved	
32	Reserved	
33	Simulate Stop Key	Externally connecting a button to simulate key function on the panel.
34	Simulate Manual Key	
35	Reserved	
36	Simulate Auto Key	Externally connecting a button to simulate key function on the panel.
37	Simulate Start Key	
38	Simulate PV Key	
39	Simulate PV Key	
40	Simulate Busbar OK	In auto mode if input is active, then busbar is OK.
41	Simulate Busbar Fail	In auto mode if input is active, then busbar is abnormal.
42	Reserved	
43	Busbar Divided 1 Power Input	If the busbar is divided into six inputs at most, it can be considered as six gensets. When one input is effective and the power of one genset is effective, all gensets will be switched on and loaded. If several input ports are effective, several gensets will be loaded. According to the configured busbar percentage N power percentage, the accumulated sum is the minimum load percentage of the current busbar to prevent reverse power transmission to the bus bar, resulting in the bus reverse work.
44	Busbar Divided 2 Power Input	
45	Busbar Divided 3 Power Input	
46	Busbar Divided 4 Power Input	

No.	Items	Description
47	Busbar Divided 5 Power Input	
48	Busbar Divided 6 Power Input	
49	Reserved	
50	Reserved	

6.5 SELECTION OF SENSORS

Table 15 Sensors Selection

No.		Description	Remark
1	Temperature Sensor	0 Not used 1 Custom resistor type curve 2 Custom curve 20mA-4 curve 3 Custom curve 0-5V curve 4 VDO 5 CURTIS 6 VOLVO-EC 7 DATCON 8 SGX 9 SGD 10 SGH 11 PT100 12 SUZUKI 13 Reserved 14 Reserved 15 Reserved	Defined resistance's range is 0~6KΩ, default is not used.
2	Pressure Sensor	0 Not used 1 Custom resistor type curve 2 Custom curve 20mA-4 curve 3 Custom curve 0-5V curve 4:VDO 10Bar 5:CURTIS 6:VDO 5Bar 7:DATCON 10Bar 8:SGX 9:SGD 10:SGH 11:VOLVO-EC 12:SUZUKI 13:4-20mA 10Bar 14:0-5V 10Bar 15 Reserved	Factory default is resistor type pressure sensor and defined resistance's range is 0~6KΩ, default is not used.

No.		Description	Remark
3	Liquid Level Sensor	0 Not used 1 Custom resistor type curve 2 Custom curve 20mA-4 curve 3 Custom curve 0-5V curve 4:SGD 5:SGH 6:SUZUKI 7-15 Reserved	Defined resistance's range is 0~6KΩ, default is not used.
4	Power Transmitter	0 Not used 1 Custom resistor type curve 2 Custom curve 20mA-4 curve 3 Custom curve 0-5V curve 4-15 Reserved	Defined resistance's range is 0~6KΩ, default is not used.
5	Irradiance sensor	0 Not used 1 Custom resistor type curve 2 Custom curve 20mA-4 curve 3 Custom curve 0-5V curve 4-15 Reserved	Defined resistance's range is 0~6KΩ, default is not used.

⚠**NOTE:** pressure sensor and flexible sensor 1 connected input signals are resistor, current and voltage signals. When configuring "custom current/voltage curve" via controller penal, X coordinate data need to be expanded tenfold, for example, for 4mA, input data is "40". When setting the "custom 0-5V curve" through the controller panel, the x-coordinate data should be enlarged by 100 times, such as 4V input data "400".

6.6 SENSOR SETTING

— When sensors are reselected, the sensor curve will be transferred into the standard value. For example, if temperature sensor is SGH (120°C resistor type) at default factory, its sensor curve is SGH (120°C resistor type); if SGD (120°C resistor type) is selected, the temperature sensor curve is SGD curve.

— If there is difference between standard sensor curves and the used sensor, users can select "defined sensor", and then input defined sensor curve.

— When the sensor curve is inputted, X value (resistor) must be inputted from small to large, otherwise, mistake occurs.

— If sensor is selected as "Not Used", sensor curve will not work.

— The corresponding sensor must be configured as "Not Used" if sensor only has alarm switch, otherwise, alarm shutdown or warning may occur.

— The headmost or backmost values in the vertical coordinates can be set as same as below.
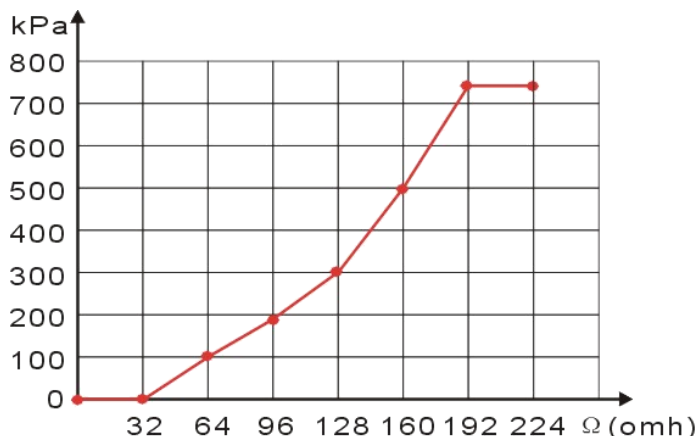
Fig.3 Curve Setting

Table 16 Common Unit Conversion Table

Items	N/m^2 (pa)	kgf/cm^2	bar	(p/in^2.psi)
1Pa	1	1.02×10^{-5}	1×10^{-5}	1.45×10^{-4}
1kgf/cm^2	9.8×10^4	1	0.98	14.2
1bar	1×10^5	1.02	1	14.5
1psi	6.89×10^3	7.03×10^{-2}	6.89×10^{-2}	1

7 COMMISSIONING

Please make sure the following checks are made before commissioning,

— Ensure all the wiring connections are correct and wire diameter is suitable.
— Ensure that the controller DC power has fuse, and controller's positive and negative and start battery are correctly connected.
— Select the AUTO mode from controller's panel, and connect busbar signal. After the normal delay of busbar, the controller will close the breaker switch (if any) to the inverter, and the controller will automatically start up with load.
— When the busbar is abnormal again, the controller will send out the shutdown command, and then send the PV power generation opening command. If not, refer to this manual to check the wiring of switch control part.
— If there is any other question, please contact SmartGen's service.

8 PV CONTROL MODE DESCRIPTION

8.1 PV ACTIVE POWER CONTROL MODE

8.1.1 FIXED POWER MODE

Constant output of the set active power.

8.1.2 BUSBAR CONTROL POWER MODE

Set the minimum load percentage ratio of the bus bar, and the part exceeding the minimum load setting value of the bus bar will be loaded by PV power generation. The bus control mode must be

connected to the bus CT or bus power transmitter or other communication methods to obtain the bus power.

8.1.3 INVERTER CONTROL MODE

The controller does not control the power output, but the active power output is controlled by the inverter itself.

8.2 PV REACTIVE POWER CONTROL MODE

8.2.1 FIXED POWER MODE

Constant output of the set reactive power.

8.2.2 BUSBAR CONTROL POWER MODE

The busbar and PV share the reactive power equally.

8.2.3 POWER FACTOR CONTROL MODE

The reactive power output outputs reactive power according to the power factor, or the controller automatically controls the inverter to control according to the power factor (if supported by the inverter).

8.2.4 INVERTER CONTROL MODE

The controller does not control the power output, but the inverter controls the output of reactive power.

9 TYPICAL APPLICATION
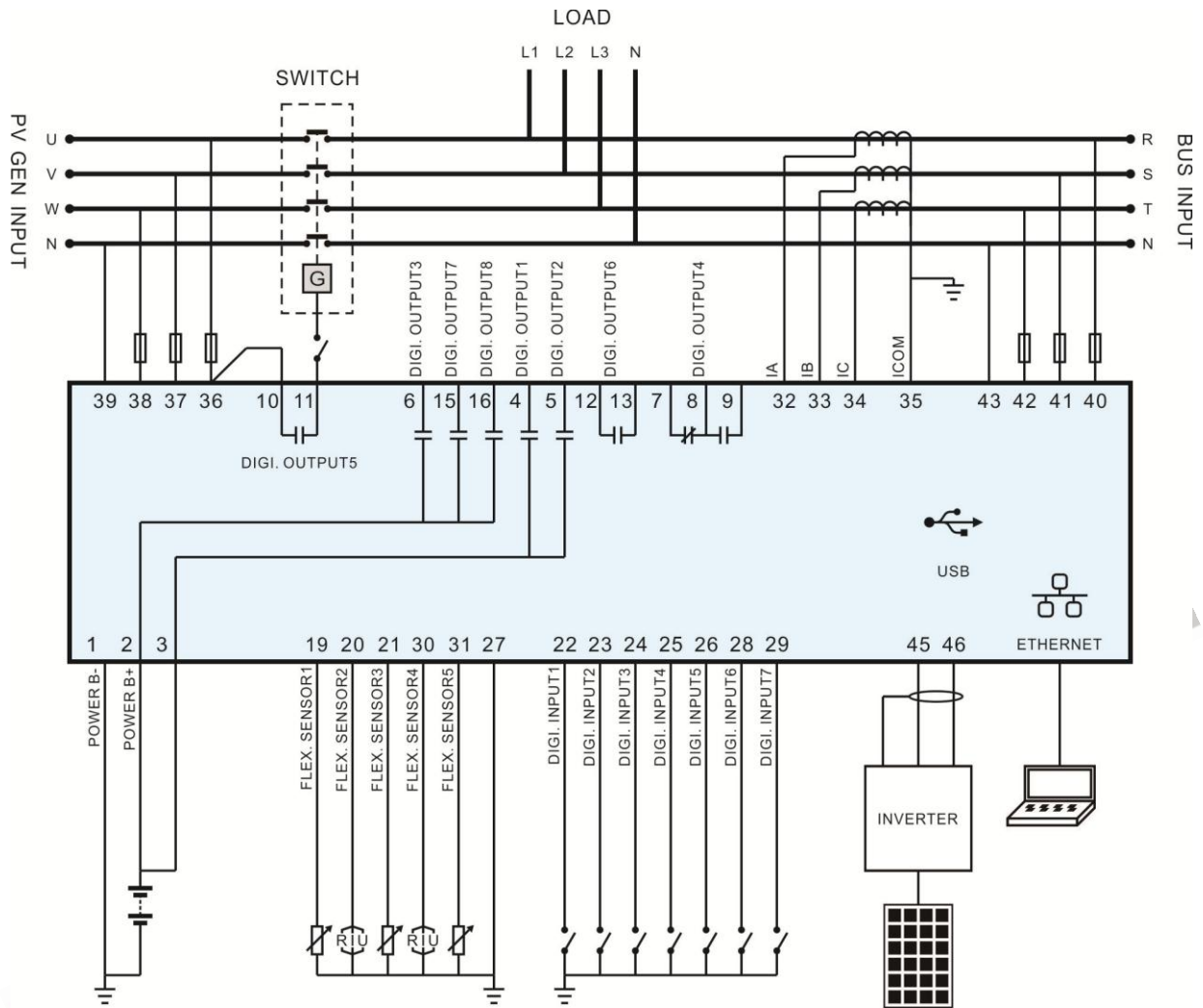
Fig.4 HES7120-PV Typical Application (Current Transformer)
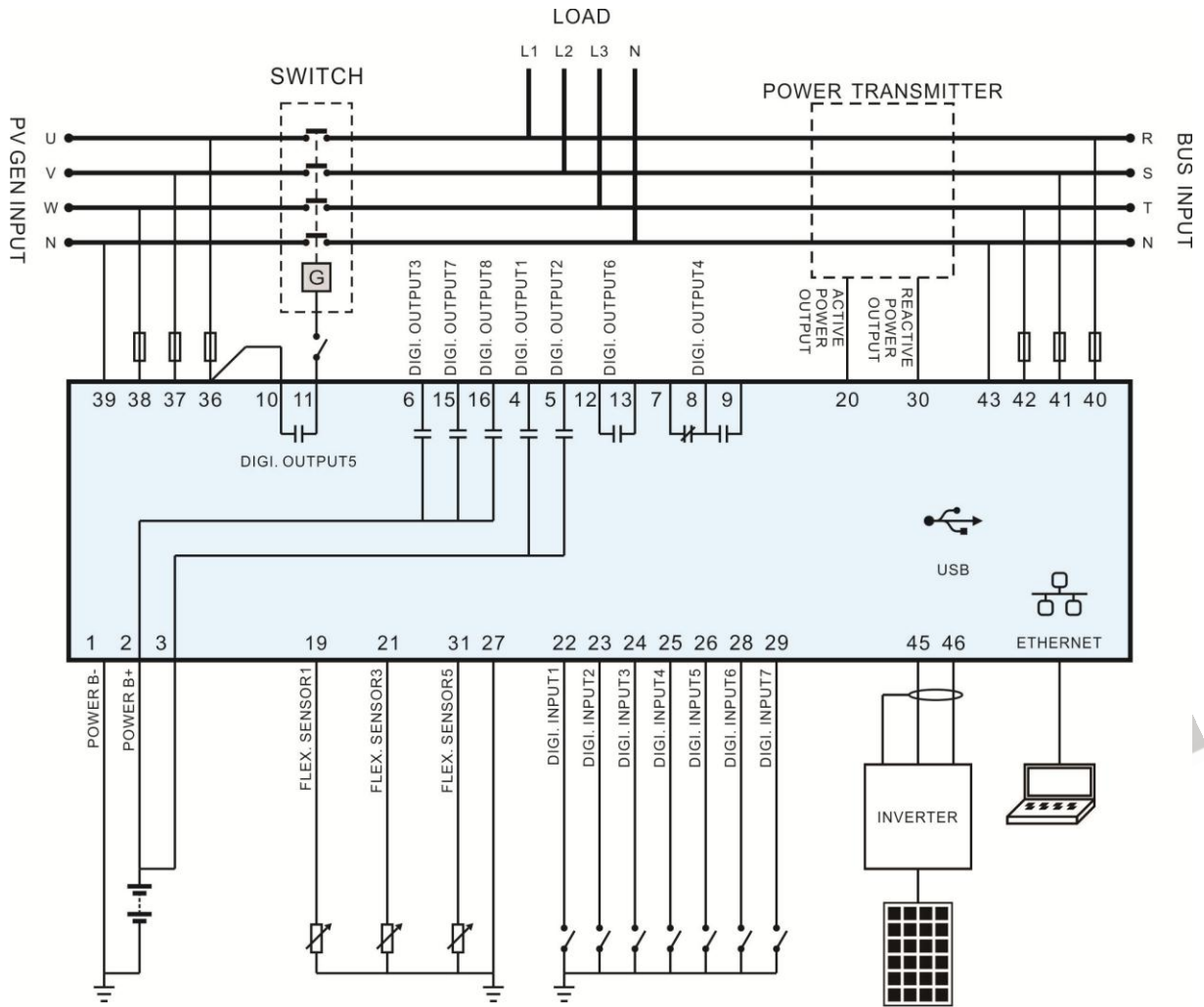
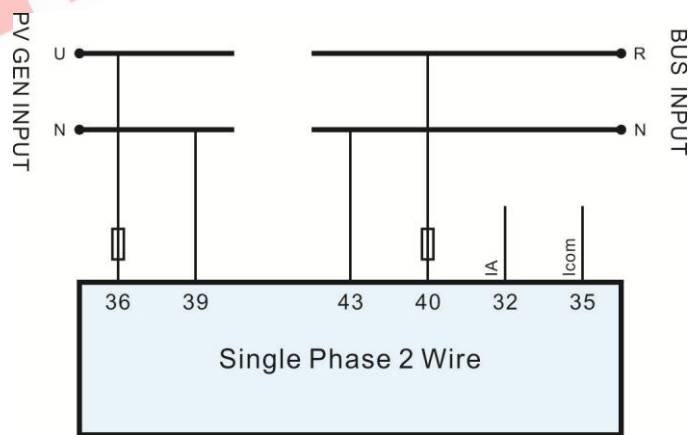**Fig.5   HES7120-PV Typical Application (Power Transmitter)**
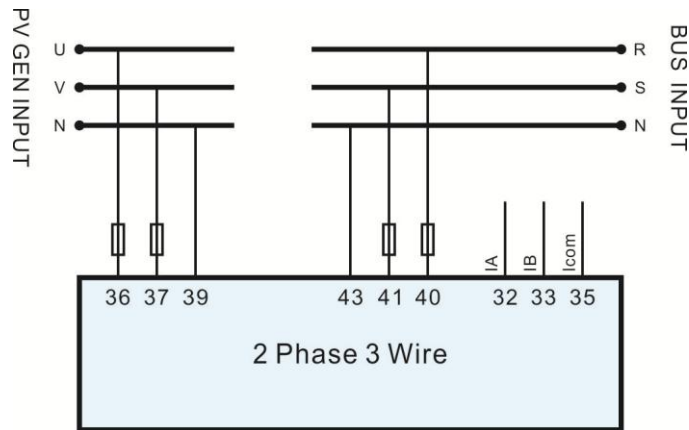

Fig.6   Single Phase 2-Wire Connection Diagram
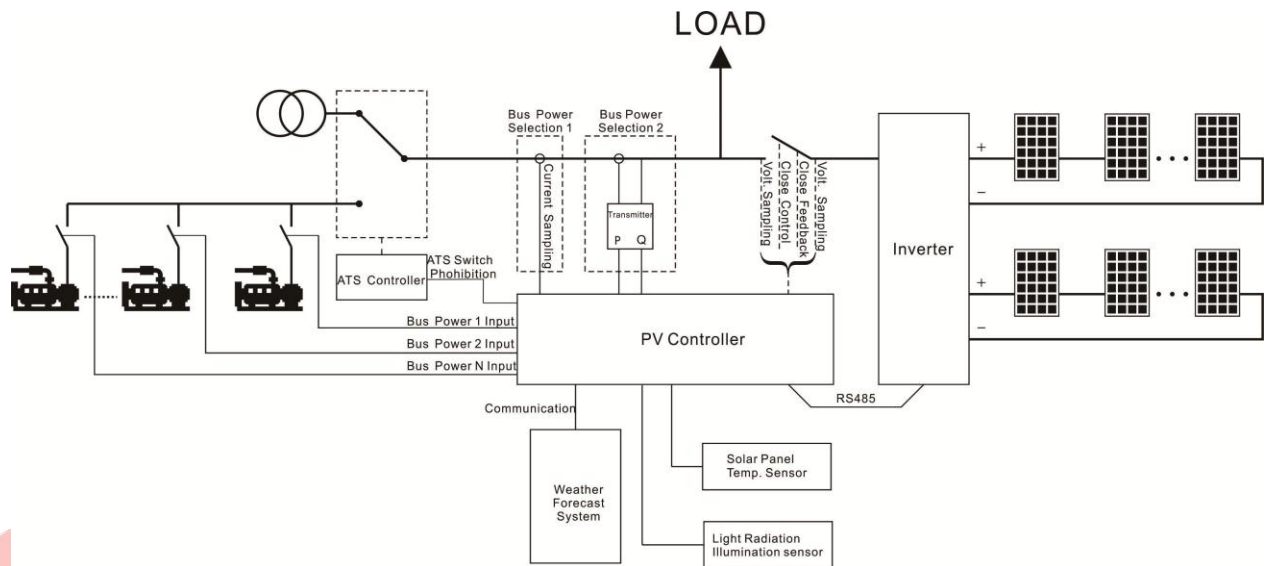
Fig.7   2-Phase 3-Wire Connection Diagram

Fig.8   HES7120-PV Application Diagram

10   INSTALLATION

10.1   FIXING CLIPS

— Controller is panel built-in design; it is fixed by clips when installed.
— Withdraw the fixing clip screw (turn anticlockwise) until it reaches proper position.
— Pull the fixing clip backwards (towards the back of the module) and ensure two clips are inside their allotted slots.
— Turn the fixing clip screws clockwise until they are fixed on the panel.
— Care should be taken not to over tighten the screws of fixing clips.
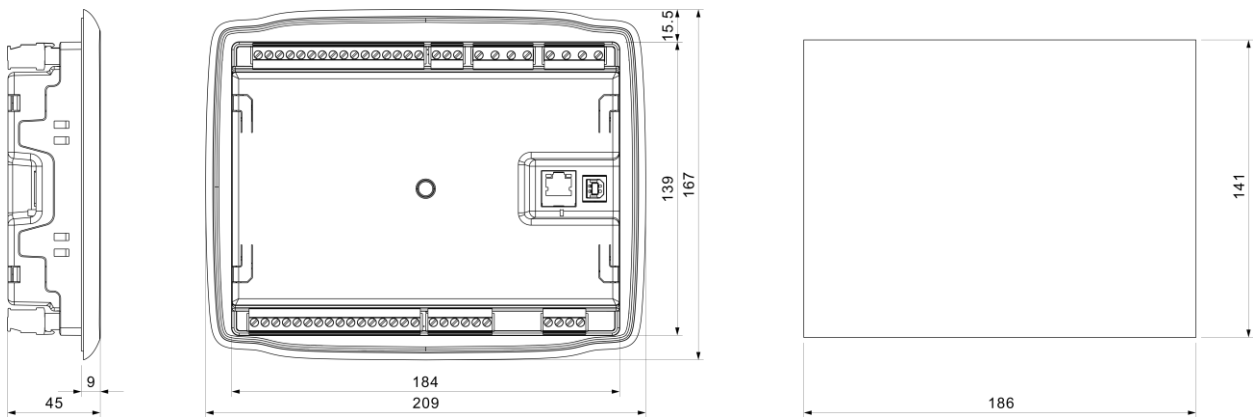
10.2   OVERALL DIMENSION AND PANEL CUTOUT

Fig.9   Overall Dimensions

⚠ **NOTE:** Unit: mm.

HES7120-PV series controller can suit for wide range of battery voltage DC (8~35) V. Diameter of wire that connects power supply with battery must be over 2.5mm². If floating charger is configured, please firstly connect output wires of charger to battery's positive and negative directly, then, connect wires from battery's positive and negative to controller's positive and negative input ports in order to prevent charger disturbing the controller's normal working.

— **OUTPUT AND EXPAND RELAYS:** All outputs of controller are relay contact output type. If expansion relays are needed, please add freewheel diode to both ends of expansion relay's coils (when coils of relay has DC current) or, increase resistance-capacitance return circuit (when coils of relay has AC current), in order to prevent disturbance to controller or other equipment.

— **AC INPUT:** Current input of HES7120-PV series controller must be connected to outside current transformer. And the current transformer's secondary side current must be 5A. At the same time, the phases of current transformer and input voltage must be correct. Otherwise, the current collected and active power maybe not be correct.

— **WITHSTAND VOLTAGE TEST:** When controller had been installed on display window, if the high voltage test is needed, please disconnect controller's all terminal connections, in order to prevent high voltage getting into controller and damaging it.

⚠**NOTES:**

  a) ICOM port must be connected to negative pole of battery.

  b) When there is load current, open circuit is prohibited on transformer's secondary side.

11 TROUBLESHOOTING

Table 17 Troubleshooting

Symptoms	Possible Solutions
Controller No Response with Power	Check starting batteries; Check controller connection wirings; Check DC fuse.
Start Failure	Check whether the waiting time is enough. Check the inverter for alarm. Check whether the AC power is connected to the inverter.
Switch Failure	Check whether the closing feedback line is connected correctly; Detect whether the switch closing and opening signal is a continuous signal. Check whether the switch acts.
Rectifier Communication Failure	Check the connection; check whether the communication baud rate or stop bit is correct. Check whether the A and B lines of RS485 are connected reversely. Check whether the communication port of inverter is damaged. Suggest to add 120Ω resistor between AB of RS485 Controller.

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