SmartGen

MAKING CONTROL SMARTER

PCC95

PCS CONTROLLER

USER MANUAL

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Table 1 Software Version

Date	Version	Note
2024-03-30	1.0	Original release.

This manual only suits for PCC95 PCS (Power Conversion System) controller.

Table 2 Symbol Instruction

Symbol	Instruction
NOTE	Highlights an essential element of a procedure to ensure correctness.
CAUTION	Indicates a procedure or practice, which, if not strictly observed, could result in damage or destruction of equipment.
WARNING	Indicates a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.

CONTENTS

1 OVERVIEW

PCC95 PCS (Power Conversion System) Controller is designed for power system consisted of single or multiple PCS and genset or mains supply, aiming to control the PCS mode transfer, auto start/stop, input/output power, data monitoring and measurement, alarm protection. It fits with large LCD display, optional Chinese, English and other languages interface, and it is reliable and easy to use.

PCC95 PCS (Power Conversion System) Controller receives the Bus power via MSC CAN interface (genset equipped with HGM9510/9530/HGM9510N/9530N controller) or AC sampling. Controller can display various real-time data and alarm data of BMS. Controller has three power control methods: constant power, demand power and genset power, which can control the PCS working mode in VF, PQ or VSG. In addition, controller can quickly command (<100ms) PCS to change output or input power, which may improve the system performance during sudden loading or unloading, and also meet the power control of battery charging/discharging for long-term running.

PCC95 PCS (Power Conversion System) Controller has several communication interfaces (2-way RS485 interface, 3-way CAN interface, 1-way Ethernet interface), the comprehensive fault protection, the comprehensive fault protection can handle different complex applications. It can be widely used in all types of parallel system of PCS and Bus with compact structure, advanced circuits, simple connections and high reliability.

2 PERFORMANCE AND CHARACTERISTICS

Main characteristics are as bellow:

– With ARM-based 32-bit SCM, high integration of hardware and more reliable;

– 240x128 LCD with backlight, multilingual interface (including Chinese, English, or other languages) which can be chosen on site, making commissioning convenient for factory personnel;

– Two RS485 communication interfaces can connect with PCS or BMS (Battery Manage System) respectively or enable remote control, remote measuring, remote communication via MODBUS protocol;

– Fitted with CAN BUS interface and can connect with PCS or BMS;

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

– Storage battery parameters: DC voltage, DC current, DC power, SOC, SOH, max. charging current, max. discharging current, storage energy accumulated charging/discharging;

– PCS AC parameters can select PCS communication or AC sampling to calculate;

– Collect and display 3-phase voltage, frequency, 3-phase current, power of PCS and voltage harmonic parameter of PCS;

– Collect and display 3-phase voltage of Bus, Bus frequency;

– When genset is equipped with HGM9510/9530/HGM9510N/9530N controller, the system may receive the Bus power through MSC(1)(LINK), or by setting Bus CT-phase to calculate Bus power. The Bus power has the detection functions for loss of phase and reverse phase;

– PCS detection functions for over/under voltage, over/under frequency, high unbalanced voltage, high waveform distortion, overcurrent, earth fault, high unbalanced current, low power factor, charging/discharging over power, loss of phase and reverse phase sequence;

– Synchronous parameters: voltage difference between PCS and Bus, frequency difference between PCS and Bus, phase angle difference between PCS and Bus (the PCS AC parameter is AC sampling);

– PCS has three power control methods: constant power, demand power and genset power) when it works in PQ or VSG mode;

– It is without power control when PCS works in VF mode;

– Power limit curve (SOC – kw) can be set. When setting the corresponding max. charging/discharging power of SOC, under no circumstances, should the target value exceed the limit;

– The adjusted power b of demand power control method can be fixed power or setting curve (SOC-b);

– 5 configurable analogue sensors;

– Configurable 2 and configurable 4 sensor inputs can directly connect with resistance/voltage/current sensors, while other sensor inputs can directly connect with resistance sensors, and for connecting voltage/current sensors, please make it clear before the order;

– More kinds of curves of temperature, sensors can be used directly and users can define the sensor curves by themselves;

– Control and protection function: automatic start/stop of PCS, ATS (Auto Transfer Switch) control and perfect 2-class fault indication and protection function etc.;

– Parameter setting function: parameters can be modified by users and stored in internal EEPROM memory, and cannot be lost even in case of power outage; most of them can be adjusted from the front panel of the controller and all of them can be modified on PC by USB interfaces or RS485 interfaces;

– Wide power supply range DC(8~35)V, suitable for different DC voltage environment;

– Event log, real-time clock can circularly record 999 pieces of events;

– Black box function can circularly record 5 groups of fault alarm data and each group of data record 60 pieces of details 50s before and 10s after the fault alarm occurs;

– All parameters apply digital adjustment, getting rid of conventional analogue modulation with normal potentiometer, and improving genset reliability and stability;

– Improved LCD wear-resistance and scratch resistance due to hard screen acrylic;

– Silicon panel and pushbuttons for better operation in high/low temperature environment;

– IP65 waterproof level is achieved with the help of rubber-ring gasket between shell and control panel;

– Metal fixing clips employed to fix the controller and make it perform better under high temperature environment;

– Modular structure design, anti-flaming ABS plastic enclosure, pluggable terminal, built-in mounting, compact structure with easy installation;

3 SPECIFICATION

Table 3 Technical Specification

Parameter	Details
Working Voltage	Range: DC8V - DC35V continuous, limit voltage DC80V, DC reverse connection protection Resolution: 0.1V Accuracy: 1%
	Range: DC12V-DC30V continuous (UL certified product)
Overall Consumption	<7W (Standby mode: ≤2.5W)
AC Voltage	Phase voltage Range: AC15V - AC360V (ph-N) Resolution: 0.1V Accuracy: 0.5%
	Line voltage Range: AC30V - AC620V (ph-ph) Resolution: 0.1V Accuracy: 0.5%
AC Frequency	Range: 5Hz -75Hz Resolution: 0.01Hz Accuracy: 0.1Hz
AC Current	Rated: 5A Range: 0A - 10A Resolution: 0.1A Accuracy: 0.5%
Analog Sensor	Resistor Input Range: 0Ω - 6000Ω Resolution: 0.1 Accuracy: 1Ω (below 300Ω)
	Voltage Input Range: 0V - 5V Resolution: 0.001V Accuracy: 1%
	Current Input Range: 0mA - 20mA Resolution: 0.01mA Accuracy: 1%
Digital Output 1	16A DC24V power supply output (relay output)
	3A DC12V/30V power supply output (relay output) (UL certified product)
Digital Output 2	16A DC24V power supply output (relay output)
	3A DC12V/30V power supply output (relay output) (UL certified

Parameter	Details
	product)
Digital Output 3	8A DC30V power supply output (relay output)
	5A DC24V power supply output (relay output) (UL certified product)
Digital Output 4	8A DC30V power supply output (relay output)
	5A DC24V power supply output (relay output) (UL certified product)
Digital Output 5	8A DC30V power supply output (relay output)
	5A DC24V power supply output (relay output) (UL certified product)
Digital Output 6	8A AC250V volt-free output (relay output)
	5A AC250V volt-free output (relay output) (UL certified product)
Digital Output 7	8A AC250V volt-free output (relay output)
	5A AC150V volt-free output (relay output) (UL certified product)
Digital Output 8	8A AC250V volt-free output (relay output)
	5A AC150V volt-free output (relay output) (UL certified product)
Digital Output 9	1A DC30V power supply output (transistor output)
	1A DC30V/12V power supply output (transistor output) (UL certified product)
Digital Output 10	1A DC30V power supply output (transistor output)
	1A DC30V/12V power supply output (transistor output) (UL certified product)
Digital Input 1-10	Low limit voltage is 1.2V, high limit voltage is 60V
RS485	Isolated, half-duplex, 9600 baud rate, maximum communication length 1000m
Ethernet	Self-adapting 10/100Mbit
MSC CAN	Isolated, maximum communication length 250m; applying Belden 9841 cable or the equivalence;
EMC/CE Certification	EN 61326-1:2013
Vibration Test	5 - 8 Hz: ±7.5 mm 8 - 500 Hz: 2g IEC 60068-2-6
Shock Test	50g, 11ms, half-sine, complete shock test from three directions, and 18 times shock for each test IEC 60068-2-27
Bump Test	25g, 16ms, half-sine IEC 60255-21-2
Safety Requirements	According to EN 61010-1 installation category (over voltage category) III, 300V, pollution class 2, altitude 3000m
Case Dimensions	242mm x 186mm x 49mm
Panel Cutout	214mm x 160mm
Working Temperature	(-25~+70)°C
Working Humidity	(20~93)%RH
Storage Temperature	(-30~+80)°C
Protection Level	Front Enclosure: IP65 when rubber-ring gasket is installed between

Parameter	Details
	the enclosure and the control panel Back Enclosure: IP20
Insulation 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	1.1kg

4 OPERATION

4.1 INDICATORS

Fig.1 PCC95 Front Panel

NOTE: Description for parts of indicators.

Table 4 Alarm Indicator Description

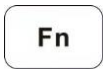
Alarm Type	Alarm Indicator
Warning	Slow flashing (1 time per second)
Block	Slow flashing (1 time per second)
Trip	Fast flashing (5 times per second)
Trip and Stop	Fast flashing (5 times per second)
Shutdown	Fast flashing (5 times per second)
No Alarm	Extinguished

Running indicator: is normally illuminated during PCS start and extinguished for other periods;

PCS normal indicator: is normally illuminated when the PCS is normal running; otherwise, it is extinguished .

4.2 KEY FUNCTION

Table 5 Key Function Description

Icons	Keys	Description
	Stop	Stop the running PCS in Auto/Manual mode; Reset alarm in stop mode; Lamp test (press at least 3 seconds).
	Start	Start the PCS in Manual mode.
	Manual Mode	Press this key and the controller goes in Manual mode.
	Auto Mode	Press this key and controller goes in Auto mode.
	Mute/Alarm Reset	Remove the alarm sound; Remove the alarm by pressing for over 3s.
	Fn	Shortcut settings combined with other keys; or other function keys (start/stop key etc.) by setting.
	Close	Close the breaker in manual mode.
	Open	Open the breaker in manual mode.
	Up/Increase	1) Screen scroll; 2) Move up the cursor and increase value in setting menu.
	Down/Decrease	1) Screen scroll; 2) Move down the cursor and decrease value in setting menu.
	Left	1) Page scroll; 2) Left move the cursor in setting menu.
	Right	1) Page scroll; 2) Right move the cursor in setting menu.
	Set/Confirm	1) Enter setting screen; 2) Enter the next menu or confirm in setting menu.
	Exit	1) Return to main menu; 2) Return to previous menu in setting menu.

CAUTION: Factory default password is "00318", and users can change it in case others change the advanced parameter settings. Please clearly remember the password after changing. If you forget it, please contact SmartGen services and send the PD information in the controller page of "**ABOUT**" to the service personnel.

4.3 LCD DISPLAY

4.3.1 MAIN DISPLAY

Paging is applied for the main screen; is used for page scroll and for screen scroll.

Main screen includes the following contents:

PCS: voltage, frequency, current, active power, reactive power, PCS working mode;

Bus: voltage, frequency, active power, reactive power;

Energy Storage Battery: battery pack voltage, battery pack current, SOC;

Part of status displays.

Status page includes the following contents:

PCS status, Bus status and ATS status.

Energy storage battery page includes the following contents:

DC voltage, DC current, DC power, SOC, SOH, max. charging/discharging current, energy storage accumulated discharging/charging.

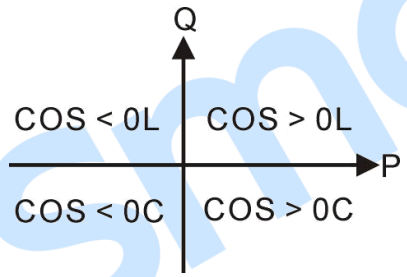
PCS page includes the following contents:

Phase voltage, line voltage, frequency, phase sequence, current, active power of different phases, total active power and percentage, reactive power of different phases, total reactive power and percentage, apparent power of different phases, total apparent power, power factor of different phases, average power factor, ground current and percentage, unbalanced current and percentage, unbalanced voltage and percentage, voltage harmonic parameter, load power, power control parameter.

Bus page includes the following contents:

Phase voltage, line voltage, frequency, phase sequence, current, Bus current power.

NOTE:



NOTE:

P stands for active power;

Q stands for reactive power.

Fig. 2 Power Factor Display Description

Table 6 Power Factor Display Description

Power Factor	Conditions	Active Power	Reactive Power	Remark
COS>0L	P>0,Q>0	Output	Output	PCS discharges, output is reactive and load is resistive induction.
COS>0C	P>0,Q<0	Output	Input	PCS discharges, input is reactive and load is resistive capacitance.
COS<0L	P<0,Q>0	Input	Output	PCS charges, output is reactive and load equals an under excitation generator.
COS<0C	P<0,Q<0	Input	Input	PCS charges, input is reactive and load equals an over excitation generator.

Sync. page includes the following contents:

Voltage difference, frequency difference, phase difference, PCS active power output and target percentage, PCS reactive power output and target percentage, active power of PCS and Bus, MSC status.

Alarm page:

Current alarm information. Paging is applied for shutdown alarm, trip and stop, trip, block and warning.

Example: PCS overvoltage shutdown alarm, PCS communication failure alarm.

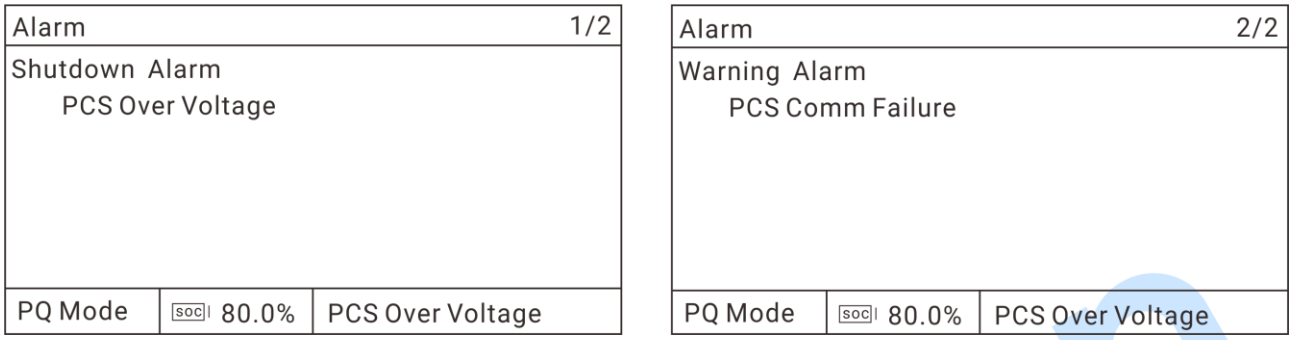
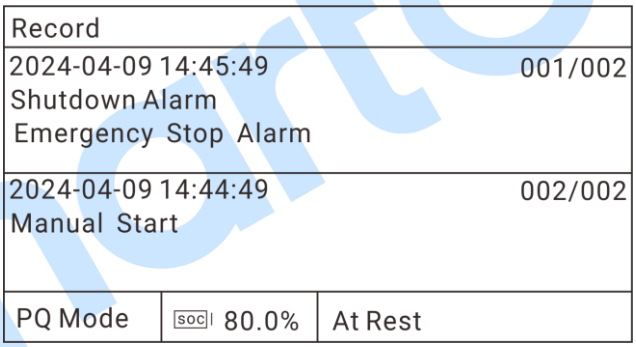


Fig.3 – Alarm Interface

Event log page:

Make records about all start/stop events (alarm events except warnings, manual start/stop events) and the real time when events occur; 999 items of events can be recorded circularly.

Example: Emergency stop alarm, manual start events.



Others page includes the following contents:

Time and date, input/output port status, communication indication and Ethernet configuration (if configured).

About page includes the following contents:

Release software version, hardware version, and product PD number.

4.3.2 USER MENU AND PARAMETER SETTING

Press 

key for more than 1s and it enters user menu.

- Parameter Setting

After inputting the correct password (factory default password is 00318) you can enter the parameter setting screen.

- Language

Optional Simplified Chinese, English and others.

- PCS Mode Select

PQ Mode, VF Mode, VSG Mode

- Control Method

Constant Power, Demand Power, Genset Power

4.4 AUTO START/STOP OPERATION

Press the  button and the indicator beside is illuminated, which means the PCS controller is in Auto Start Mode.

Automatic Start Sequence:

1) When remote start input is active, “start delay” timer is initiated;
2) “Start Delay” countdown will be displayed on PCS status page;
3) When start delay is over, PCS is in PQ mode and initiates a closing command, waiting for closed and then enters into starting; When in VSG mode or VF mode, it enters into starting directly and “Staring XXs” information will be displayed on LCD;
4) In staring delay process, if PCS starts successfully and enters normal running, the controller will enter normal running status. After the above delay, if PCS fails to start successfully, the controller will send a start failure warning and the related information will be displayed on LCD. If pressing the stop key and the controller enters standby status, otherwise, PCS will be always in waiting for starting successfully.
5) After crank disconnect, the unit enters the “Normal Running”. If the PCS voltage or frequency is abnormal, the controller will send a shutdown alarm (the related the alarm information will be displayed on LCD);
6) When in normal running
   a) VF and VSG mode: when in normal running, if bus is power off, the controller will send a closing output command; if bus is power on, the controller will wait for PCS and bus to meet the synchronization conditions and send a closing command.
   b) PQ and VSG mode: according to the setting power control method to receive the demand power, the controller will send a corresponding power command to PCS.
   c) VF mode: power control is disabled.

Automatic Stop Sequence:

1) When the remote start signal is inactive, the “stop delay” is initiated;
2) Once this “stop delay” has expired,
   a) VF Mode: it will send an opening signal, the controller will enter shutdown status and send shutdown command to PCS;
   b) PQ Mode: the controller will enter the shutdown status and send command to PCS, waiting for PCS shutdown, then send opening signal.
   c) VSG Mode: when detecting Bus has other closing signal, after the soft unload, then send opening signal; the controller will enter the shutdown status and send command to PCS.
3) After PCS shutdown, the controller will enter the standby status.

4.5 MANUAL START/STOP OPERATION

1) MANUAL START: Manual mode is selected by pressing  ; a LED beside will be illuminated to confirm the operation; then press  to start the PCS; (please refer to No.3~9 of **Automatic Start Sequence** for detailed procedures).

2) MANUAL STOP: Press  and it can shut down the running PCS. (Please refer to No.2~3 of **Automatic Start Sequence** for detailed procedures).

NOTE: In "manual mode", for the procedures of ATS please refer to **Switch Control Procedures** in this manual.

4.6 SWITCH CONTROL PROCEDURES

4.6.1 MANUAL CONTROL PROCEDURES

When controller is in Manual mode, the switch control procedures will start through manual transfer procedures. Users can control the closing/opening of ATS via pressing button to switch on or off.

Breaker Close Operation:

1) PQ Mode: when Bus is normal, press  to send a closing signal directly;

2) VF Mode or VSG Mode: when PCS is in normal running, press  key;

   a) If Bus is power off, it will send a closing signal directly;

   b) If Bus is power on, the controller will wait for PCS and Bus to meet the synchronization conditions and send a closing signal.

3) VF Mode or VSG Mode: if PCS is not in normal running, and the breaker is closed or is closing, the breaker status of controller is transferred to opening action.

Breaker Open Operation: Press the  button:

1) VF Mode: the controller sends open breaker signal;

2) PQ Mode: after unloading, the controller sends open breaker signal;

3) VSG Mode: when controller detects that the bus has other close signals, it opens after soft unloading, otherwise, it will open directly.

4.6.2 AUTOMATIC CONTROL PROCEDURES

When controller is in Auto mode, the switch control procedure is automatic control procedure.

NOTE: The auxiliary close input is not configured, the breaker is not in control and the closing status is always active.

5 PROTECTIONS

5.1 WARNING ALARMS

When controller detects the warning alarm, it only issues warning, and the unit does not open and shut down. When the warning signal disappears, it is removed automatically.

Table 7 Warning Alarms

No	Type	Description
1	BMS Comm. Failure	When BMS communication is enabled and controller cannot read the BMS data, it will initiate a warning signal. It is always detected.
2	PCS Comm. Failure	When PCS communication is enabled and controller cannot read the PCS data, it will initiate a warning signal. It is always detected.
3	PCS Over Frequency	When this is enabled, and the controller detects the PCS frequency is above the preset limit, it will initiate a warning signal. It is always detected.
4	PCS Under Frequency	When this is enabled, and the controller detects the PCS frequency is below the preset limit, it will initiate a warning signal. It is detected in normal running.
5	PCS Over Voltage	When this is enabled, and the controller detects the PCS voltage is above the preset limit, it shall issue a warning. It is always detected.
6	PCS Under Voltage	When this is enabled, and the controller detects the PCS voltage is below the preset limit, it will initiate a warning signal. It is detected in normal running.
7	PCS Over Current	When this is enabled, and the controller detects the PCS current is above the preset limit, it will initiate a warning signal. It is always detected.
8	Start Failure	When starting delay is over, if PCS doesn't enter the normal running, it will initiate a warning signal.
9	Unbalanced Current	When this is enabled, and the controller detects the value is above the preset limit, it will initiate a warning signal. It is always detected.
10	Earth Fault	When this is enabled, and the controller detects the earth current is above the preset limit, it will initiate a warning signal. It is always detected.
11	Charging Over Power	When it is enabled, and the controller detects that PCS charging power is above the preset limit, it will initiate a warning signal. It is always detected.
12	Discharging Over Power	When it is enabled, and the controller detects that PCS discharging power is above the preset limit, it will initiate a warning signal. It is always detected.

No	Type	Description
13	PCS Reverse Phase Sequence	In PCS AC sampling, when controller detects PCS reverse phase sequence, it will initiate a warning signal. It is detected when voltage of 3P4W or 2P3W is over than 30V or voltage of 3P3W is over than 50V.
14	PCS Loss of Phase	In PCS AC sampling, when controller detects PCS loss of phase, it will initiate a warning signal. It is detected when voltage of 3P4W or 2P3W is over than 30V or voltage of 3P3W is over than 50V.
15	Flex. Sensor 1 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
16	Flex. Sensor 1 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
17	Flex. Sensor 1 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
18	Flex. Sensor 1 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
19	Flex. Sensor 2 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
20	Flex. Sensor 2 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
21	Flex. Sensor 2 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
22	Flex. Sensor 2 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
23	Flex. Sensor 3 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.

No	Type	Description
24	Flex. Sensor 3 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
25	Flex. Sensor 3 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
26	Flex. Sensor 3 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
27	Flex. Sensor 4 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
28	Flex. Sensor 4 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
29	Flex. Sensor 4 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
30	Flex. Sensor 4 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
31	Flex. Sensor 5 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
32	Flex. Sensor 5 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
33	Flex. Sensor 5 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
34	Flex. Sensor 5 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to

No	Type	Description
		resistor type to prevent damaging the controller. It is always detected.
35	Supply Over Voltage	When this is enabled, and the controller detects the supply voltage is above the preset limit, it will initiate a warning signal. It is always detected.
36	Supply Under Voltage	When this is enabled, and the controller detects the supply voltage is below the preset limit, it will initiate a warning signal. It is always detected.
37	Fail to Sync.	If the controller doesn't detect sync. signal within the pre-set time, it will initiate a warning alarm. It is detected when breaker closes.
38	Digital Input Alarm	When the digital input port is set users-defined and if it is active, the controller will initiate a warning for the input port. It is detected in the detection range set for the input port.
39	PLC Function Alarm	When PLC function is set users-defined and if it is active, the controller will initiate a warning. It is detected in the detection range set by the PLC function.
40	THD High	When this is enabled and the controller detects that the THD has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.
41	PCS Volt Unbalance	When this is enabled and the controller detects that the voltage unbalanced value of PCS has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.

5.2 BLOCK ALARMS

When the controller detects block signals, it only issues warning and the unit does not shut down and not open. Users need to reset alarms manually.

Table 8 Block Alarms

No	Type	Description
1	BMS Comm. Failure	When BMS communication is enabled and controller cannot read the BMS data, it will initiate a warning signal. It is always detected.
2	PCS Comm. Failure	When PCS communication is enabled and controller cannot read the PCS data, it will initiate a warning signal. It is always detected.
3	PCS Over Frequency	When this is enabled, and the controller detects the PCS frequency is above the preset limit, it will initiate a warning signal. It is always detected.
4	PCS Under Frequency	When this is enabled, and the controller detects the PCS frequency is below the preset limit, it will initiate a warning signal. It is detected in normal running.
5	PCS Over Voltage	When this is enabled, and the controller detects the PCS voltage is above the preset limit, it shall issue a warning. It is always detected.
6	PCS Under Voltage	When this is enabled, and the controller detects the PCS voltage is below the preset limit, it will initiate a warning signal. It is detected in normal running.
7	PCS Over Current	When this is enabled, and the controller detects the PCS current is above the preset limit, it will initiate a warning signal. It is always detected.
8	Unbalanced Current	When this is enabled, and the controller detects the value is above the preset limit, it will initiate a warning signal. It is always detected.
9	Earth Fault	When this is enabled, and the controller detects the earth current is above the preset limit, it will initiate a warning signal. It is always detected.
10	Charging Over Power	When it is enabled, and the controller detects that PCS charging power is above the preset limit, it will initiate a warning signal. It is always detected.
11	Discharging Over Power	When it is enabled, and the controller detects that PCS discharging power is above the preset limit, it will initiate a warning signal. It is always detected.
12	Flex. Sensor 1 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
13	Flex. Sensor 1 High	When over high warning is enabled, and the controller detects the

No	Type	Description
		sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
14	Flex. Sensor 1 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
15	Flex. Sensor 1 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
16	Flex. Sensor 2 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
17	Flex. Sensor 2 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
18	Flex. Sensor 2 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
19	Flex. Sensor 2 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
20	Flex. Sensor 3 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
21	Flex. Sensor 3 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
22	Flex. Sensor 3 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
23	Flex. Sensor 3 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller.

No	Type	Description
		It is always detected.
24	Flex. Sensor 4 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
25	Flex. Sensor 4 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
26	Flex. Sensor 4 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
27	Flex. Sensor 4 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
28	Flex. Sensor 5 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
29	Flex. Sensor 5 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
30	Flex. Sensor 5 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
31	Flex. Sensor 5 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
32	Supply Over Voltage	When this is enabled, and the controller detects the supply voltage is above the preset limit, it will initiate a warning signal. It is always detected.
33	Supply Under Voltage	When this is enabled, and the controller detects the supply voltage is below the preset limit, it will initiate a warning signal. It is always detected.
34	Fail to Sync.	If the controller doesn't detect sync. signal within the pre-set time, it will initiate a warning alarm. It is detected when breaker closes.
35	Digital Input Alarm	When the digital input port is set users-defined and if it is active, the

No	Type	Description
		controller will initiate a warning for the input port. It is detected in the detection range set for the input port.
36	PLC Function Alarm	When PLC function is set users-defined and if it is active, the controller will initiate a warning. It is detected in the detection range set by the PLC function.
37	THD High	When this is enabled and the controller detects that the THD has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.
38	PCS Volt Unbalance	When this is enabled and the controller detects that the voltage unbalanced value of PCS has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.

5.3 SAFETY TRIP ALARMS

When controller detects safety trip signals, it will open breaker but not stop the unit. Users need to reset alarms manually.

Table 9 Safety Trip Alarms

No	Type	Description
1	BMS Comm. Failure	When BMS communication is enabled and controller cannot read the BMS data, it will initiate a warning signal. It is always detected.
2	PCS Comm. Failure	When PCS communication is enabled and controller cannot read the PCS data, it will initiate a warning signal. It is always detected.
3	PCS Over Frequency	When this is enabled, and the controller detects the PCS frequency is above the preset limit, it will initiate a warning signal. It is always detected.
4	PCS Under Frequency	When this is enabled, and the controller detects the PCS frequency is below the preset limit, it will initiate a warning signal. It is detected in normal running.
5	PCS Over Voltage	When this is enabled, and the controller detects the PCS voltage is above the preset limit, it shall issue a warning. It is always detected.
6	PCS Under Voltage	When this is enabled, and the controller detects the PCS voltage is below the preset limit, it will initiate a warning signal. It is detected in normal running.
7	PCS Over Current	When this is enabled, and the controller detects the PCS current is above the preset limit, it will initiate a warning signal. It is always detected.
8	Unbalanced Current	When this is enabled, and the controller detects the value is above the preset limit, it will initiate a warning signal. It is always detected.
9	Earth Fault	When this is enabled, and the controller detects the earth current is above the preset limit, it will initiate a warning signal. It is always detected.
10	Charging Over Power	When it is enabled, and the controller detects that PCS charging power is above the preset limit, it will initiate a warning signal. It is always detected.
11	Discharging Over Power	When it is enabled, and the controller detects that PCS discharging power is above the preset limit, it will initiate a warning signal. It is always detected.
12	Close Failure	When controller detects Gen close failure (closed input is inactive after closing output), it will initiate a warning signal. It is detected when breaker closed.
13	Open Failure	When controller detects Gen open failure (closed input is active after

No	Type	Description
		opening output), it will initiate a warning signal. It is detected when breaker open.
14	Flex. Sensor 1 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
15	Flex. Sensor 1 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
16	Flex. Sensor 1 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
17	Flex. Sensor 1 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
18	Flex. Sensor 2 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
19	Flex. Sensor 2 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
20	Flex. Sensor 2 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
21	Flex. Sensor 2 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
22	Flex. Sensor 3 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
23	Flex. Sensor 3 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
24	Flex. Sensor 3 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning

No	Type	Description
		signal. It is always detected.
25	Flex. Sensor 3 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
26	Flex. Sensor 4 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
27	Flex. Sensor 4 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
28	Flex. Sensor 4 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
29	Flex. Sensor 4 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
30	Flex. Sensor 5 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
31	Flex. Sensor 5 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
32	Flex. Sensor 5 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
33	Flex. Sensor 5 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
34	Supply Over Voltage	When this is enabled, and the controller detects the supply voltage is above the preset limit, it will initiate a warning signal. It is always detected.
35	Supply Under Voltage	When this is enabled, and the controller detects the supply voltage is

No	Type	Description
		below the preset limit, it will initiate a warning signal. It is always detected.
36	Fail to Sync.	If the controller doesn't detect sync. signal within the pre-set time, it will initiate a warning alarm. It is detected when breaker closes.
37	Volt. Out-sync.	After breaker closed, when voltage difference between Bus and Gen is over than the pre-set value, it will initiate a warning signal. It is detected after closed.
38	Freq. Out-sync.	After breaker closed, when frequency difference between Bus and Gen is over than the pre-set value, it will initiate a warning signal. It is detected after closed.
39	Phase Out-sync.	After breaker closed, when phase difference between Bus and Gen is over than the pre-set value, it will initiate a warning signal. It is detected after closed.
40	Digital Input Alarm	When the digital input port is set users-defined and if it is active, the controller will initiate a warning for the input port. It is detected in the detection range set for the input port.
41	PLC Function Alarm	When PLC function is set users-defined and if it is active, the controller will initiate a warning. It is detected in the detection range set by the PLC function.
42	THD High	When this is enabled and the controller detects that the THD has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.
43	PCS Volt Unbalance	When this is enabled and the controller detects that the voltage unbalanced value of PCS has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.

5.4 TRIP AND STOP ALARMS

When controller detects safety trip and stop signals, it will open breaker directly and enter the stop status. Users need to reset alarms manually.

Table 10 Trip and Stop Alarms

No	Type	Description
1	BMS Comm. Failure	When BMS communication is enabled and controller cannot read the BMS data, it will initiate a warning signal. It is always detected.
2	PCS Comm. Failure	When PCS communication is enabled and controller cannot read the PCS data, it will initiate a warning signal. It is always detected.
3	PCS Over Frequency	When this is enabled, and the controller detects the PCS frequency is above the preset limit, it will initiate a warning signal. It is always detected.
4	PCS Under Frequency	When this is enabled, and the controller detects the PCS frequency is below the preset limit, it will initiate a warning signal. It is detected in normal running.
5	PCS Over Voltage	When this is enabled, and the controller detects the PCS voltage is above the preset limit, it shall issue a warning. It is always detected.
6	PCS Under Voltage	When this is enabled, and the controller detects the PCS voltage is below the preset limit, it will initiate a warning signal. It is detected in normal running.
7	PCS Over Current	When this is enabled, and the controller detects the PCS current is above the preset limit, it will initiate a warning signal. It is always detected.
8	Unbalanced Current	When this is enabled, and the controller detects the value is above the preset limit, it will initiate a warning signal. It is always detected.
9	Earth Fault	When this is enabled, and the controller detects the earth current is above the preset limit, it will initiate a warning signal. It is always detected.
10	Charging Over Power	When it is enabled, and the controller detects that PCS charging power is above the preset limit, it will initiate a warning signal. It is always detected.
11	Discharging Over Power	When it is enabled, and the controller detects that PCS discharging power is above the preset limit, it will initiate a warning signal. It is always detected.
12	Flex. Sensor 1 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
13	Flex. Sensor 1 High	When over high warning is enabled, and the controller detects the

No	Type	Description
		sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
14	Flex. Sensor 1 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
15	Flex. Sensor 1 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
16	Flex. Sensor 2 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
17	Flex. Sensor 2 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
18	Flex. Sensor 2 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
18	Flex. Sensor 2 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
20	Flex. Sensor 3 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
21	Flex. Sensor 3 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
22	Flex. Sensor 3 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
23	Flex. Sensor 3 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller.

No	Type	Description
		It is always detected.
24	Flex. Sensor 4 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
25	Flex. Sensor 4 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
26	Flex. Sensor 4 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
27	Flex. Sensor 4 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
28	Flex. Sensor 5 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
29	Flex. Sensor 5 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
30	Flex. Sensor 5 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
31	Flex. Sensor 5 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
32	Supply Over Voltage	When this is enabled, and the controller detects the supply voltage is above the preset limit, it will initiate a warning signal. It is always detected.
33	Supply Under Voltage	When this is enabled, and the controller detects the supply voltage is below the preset limit, it will initiate a warning signal. It is always detected.
34	Fail to Sync.	If the controller doesn't detect sync. signal within the pre-set time, it will initiate a warning alarm. It is detected when breaker closes.
35	Digital Input Alarm	When the digital input port is set users-defined and if it is active, the

No	Type	Description
		controller will initiate a warning for the input port. It is detected in the detection range set for the input port.
36	PLC Function Alarm	When PLC function is set users-defined and if it is active, the controller will initiate a warning. It is detected in the detection range set by the PLC function.
37	THD High	When this is enabled and the controller detects that the THD has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.
38	PCS Volt Unbalance	When this is enabled and the controller detects that the voltage unbalanced value of PCS has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.

5.5 SHUTDOWN ALARMS

When controller detects shutdown alarms, it will send signal to open breaker and shut down the unit. Users need to reset alarms manually.

Table 11 Shutdown Alarms

No	Type	Description
1	Emergency Stop	When the controller detects emergency stop signals, it will initiate a shutdown alarm. It is always detected.
2	BMS Comm. Failure	When BMS communication is enabled and controller cannot read the BMS data, it will initiate a warning signal. It is always detected.
3	PCS Comm. Failure	When PCS communication is enabled and controller cannot read the PCS data, it will initiate a warning signal. It is always detected.
4	PCS Over Frequency	When this is enabled, and the controller detects the PCS frequency is above the preset limit, it will initiate a warning signal. It is always detected.
5	PCS Under Frequency	When this is enabled, and the controller detects the PCS frequency is below the preset limit, it will initiate a warning signal. It is detected in normal running.
6	PCS Over Voltage	When this is enabled, and the controller detects the PCS voltage is above the preset limit, it shall issue a warning. It is always detected.
7	PCS Under Voltage	When this is enabled, and the controller detects the PCS voltage is below the preset limit, it will initiate a warning signal. It is detected in normal running.
8	PCS Over Current	When this is enabled, and the controller detects the PCS current is above the preset limit, it will initiate a warning signal. It is always detected.
9	Unbalanced Current	When this is enabled, and the controller detects the value is above the preset limit, it will initiate a warning signal. It is always detected.
10	Earth Fault	When this is enabled, and the controller detects the earth current is above the preset limit, it will initiate a warning signal. It is always detected.
11	Charging Over Power	When it is enabled, and the controller detects that PCS charging power is above the preset limit, it will initiate a warning signal. It is always detected.
12	Discharging Over Power	When it is enabled, and the controller detects that PCS discharging power is above the preset limit, it will initiate a warning signal. It is always detected.
13	Flex. Sensor 1 Open	When the controller detects the sensor circuit is open, it will initiate a

No	Type	Description
		warning signal. It is always detected.
14	Flex. Sensor 1 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
15	Flex. Sensor 1 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
16	Flex. Sensor 1 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
17	Flex. Sensor 2 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
18	Flex. Sensor 2 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
19	Flex. Sensor 2 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
20	Flex. Sensor 2 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
21	Flex. Sensor 3 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
22	Flex. Sensor 3 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
23	Flex. Sensor 3 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
24	Flex. Sensor 3 Wrong	When voltage or current input is selected for the curve type of the

No	Type	Description
		controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
25	Flex. Sensor 4 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
26	Flex. Sensor 4 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
27	Flex. Sensor 4 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
28	Flex. Sensor 4 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
29	Flex. Sensor 5 Open	When the controller detects the sensor circuit is open, it will initiate a warning signal. It is always detected.
30	Flex. Sensor 5 High	When over high warning is enabled, and the controller detects the sensor value is above the preset upper limit, it will initiate a warning signal. It is always detected.
31	Flex. Sensor 5 Low	When over low warning is enabled, and the controller detects the sensor value is below the preset low limit, it will initiate a warning signal. It is always detected.
32	Flex. Sensor 5 Wrong	When voltage or current input is selected for the curve type of the controller, and the controller detects input signal is abnormal, it will initiate a warning signal, and meanwhile the curve is transferred to resistor type to prevent damaging the controller. It is always detected.
33	MSC ID Wrong	When controller detects the same ID on MSC bus, it will initiate a warning signal. It is always detected.
34	Supply Over Voltage	When this is enabled, and the controller detects the supply voltage is above the preset limit, it will initiate a warning signal. It is always detected.
35	Supply Under Voltage	When this is enabled, and the controller detects the supply voltage is

No	Type	Description
		below the preset limit, it will initiate a warning signal. It is always detected.
36	Fail to Sync.	If the controller doesn't detect sync. signal within the pre-set time, it will initiate a warning alarm. It is detected when breaker closes.
37	Digital Input Alarm	When the digital input port is set users-defined and if it is active, the controller will initiate a warning for the input port. It is detected in the detection range set for the input port.
38	PLC Function Alarm	When PLC function is set users-defined and if it is active, the controller will initiate a warning. It is detected in the detection range set by the PLC function.
39	THD High	When this is enabled and the controller detects that the THD has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.
40	PCS Volt Unbalance	When this is enabled and the controller detects that the voltage unbalanced value of PCS has exceeded the pre-set value, it will initiate a warning alarm. It is always detected.

6 WIRING CONNECTION

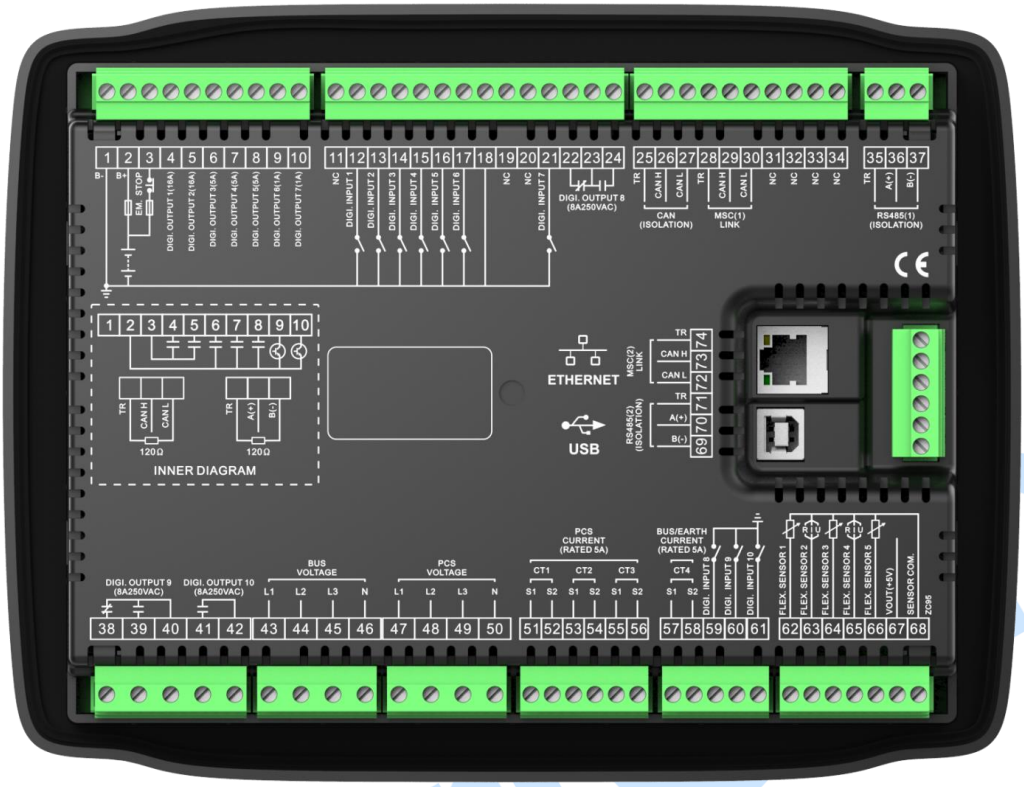


Fig. 4 PCC95 Controller Rear Panel

Table 12 Terminal Connection Description

No.	Functions	Cable Size	Remark
1	B-	2.5mm²	Connect with starter battery negative.
2	B+	2.5mm²	Connect with starter battery positive. If wire length is over 30m, it's better to double wires in parallel. Max. 20A fuse is recommended.
3	Emergency stop	2.5mm²	Connect with B+ via emergency stop button.
4	Digi. output 1	1.5mm²	B+ is supplied by 3 points, rated 16A.
5	Digi. output 2	1.5mm²	B+ is supplied by 3 points, rated 16A, connect with starter coil
6	Digi. output 3	1.5mm²	B+ is supplied by 2 points, rated 5A.
7	Digi. output 4	1.5mm²	B+ is supplied by 2 points, rated 5A.
8	Digi. output 5	1.5mm²	B+ is supplied by 2 points, rated 5A.
9	Digi. output 6	1.0mm²	B+ is supplied by 2 points, rated 1A.
10	Digi. output 7	1.0mm²	B+ is supplied by 2 points, rated 1A.
11	Reserved	/	
12	Digi. input 1	1.0mm²	Ground connected is active (B-).
13	Digi. input 2	1.0mm²	Ground connected is active (B-).
14	Digi. input 3	1.0mm²	Ground connected is active (B-).
15	Digi. input 4	1.0mm²	Ground connected is active (B-).

No.	Functions	Cable Size	Remark
16	Digi. input 5	1.0mm²	Ground connected is active (B-).
17	Digi. input 6	1.0mm²	Ground connected is active (B-).
18	Digi. Input COM	1.0mm²	
19	Reserved	/	
20	Reserved	/	
21	Digi. input 7	1.0mm²	Ground connected is active (B-).
22	Digi. output 8	1.5mm²	Normally close output, rated 8A.
23			Common points of relay.
24			Normally open output, rated 8A.
25	CAN TR	/	Impedance-120Ω shielding wire is recommended, and the single-end shall be earth connected. Short connect TR with H and then connect to 120Ω terminal resistor.
26	CAN H	0.5mm²	
27	CAN L	0.5mm²	
28	MSC(1) TR	/	Impedance-120Ω shielding wire is recommended, and the single-end shall be earth connected. Short connect TR with H and then connect to 120Ω terminal resistor.
29	MSC(1) CAN H	0.5mm²	
30	MSC(1) CAN L	0.5mm²	
31	Reserved	0.5mm²	
32	Reserved	0.5mm²	
33	Reserved	0.5mm²	
34	Reserved	0.5mm²	
35	RS485(1) TR	/	Impedance-120Ω shielding wire is recommended, and the single-end shall be earth connected. Short connect TR with A(+) and then connect to 120Ω terminal resistor.
36	RS485(1) A(+)	0.5mm²	
37	RS485(1) B(-)	0.5mm²	
38	Digi. output 9	1.5mm²	Normally close output, rated 8A.
39		1.5mm²	Normally open output, rated 8A.
40		1.5mm²	Common points of relay.
41	Digi. output 10	1.5mm²	Normally open output, rated 8A.
42		1.5mm²	Public points of relay.
43	Bus A-phase voltage input	1.0mm²	Connect to A-phase of bus (2A fuse is recommended).
44	Bus B-phase voltage input	1.0mm²	Connect to B-phase of bus (2A fuse is recommended).
45	Bus C-phase voltage input	1.0mm²	Connect to C-phase of bus (2A fuse is recommended).
46	Bus N-wire input	1.0mm²	Connect to N-wire of bus.
47	PCS A-phase voltage input	1.0mm²	Connect to A-phase of PCS (2A fuse is recommended).
48	PCS B-phase voltage input	1.0mm²	Connect to B-phase of PCS (2A fuse is recommended).
49	PCS C-phase voltage input	1.0mm²	Connect to C-phase of PCS (2A fuse is recommended).
50	PCS N-wire input	1.0mm²	Connect to N-wire of PCS.
51	CT A-phase input	1.5mm²	Outside connect to secondary coil of current

No.	Functions	Cable Size	Remark
52		1.5mm²	transformer (rated 5A).
53	CT B-phase input	1.5mm²	Outside connect to secondary coil of current transformer (rated 5A).
54		1.5mm²	
55	CT C-phase input	1.5mm²	Outside connect to secondary coil of current transformer (rated 5A).
56		1.5mm²	
57	Earth/Bus CT input	1.5mm²	Outside connect to secondary coil of current transformer (rated 5A).
58		1.5mm²	
59	Digi. input 8	1.0mm²	Ground connected is active (B-).
60	Digi. input 9	1.0mm²	Ground connected is active (B-).
61	Digi. input 10	1.0mm²	Ground connected is active (B-).
62	Flex. sensor 1	1.0mm²	Connect to temp. resistance- type sensor.
63	Flex. sensor 2	1.0mm²	Connect to temp. sensor. Voltage type (0-5V), current type (4-20mA) and resistance sensor can be chosen.
64	Flex. Sensor 3	1.0mm²	Connect to temp. resistance- type sensor.
65	Flex. Sensor 4	1.0mm²	Connect to temp. sensor. Voltage type (0-5V), current type (4-20mA) and resistance sensor can be chosen.
66	Flex. Sensor 5	1.0mm²	Connect to temp. resistance- type sensor.
67	VOUT(+5V)	1.0mm²	Provide +5V voltage for voltage type sensor, and current is below 50mA.
68	Sensor COM.	/	Sensor common terminal, and B- is already connected in the controller.
69	RS485(2) B(-)	0.5mm²	Impedance-120Ω shielding wire is recommended, and the single-end shall be earth connected. Short connect TR with A(+) and then connect to 120Ω terminal resistor.
70	RS485(2) A(+)	0.5mm²	
71	RS485(2) TR	/	
72	MSC(2) CAN L	0.5mm²	Impedance-120Ω shielding wire is recommended, and the single-end shall be earth connected. Short connect TR with H and then connect to 120Ω terminal resistor.
73	MSC(2) CAN H	0.5mm²	
74	MSC(2) TR	/	

NOTE: USB ports on the controller rear panel are configurable parameter ports, and users can directly program the controller on PC. ETHERNET port on the controller rear panel is parameter programming and monitoring port, and it can be programmed and monitored on PC.

7 SCOPES AND DEFINITIONS OF PROGRAMMABLE PARAMETERS

7.1 CONTENTS AND SCOPES OF PARAMETERS

Table 13 Parameter Configuration

No.	Items	Parameters	Defaults	Description
Module Setting				
1.	Power On Mode	(0-2)	0	0: Stop Mode 1: Manual Mode 2: Auto Mode
2.	Language	(0-2)	0	0: Simplified Chinese 1: English 2: Other
3.	Password	(0-65535)	00318	It is used to enter advanced parameter setting.
4.	Fn Function	(0-10)	0	0: Fn Key 1: Stop Key 2: Start Key 3: Manual Key 4: Auto Key 5: Close Key 6: Open Key 7: Reserved 8: Reserved 9: Reserved 10: Reserved
5.	Module Silence	(0-2)	0	0: Disable 1: Enable 2: Silence
6.	Backlight Time	(0-3600)s	(0-3600)	Backlight is off after delay.
7.	Alarm Data Interval	(0-60.0)s	0.1	
8.	TCP MODBUS	(0-1)	1	0: Disable 1: Enable
9.	Auto IP	(0-1)	0	0: Disable 1: Enable
10.	Network Set	(0-1)	1	0: Disable 1: Enable IP address, subnet mask, DNS, default gateway can be set.
11.	Daylight Saving Time	(0-1)	0	0: Disable 1: Enable Start and end time for this can be set.
12.	Start Interface	(0-1)	0	0: Disable 1: Enable
13.	RS485(1)	(0-3)	2	0：2400bps; 1：4800bps; 2：9600bps; 3：19200bps.
		(1-254)	1	Controller address for remote monitoring
		(0-1)	0	0: 2-bit Stop Bit

No.	Items	Parameters	Defaults	Description
				1: 1-bit Stop Bit
14.	RS485(2)	(0-3)	2	0：2400bps; 1：4800bps; 2：9600bps; 3：19200bps.
		(1-254)	1	Controller address for remote monitoring
		(0-1)	0	0: 2-bit Stop Bit 1: 1-bit Stop Bit
15.	Date and Time			It is used to set date and time.
Bus Setting				
1	AC System	(0-3)	0	0: 3P4W; 1: 3P3W; 2: 2P3W; 3: 1P2W.
2	CT Phase	(0-3)	0	0: Disable; 1: A-phase; 2: B-phase; 3: C-phase
3	Normal Delay	(0-3600)s	10	The confirm time from bus abnormal to bus normal.
4	Abnormal Delay	(0-3600)s	5	The confirm time from bus normal to bus abnormal.
5	CT Ratio	(5-6000)/5	500	The primary current of bus current transformer.
6	Rated Active Power	(0-6000)kW	345	Bus rated active power, it is standard of active power adjustment when bus CT enables.
7	Rated Reactive Power	(0-6000)kvar	258	Bus rated reactive power, it is standard of reactive power adjustment when bus CT enables.
8	Bus Rated Voltage	(30-30000)V	230	Provide standard for mains over/under voltage judgement. If voltage transformer is used, the value is the primary voltage. When AC system is 3P3W, this value is line voltage; when AC system is others, this value is phase voltage.
9	Bus Volt. Transformer	(0-1) (30-30000) (30-1000)	0 100 60	0: Disable; 1: Enable The primary voltage is the voltage transformer's voltage. The second voltage is the voltage transformer's voltage.
9	Bus Over Volt. Set	(0-1) (0-200.0)% (0-200.0)% (0-3600)s	1 120.0 116.0 5	0: Disable 1: Enable Set value is bus rated voltage percentage. Return value is bus rated voltage percentage. Delay value
10	Bus Under Volt. Set	(0-1) (0-200.0)% (0-200.0)%	1 120.0 116.0	0: Disable 1: Enable Set value is bus rated volt percentage. Return value is bus rated volt percentage.

No.	Items	Parameters	Defaults	Description
		(0-3600)s	5	Delay value
12	Bus Rated Freq. Set	(10.0-75.0)Hz	50.0	Provide standard for bus over/under frequency judgement.
13	Bus Over Freq. Set	(0-1) (0-200.0)% (0-200.0)% (0-3600)s	0 114.0 110.0 5	0: Disable 1: Enable Set value is bus rated freq. percentage. Return value is bus rated freq. percentage. Delay value
14	Gen Under Freq. Set	(0-1) (0-200.0)% (0-200.0)% (0-3600)s	0 90.0 94.0 5	0: Disable 1: Enable Set value is bus rated freq. percentage. Return value is bus rated freq. percentage. Delay value
Timer Setting				
1.	Start Delay	(0-3600)s	5	Time from remote start signal is active to PCS is starting.
2.	Stop Delay	(0-3600)s	30	Time from remote start signal is inactive to PCS is stopping.
Supply Voltage Setting				
1	Volt. Setting	(0-60.0)V	24.0	Provide standard for supply over/under voltage.
2	Over Volt. Alarm	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 120.0 115.0 60 1	0: Disable 1: Enable Set value is supply volt. percentage. Return value is supply volt. Percentage. Delay value Action
3	Under Volt. Alarm	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 85.0 90.0 60 1	0: Disable 1: Enable Set value is supply volt. percentage. Return value is supply volt. Percentage. Delay value Action
BMS Setting				
1	BMS Model	(0-39)	0	0: Disable; 1: SmartGen-HBCU200； 2-39: Reserved
2	Comm. Port	(0-4)	3	0: Disable; 1: CAN; 2: TCP/IP; 3: RS485(1); 4: RS485(2).
3	Comm. Failure Action	(0-5)	1	0: None; 1: Warn; 2: Block; 3: Trip; 4: Trip and Stop; 5: Shutdown Alarm
4	Comm. Failure Delay	(0-3600)s	5	

No.	Items	Parameters	Defaults	Description
5	IP Address	(192.168.0.100)		用于设置 BMS 通过 TCP/IP 通信时的 IP 地址和端口号。 Used to set IP address and port number of BMS communication via TCP/IP.
6	COM Number	(0-65535)	502	
7	RS485 Comm. ID	(1-254)	1	
8	CAN Comm. Baud Rate	(0-3)	1	0: 500kBit/s; 1: 250kBit/s; 2: 125kBit/s; 3: 50kBit/s.
PCS Setting				
1	PCS model	(0-39)	0	0: Reserved; 1: Sinexcel-PWS; 2: SCU-PCM; 3~39: Reserved
2	Comm. Port	(0-4)	2	0: Disable; 1: CAN; 2: TCP/IP; 3: RS485(1); 4: RS485(2)
3.	Comm. Failure	(0-5)	1	0: None; 1: Warn; 2: Block; 3: Trip; 4: Trip and Stop; 5: Shutdown Alarm
4	Comm. Failure Delay	(0-3600)s	5	
5	IP Address	(192.168.40.44)		Set for IP address and port number of PCS communication via TCP/IP.
6	Port No.	(0-65535)	502	
7	RS485 Comm. ID	(1-254)	1	
8	CAN Comm. Baud Rate	(0-3)	1	0:500kBit/s; 1:250kBit/s; 2:125kBit/s; 3: 50kBit/s。
9	PCS AC system	(0-3)	0	0: 3P4W; 1: 3P3W; 2: 2P3W; 3: 1P2W.
10	PCS Rated Voltage	(30-30000)V	230	Provide standard judgement for gen over/under voltage and on-load voltage. If voltage transformer is used, the value is the primary voltage. When AC system is 3P3W, this value is line voltage; when AC system is others, this value is phase voltage.
11	PCS Rated Frequency	(10.0-75.0)Hz	50.0	Provide standard for over/under/on-load frequency judgement.
12	PCS Voltage	(0-1)	0	0: Disable; 1: Enable

No.	Items	Parameters	Defaults	Description
	Transformer	(30-30000) (30-1000)	100 60	The primary voltage is the voltage transformer's voltage. The second voltage is the voltage transformer's voltage.
13	Rated Active Power	(0-6000)kW	100	PCS rated active power, it is standard of active power adjustment.
14	Rated Reactive Power	(0-6000)kvar	60	PCS rated reactive power, it is standard of reactive power adjustment.
15	PCS AC Parameter Select	(0-1)	0	0: PCS communication; 1: AC sampling.
16	PCS Start Delay	(0-3600) s	120	
17	Start Failure Alarm	(0-5)	1	
18	PCS Over Volt. Alarm 1	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 120.0 118.0 3 5	0: Disable 1: Enable The set value is the percentage of PCS rated voltage. The return value is the percentage of PCS rated voltage. Delay value Action
19	PCS Over Volt. Alarm 2	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 110.0 108.0 5 1	0: Disable 1: Enable The set value is the percentage of PCS rated voltage. The return value is the percentage of PCS rated voltage. Delay value Action
20	PCS Under Volt. Alarm 1	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 80.0 82.0 3 5	0: Disable 1: Enable The set value is the percentage of PCS rated voltage. The return value is the percentage of PCS rated voltage. Delay value Action
21	PCS Under Volt. Alarm 2	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 84.0 86.0 5 1	0: Disable 1: Enable The set value is the percentage of PCS rated voltage. The return value is the percentage of PCS rated voltage. Delay value Action
22	PCS Over Frequency Alarm 1	(0-1) (0-200.0)% (0-200.0)%	1 114.0 112.0	0: Disable 1: Enable The set value is the percentage of PCS rated frequency.

No.	Items	Parameters	Defaults	Description
		(0-3600)s (0-5)	2 5	The return value is the percentage of PCS rated frequency. Delay value Action
23	PCS Over Frequency Alarm 2	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 110.0 108.0 3 1	0: Disable 1: Enable The set value is the percentage of PCS rated frequency. The return value is the percentage of PCS rated frequency. Delay value Action
24	PCS Under Frequency Alarm 1	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 80.0 82.0 3 5	0: Disable 1: Enable The set value is the percentage of PCS rated frequency. The return value is the percentage of PCS rated frequency. Delay value Action
25	PCS Under Frequency Alarm 2	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 84.0 86.0 5 1	0: Disable 1: Enable The set value is the percentage of PCS rated frequency. The return value is the percentage of PCS rated frequency. Delay value Action
26	Harmonic Display	(0-1)	0	0: Disable 1: Enable
27	Volt Unbalance 1	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 10.0 5.0 5 1	0: Disable 1: Enable Set value is PCS unbalance degree. Return value is PCS unbalance degree. Delay value Action
28	Volt Unbalance 2	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	0 10.0 5.0 5 1	0: Disable 1: Enable Set value is PCS unbalance degree. Return value is PCS unbalance degree. Delay value Action
29	THD Alarm 1	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	0 10.0 5.0 5 0	0: Disable 1: Enable Set value is PCS distortion degree. Return value is PCS distortion degree. Delay value Action
30	THD Alarm 2	(0-1) (0-200.0)%	0 10.0	0: Disable 1: Enable Set value is PCS distortion degree.

No.	Items	Parameters	Defaults	Description
		(0-200.0)% (0-3600)s (0-5)	5.0 5 0	Return value is PCS distortion degree. Delay value Action
31	CT Ratio	(5-6000)/5	500	Ratio of external connected current transformer.
32	Rated Current	(5-6000)A	500	It is rated current of generator and used for loading current standard.
33	Over Current 1	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 120.0 118.0 3 4	0: Disable 1: Enable Set value is percentage of PCS rated current. Return value is percentage of PCS rated current. Delay value Action
34	Over Current 2	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 110.0 108.0 5 1	0: Disable 1: Enable Set value is percentage of PCS rated current. Return value is percentage of PCS rated current. Delay value Action
35	Unbalanced Current 1	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 20.0 18.0 5 1	0: Disable 1: Enable Set value is percentage of PCS rated current. Return value is percentage of PCS rated current. Delay value Action
36	Unbalanced Current 2	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	0 20.0 18.0 5 0	0: Disable 1: Enable Set value is percentage of PCS rated current. Return value is percentage of PCS rated current. Delay value Action
37	Earth Fault 1	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	1 20.0 18.0 5 1	0: Disable 1: Enable Set value is percentage of PCS rated current. Return value is percentage of PCS rated current. Delay value Action
38	Earth Fault 2	(0-1)	0	0: Disable 1: Enable

No.	Items	Parameters	Defaults	Description
		(0-200.0)% (0-200.0)% (0-3600)s (0-5)	20.0 18.0 5 0	Set value is percentage of PCS rated current. Return value is percentage of PCS rated current. Delay value Action
39	Charging Over Power 1 Set	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	0 120.0 118.0 3 4	0: Disable 1: Enable Set value is percentage of PCS rated active power. Return value is percentage of PCS rated active power. Delay value Action
40	Charging Over Power 2 Set	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	0 110.0 108.0 5 1	0: Disable 1: Enable Set value is percentage of PCS rated active power. Return value is percentage of PCS rated active power. Delay value Action
41	Discharging Over Power 1 Set	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	0 120.0 118.0 3 4	0: Disable 1: Enable Set value is percentage of PCS rated active power. Return value is percentage of PCS rated active power. Delay value Action
42	Discharging Over Power 2 Set	(0-1) (0-200.0)% (0-200.0)% (0-3600)s (0-5)	0 110.0 108.0 5 1	0: Disable 1: Enable Set value is percentage of PCS rated active power. Return value is percentage of PCS rated active power. Delay value Action
ATS Setting				
1.	Close Time	(0-20.0)s	5.0	Pulse width of switch on. When it is 0, it means output constantly.
2.	Open Time	(0-20.0)s	3.0	Pulse width of switch off. When it is 0, it means output constantly.
3.	Check Time	(0-20.0)s	5.0	Feedback and check time of breaker close status input.
Analog Sensor Setting				
Flexible Sensor 1				

No.	Items	Parameters	Defaults	Description
1.	Sensor Selection	(0-4)	0	0: Not Used; 1: Temperature Sensor; 2: Reserved; 3: Reserved; 4: Digital Input Port.
2.	Custom Sensor Name			The sensor display name of controller. When sensor alarms, the display content of controller.
3.	Curve Type	(0-15)	0	0: Not Used.
4.	Open Action	(0-5)	0	0: None; 1: Warn; 2: Block 3: Trip; 4: Trip and Stop; 5: Alarm Shutdown.
5.	High Alarm 1 Set	(0-1) (0-1000) (0-1000) (0-3600)s (0-5)	0 100 90 5 5	0: Disable; 1: Enable. Set value is the engine temperature. Return value is the engine temperature. Delay value Action
6.	High Alarm 2 Set	(0-1) (0-1000) (0-1000) (0-3600)s (0-5)	0 90 80 5 1	0: Disable; 1: Enable. Set value is the engine temperature. Return value is the engine temperature. Delay value Action
7.	Low Alarm 1 Set	(0-1) (0-1000) (0-1000) (0-3600)s (0-5)	0 10 20 5 5	0: Disable; 1: Enable. Set value is the engine temperature. Return value is the engine temperature. Delay value Action
8.	Low Alarm 2 Set	(0-1) (0-1000) (0-1000) (0-3600)s (0-5)	0 20 30 5 1	0: Disable; 1: Enable. Set value is the engine temperature. Return value is the engine temperature. Delay value Action
Flexible Sensor 2				
1.	Sensor Selection	(0-4)	0	0: Not Used; 1: Temperature Sensor; 2: Reserved; 3: Reserved; 4: Digital Input Port.
Flexible Sensor 3				
2	Sensor Selection	(0-4)	0	0: Not Used; 1: Temperature Sensor; 2: Reserved; 3: Reserved; 4: Digital Input Port.
Flexible Sensor 4				
3	Sensor Selection	(0-4)	0	0: Not Used; 1: Temperature Sensor; 2: Reserved; 3: Reserved; 4: Digital Input Port.
Flexible Sensor 5				
4	Sensor Selection	(0-4)	0	0: Not Used; 1: Temperature Sensor;

No.	Items	Parameters	Defaults	Description
				2: Reserved; 3: Reserved; 4: Digital Input Port.
Digital Input Ports				
Digital Input Port 1				
1.	Contents Setting	(0-70)	28	Remote start.
2.	Active Type	(0-1)	0	0: Close 1: Open
Digital Input Port 2				
1.	Contents Setting	(0-70)	27	Reserved.
2.	Active Type	(0-1)	0	0: Close 1: Open
Digital Input Port 3				
1.	Contents Setting	(0-70)	26	Reserved.
2.	Active Type	(0-1)	0	0: Close 1: Open
Digital Input Port 4				
1.	Contents Setting	(0-70)	13	Closed status input
2.	Active Type	(0-1)	0	0: Close 1: Open
Digital Input Port 5				
1.	Contents Setting	(0-70)	0	Users-defined
2.	Active Type	(0-1)	0	0: Close 1: Open
3.	Active Range	(0-3)	3	0: From safety on 1: From starting 2: Always 3: Never
4.	Active Actions	(0-7)	4	0: None; 1: Warn; 2: Block; 3: Safety Trip; 4: Safety Trip and Stop; 5: Trip; 6: Trip and Stop; 7: Shutdown.
5.	Active Delay	(0-20.0)s	2.0	Time from detecting active to confirm
6.	Description			LCD displays alarm contents when the input is active.
Digital Input Port 6				
1.	Contents Setting	(0-70)	44	Master choice
2.	Active Type	(0-1)	0	0: Close 1: Open
Digital Input Port 7				
1.	Contents Setting	(0-70)	0	Users-defined.
2.	Active Type	(0-1)	0	0: Close 1: Open
3.	Active Range	(0-3)	3	0: From safety on 1: From starting 2: Always 3: Never
4.	Active Actions	(0-5)	4	0: None; 1: Warn; 2: Block; 3: Safety Trip; 4: Safety Trip and Stop; 5: Trip; 6: Trip and Stop; 7: Shutdown.
5.	Active Delay	(0-20.0)s	2.0	Time from detecting active to confirm
6.	Description			LCD displays alarm contents when the input is active.
Digital Input Port 8				
1.	Contents Setting	(0-70)	0	User defined.

No.	Items	Parameters	Defaults	Description
2.	Active Type	(0-1)	0	0: Close 1: Open
3.	Active Range	(0-3)	3	0: From safety on 1: From starting 2: Always 3: Never
4.	Active Actions	(0-5)	4	0: None; 1: Warn; 2: Block; 3: Safety Trip; 4: Safety Trip and Stop; 5: Trip; 6: Trip and Stop; 7: Shutdown.
5.	Active Delay	(0-20.0)s	2.0	Time from detecting active to confirm
6.	Description			LCD displays alarm contents when the input is active.
Digital Input Port 9				
1.	Contents Setting	(0-70)	0	Users-defined
2.	Active Type	(0-1)	0	0: Close 1: Open
3.	Active Range	(0-3)	3	0: From safety on 1: From starting 2: Always 3: Never
4.	Active Actions	(0-5)	4	0: None; 1: Warn; 2: Block; 3: Safety Trip; 4: Safety Trip and Stop; 5: Trip; 6: Trip and Stop; 7: Shutdown.
5.	Active Delay	(0-20.0)s	2.0	Time from detecting active to confirm
6.	Description			LCD displays alarm contents when the input is active.
Digital Input Port 10				
1.	Contents Setting	(0-70)	0	Users-defined
2.	Active Type	(0-1)	0	0: Close 1: Open
3.	Active Range	(0-3)	3	0: From safety on 1: From starting 2: Always 3: Never
4.	Active Actions	(0-5)	4	0: None; 1: Warn; 2: Block; 3: Trip; 4: Trip and Stop; 5: Shutdown.
5.	Active Delay	(0-20.0)s	2.0	Time from detecting active to confirm
6.	Description			LCD displays detailed contents when the input is active.
Digital Output Ports				
Digital Output Port 1				
1	Contents Setting	(0-299)	44	Normal output of PCS voltage.
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Digital Output Port 2				
1	Contents Setting	(0-299)	48	Common Alarm
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Digital Output Port 3				
1	Contents Setting	(0-299)	38	Reserved.
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Digital Output Port 4				
1	Contents Setting	(0-299)	35	Reserved.

No.	Items	Parameters	Defaults	Description
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Digital Output Port 5				
1	Contents Setting	(0-299)	30	Open Output
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Digital Output Port 6				
1	Contents Setting	(0-299)	29	Close Output
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Digital Output Port 7				
1	Contents Setting	(0-299)	0	Not Used
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Digital Output Port 8				
1	Contents Setting	(0-299)	0	Not Used
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Digital Output Port 9				
1	Contents Setting	(0-299)	0	Not Used
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Digital Output Port 10				
1	Contents Setting	(0-299)	0	Not Used
2	Active Type	(0-1)	0	0: Normally open; 1: Normally close
Alternative Configuration				
1	Alt. Config. 1	(0-1)	0	0: Disable; 1: Enable Bus power supply system, rated voltage, rated frequency, PCS power supply system, rated voltage, rated frequency, rated current, rated active power and rated reactive power can be set.
2	Alt. Config. 2	(0-1)	0	0: Disable; 1: Enable
3	Alt. Config. 3	(0-1)	0	0: Disable; 1: Enable
Sync Check				
1	Dead Bus Volt.	(10-50)V	30	It is considered Bus no power when Bus voltage is lower than dead Bus voltage.
2	Sync Volt. Difference	(0-30)V	3	It is considered voltage synchronization when the voltage difference between PCS and Bus is lower than synchronization voltage difference.
3	Sync Pos. Freq.	(0-2.00)Hz	0.20	It is considered frequency synchronization when the frequency difference between PCS and Bus is less than “Sync Pos. Freq.” but more than “Sync Neg. Freq.”.
4	Sync Neg. Freq.	(0-2.00)Hz	0.10	
5	Sync Phase	(0-20)°	10	It is considered “Sync Phase” when the initial phase difference is lower than synchronization phase difference.

No.	Items	Parameters	Defaults	Description
6	Phase Angle Offset	(0-360)°	0	PCS initial phase will add pre-set phase offset based on the sampling initial phase.
7	Fail Sync Delay	(5.0-300.0) s	60.0	If sync signals are not detected during the set "Fail Sync Delay", controller will initiate corresponding alarms based on the "Fail Sync Action".
8	Fail Sync Action	(0-5)	1	
Power Control				
1	Control Method	(0-2)	0	0: Constant Power; 1: Demand Power; 2: Unit Power
2	Output Active	(-100.0-100.0%)	30.0%	Used for constant power control of PCS.
3	Output Reactive Selection	(0-1)	0	0: kvar reactive power control; 1: PF power factor control.
4	Output Reactive	(0-100.0)%	8.0	Used for constant power control of PCS.
5	Demand Power Coefficient k	(0.1-10.0)	1.0	Demand power adjusted coefficient.
6	Demand Power Adjusted Power b	(-6000-6000)kW	0	Demand power adjusted parameter.
7	Adjusted Power b Selection	(0-1)	0	0: Fixed Power; 1: SOC-b Curve.
8	SOC-b Curve x1-x8	(0-100.0)%	/	SOC value of energy storage battery pack.
9	SOC-b Curve y1-y8	(-6000-6000)kW 0	/	Demand power adjusted parameter.
10	Unit Constant Power	(0-100.0)%	50.0	Used for fixed power percentage of the unit.
11	Power Limit Curve x1-x8(SOC)	(0-100.0%)	/	Set max. charge/discharge power according to the SOC value.
12	Power Limit Curve y1-y8 (Max. Discharge Power)	(0-100.0)%	/	
13	Power Limit Curve (Max. Charge Power)	(-100.0-0.0)%	/	
14	Freq. Droop Enable	(0-1)	1	0: Disable; 1: Enable
15	Sudden Applied Full-load Droop Freq.	(0-100.0)Hz	47.5	When frequency droop enables and used for load transient change, adjust PCS output power.
16	Sudden Applied Cut-off Droop Freq.	(0-100.0)Hz	49.0	
17	Sudden Remove	(0-100.0)Hz	52.5	

Constant Power

Demand Power

y = k*x + b

No.	Items	Parameters	Defaults	Description
	Full-load Droop Freq.			
18	Sudden Remove Cut-off Droop Freq.	(0-100.0)Hz	51.0	
MSC				
1.	MSC Number	(1-32)	2	
2.	Alarm Action	(0-5)	1	0: None; 1: Warn; 2: Block; 3: Trip; 4: Trip and Stop; 5: Shutdown.
3.	Communication Rate	(0-3)	1	0:500kBit/s;
4.	MSC ID	(0-31)	1	It is the ID in the MSC communication network, which indicates that the MSC ID in the entire communication network should be unique.
5.	Smart MSC ID	(0-1)	0	0: Disable; 1: Enable When it is enabled, the controller randomly selects an available ID based on the current bus unit ID at each power-up.
6.	Module Priority	(0-31)	0	Smaller the value, higher the priority.

7.2 DEFINED CONTENTS OF DIGITAL OUTPUT PORTS

7.2.1 DEFINED CONTENTS OF DIGITAL OUTPUT PORTS

Table 14 Defined Contents of Digital Output Ports

No.	Type	Description
0	Not Used	
1	Custom Period 1	Details of function description please see the following description.
2	Custom Period 2	
3	Custom Period 3	
4	Custom Period 4	
5	Custom Period 5	
6	Custom Period 6	
7	Custom Combined 1	
8	Custom Combined 2	
9	Custom Combined 3	
10	Custom Combined 4	
11	Custom Combined 5	
12	Custom Combined 6	
13	Reserved	
14	Reserved	
15	Reserved	
16	Reserved	
17	Reserved	
18	Audible Alarm	Act on warning, shutdown, and trips. An annunciator can be connected externally. If “alarm mute” configurable input port is active, this is prohibited.
19	Reserved	
20	Reserved	
21	Reserved	
22	Reserved	
23	Reserved	
24	Reserved	
25	Reserved	
26	Remote Control Output	This port is controlled by communication (PC).
27	Reserved	
28	Sync Indication	
29	Close Gen Output	It can control generating switch to take load.
30	Open Gen Output	It can control generating switch to take off load.
31-42	Reserved	
43	Normal Running	Output when PCS is in normal running.
44	PCS Volt. Normal	Output when the voltage of PCS is normal.
45	Reserved	

No.	Type	Description
46	Reserved	
47	Synchronizing	Act when controller is synchronizing.
48	Common Alarm	Act when genset common warning, common shutdown, common trip alarms occur.
49	Common Trip and Stop	Act when common trip and stop alarm occurs.
50	Common Shutdown	Act when common shutdown alarm occurs.
51	Common Trip	Act when common trip alarm occurs.
52	Common Warn	Act when common warning alarm occurs.
53	Common Block	
54	High Supply Voltage	Act when high voltage of power supply warns.
55	Low Supply Voltage	Act when low voltage of power supply warns.
56-68	Reserved	
69	Digital Input 1 Active	Act when input port 1 is active.
70	Digital Input 2 Active	Act when input port 2 is active.
71	Digital Input 3 Active	Act when input port 3 is active.
72	Digital Input 4 Active	Act when input port 4 is active.
73	Digital Input 5 Active	Act when input port 5 is active.
74	Digital Input 6 Active	Act when input port 6 is active.
75	Digital Input 7 Active	Act when input port 7 is active.
76	Digital Input 8 Active	Act when input port 8 is active.
77	Digital Input 9 Active	Act when input port 9 is active.
78	Digital Input 10 Active	Act when input port 10 is active.
79	Reserved	
80	Reserved	
81-98	Reserved	
99	Emergency Stop	Act when emergency stop alarm occurs.
100	Fail to Start	Act when start failure alarm occurs.
101	Reserved	
102	Reserved	
103	Reserved	
104	Reserved	
105	Reserved	
106	Reserved	
107	Reserved	
108	Reserved	
109	PCS Over Freq. Warn	Act when PCS over frequency warning occurs.
110	PCS Over Freq. Alarm	Act when PCS over frequency alarm (except warning) occurs.
111	PCS Over Volt Warn	Act when PCS over voltage warning occurs.
112	PCS Over Volt Alarm	Act when PCS over voltage alarm (except warning) occurs.
113	PCS Under Freq. Warn	Act when PCS low frequency warning occurs.
114	PCS Under Freq. Alarm	Act when PCS low frequency alarm (except warning) occurs.

No.	Type	Description
115	PCS Under Volt. Warn	Act when PCS low voltage warning occurs.
116	PCS Under Volt. Alarm	Act when PCS low voltage alarm (except warning) occurs.
117	PCS Loss of Phase	Act when PCS loss phase occurs.
118	PCS Reverse Phase Seq.	Act when PCS reverse phase occurs.
119	Discharging Over Power Warn	Act when PCS over power warning occurs.
120	Discharging Over Power Alarm	Act (except warning) when over power alarm occurs.
121	Charging Over Power Warn	Act when PCS reverse power warning occurs.
122	Charging Over Power Alarm	Act except warning) when controller detects PCS have reverse power.
123	PCS Over Current Warn	Act when over current warning occurs.
124	PCS Over Current Alarm	Act when PCS over current alarm (except warning) occurs.
125-138	Reserved	
139	Flexible Sensor 1 High Warn	Act when controller has flexible sensor 1 high warning alarm.
140	Flexible Sensor 1 Low Warn	Act when controller has flexible sensor 1 low warning alarm.
141	Flexible Sensor 1 High Alarm	Act when controller has flexible sensor 1 high alarm (except warning).
142	Flexible Sensor 1 Low Alarm	Act when controller has flexible sensor 1 low alarm (except warning).
143	Flexible Sensor 2 High Warn	Act when controller has flexible sensor 2 high warning alarm.
144	Flexible Sensor 2 Low Warn	Act when controller has flexible sensor 2 low warning alarm.
145	Flexible Sensor 2 High Alarm	Act when controller has flexible sensor 2 high alarm (except warning).
146	Flexible Sensor 2 Low Alarm	Act when controller has flexible sensor 2 low alarm (except warning).
147	Flexible Sensor 3 High Warn	Act when controller has flexible sensor 3 high warning alarm.
148	Flexible Sensor 3 Low Warn	Act when controller has flexible sensor 3 low warning alarm.
149	Flexible Sensor 3 High Alarm	Act when controller has flexible sensor 3 high alarm (except warning).
150	Flexible Sensor 3 Low Alarm	Act when controller has flexible sensor 3 low alarm (except warning).
151	Flexible Sensor 4 High Warn	Act when controller has flexible sensor 4 high warning alarm.
152	Flexible Sensor 4 Low Warn	Act when controller has flexible sensor 4 low warning alarm.
153	Flexible Sensor 4 High Alarm	Act when controller has flexible sensor 4 high alarm (except warning).
154	Flexible Sensor 4 Low Alarm	Act when controller has flexible sensor 4 low alarm (except warning).
155	Flexible Sensor 5 High Warn	Act when controller has flexible sensor 5 high warning alarm.
156	Flexible Sensor 5 Low Warn	Act when controller has flexible sensor 5 low warning alarm.
157	Flexible Sensor 5 High Alarm	Act when controller has flexible sensor 5 high alarm (except warning).

No.	Type	Description
158	Flexible Sensor 5 Low Alarm	Act when controller has flexible sensor 5 low alarm (except warning).
159-229	Reserved	
230	Stop Mode	Act when the system is in Stop mode.
231	Manual Mode	Act when the system is in Manual mode.
232	Reserved	Reserved
233	Auto Mode	Act when the system is in Auto mode.
234	PCS Load Indication	
235-239	Reserved	
240-279	PLC Flag1-40	PLC flag output.
280-299	Reserved	

7.2.2 DEFINED PERIOD OUTPUT

Defined period output is composed by 2 parts, **period output S1** and **condition output S2.**

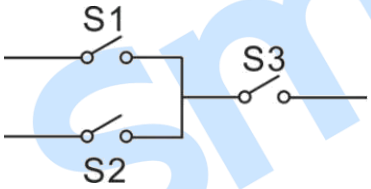
While **S1** and **S2** are **TRUE** synchronously, OUTPUT;
While **S1** or **S2** is **FALSE**, NOT OUTPUT.
Period output S1 can set generator's one or more period output freely, can set the delayed time and output time after enter into period.
Condition output S2 can set as any conditions in output ports.

NOTE: when delay time and output time both are 0 in period output S1, it is TRUE in this period.

For example:
Output period: start
Delay output time: 2s
Output time: 3s
Condition output contents: input port 1 is active
Close when condition output active/inactive: close when active (disconnect when inactive);
Input port 1 active, after enter "starts time" and delay 2s, this defined period output is outputting, after 3s, stop outputting;
Input port 1 inactive, defined output period is not outputting.

7.2.3 DEFINED COMBINATION OUTPUT

Defined combination output is composed by 3 parts, **or condition output S1, or condition output S2, and condition output S3**.



S1 or S2 is **TRUE**, and 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, S3) couldn't include or recursively include themselves.

For example:
Contents of or condition output S1: input port 1 is active;
Close when or condition output S1 is active/inactive: close when active (disconnect when inactive);
Contents of or condition output S2, input port 2 is active;
Close when or condition output S2 is active/inactive: close when active (disconnect when inactive);
Contents of and condition output S3: input port 3 is active;
Close when and 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.

7.3 DEFINED CONTENTS OF DIGITAL INPUT PORTS

Table 15 Defined Contents of Digital Input Ports

No.	Type	Description
0	Users Configured	Users-defined alarm. Active range: Never: input inactive. Always: input is active all the time. From crank: detecting as soon as start. From safety on: detecting after safety on run delay.
1	Reserved	
2	Alarm Mute	Can prohibit “Audible Alarm” output when input is active.
3	Reset Alarm	Can reset shutdown alarm and trip alarm when input is active.
4	Reserved	
5	Lamp Test	All LED indicators are illuminating when input is active.
6	Panel Lock	All buttons in panel is inactive except navigation buttons and there is in the right top corner in LCD when input is active.
7	Reserved	
8	Reserved	
9	Inhibit Auto Stop	In **Auto** mode, during PCS normal running, when input is active, prohibit PCS shutdown automatically.
10	Inhibit Auto Start	In **Auto** mode, prohibit PCS start automatically when input is active.
11	Reserved	
12	Close Inhibit	When input is active and “PCS Close” needs to be output, “PCS Close” process will wait and will not close genset.
13	Closed Input	Connect PCS loading switch’s auxiliary point.
14	Inhibit Gen Load	Prohibit PCS take load when input is active, close process will not be performed.
15	Reserved	
16	Reserved	
17	Auto Mode Input	When input is active, controller enters into Auto mode.
18	Auto Mode Invalid	When input is active, controller won’t work under Auto mode. Auto key and simulate auto key input do not work.
19	Reserved	
20	Reserved	
21	Inhibit Alarm Stop	All shutdown alarms are prohibited except emergence stop.(Means battle mode)
22	Instrument Mode	All outputs are prohibited in this mode.
23	Reserved	

No.	Type	Description
24	Reserved	
25	Reserved	
26	Reserved	
27	Reserved	
28	Remote Start	In Auto mode, when input active, PCS will close in PQ mode. Auto start enables after PCS is OK; In other modes, PCS will start first and go normal running to control breaker close. when input is inactive, PCS will stop automatically.
29	Reserved	
30	Manual Start	In Manual mode, when input active, PCS will start automatically; when input inactive, PCS will stop automatically
31	Reserved	
32	Reserved	
33	Simulate Stop key	An external button (Not Self-locking) can be connected and pressed as simulate panel.
34	Simulate Manual key	
35	Reserved	
36	Simulate Auto key	An external button (Not Self-locking) can be connected and pressed as simulate panel.
37	Simulate Start key	
38	Simulate Gen C/O key	This is simulate G-close key.
39	Simulate Mains C/O key	This is simulate M-open key.
40	VF Mode	
41	VSG Mode	
42	PQ Mode	
43-46	Reserved	
47	Alternative Config 1	The alternative configuration is active when the input is active. Users can set different parameters to make it easy to select current configuration via input port.
48	Alternative Config 2	
49	Alternative Config 3	
50-70	Reserved	

7.4 SELECTION OF SENSORS

Table 16 Sensor Selection

No.	Items	Description	Remark
1	Temperature Sensor	0 Not used 1 Custom Res Curve 2 Custom (4-20)mA curve 3 Custom (0-5)V curve 4 VDO 5 CURTIS 6 DATCON 7 SGX 8 SGD 9 SGH 10 PT100 11 SUSUKI 12 PRO 13-15 Reserved	Defined resistance's range is (0~6)kΩ.

8 PARAMETERS SETTING

CAUTION: Please change the controller parameters in standby mode only (e. g. Control method selection, configurable input, configurable output, various delay etc.), otherwise, alarming to stop and other abnormal conditions may happen.

NOTE: Maximum set value must over minimum set value in case that the condition of too high as well as too low will happen.

NOTE: When the warning alarm is set, please set the correct return value; otherwise, maybe there is abnormal alarm. When the maximum value is set, the return value must be less than the set value; when the minimum value is set, the return value must be over the set value.

NOTE: Configurable input could not be set as the same items (except for user-defined); otherwise, there are abnormal functions. However, the configurable output can be set as the same items.

9 SENSOR SETTING

1) When sensors are reselected, the sensor curves will be transferred into the standard value. For example, if temperature sensor is SGX (120°C resistor type), its sensor curve is SGX (120°C resistor type); if select the SGH (120°C resistor type), the temperature sensor curve is SGH curve.
2) When there is difference between standard sensor curves and used sensor curves, users can adjust it in the “sensor curve type”.
3) When the sensor curve is inputted, x value (resistor) must be inputted from small to large, otherwise, mistake occurs.
4) If sensor type is selected as “none”, sensor curve is not working.
5) If the corresponding sensor has alarm switch only, users must set this sensor as “none”, otherwise, shutdown or warning may occur.
6) The headmost or backmost values in the vertical coordinates can be set as the same as below.

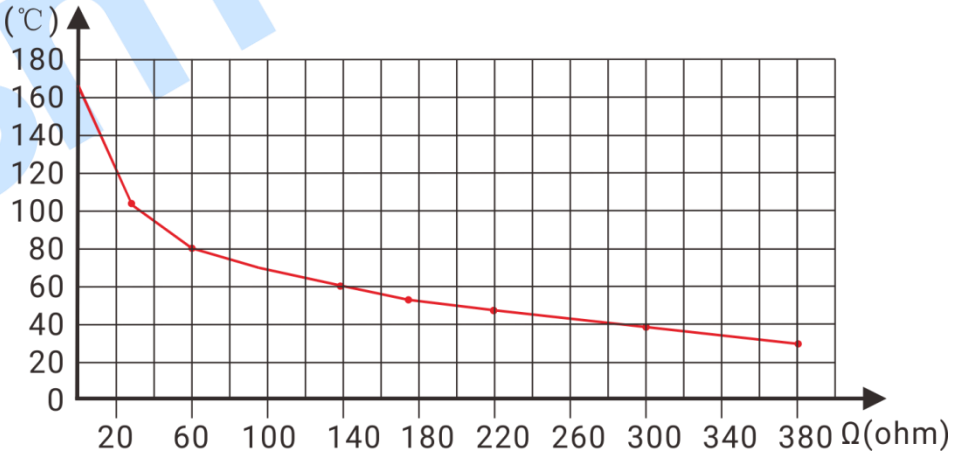


Fig. 5 Sensor Curve Diagram

10 COMMISSIONING

10.1 STEP 1: PCS CONSTANT POWER DEBUGGING

1) Check the parameter configurations of the controller (set PCS model, power control method>constant power);
2) Check the wiring connection between PCS controller and MSC CAN of genset controller;
3) In manual mode, switch the PCS working mode to PQ mode;
4) When genset starts, after normal running and normal closing, check whether the bus data of PCS controller are normal;
5) In manual mode, press the key to close the breaker of PCS;
6) In manual mode, press the start key, after normal running of PCS;
7) If PCS outputs power to charge or discharge can base on the setting power value (e.g. set charging 10 kW to check if PCS power is correct).

10.2 STEP 2: PCS DEMAND POWER DEBUGGING

1) In standby mode, change the power control method to demand power, set the coefficient of demand power to 1, adjusted power b to 0kW, adjusted power b to fixed power;
2) PCS will start after manually closed; after normal running, load increase /decrease test is performed (details see demand power description).

11 TYPICAL APPLICATION

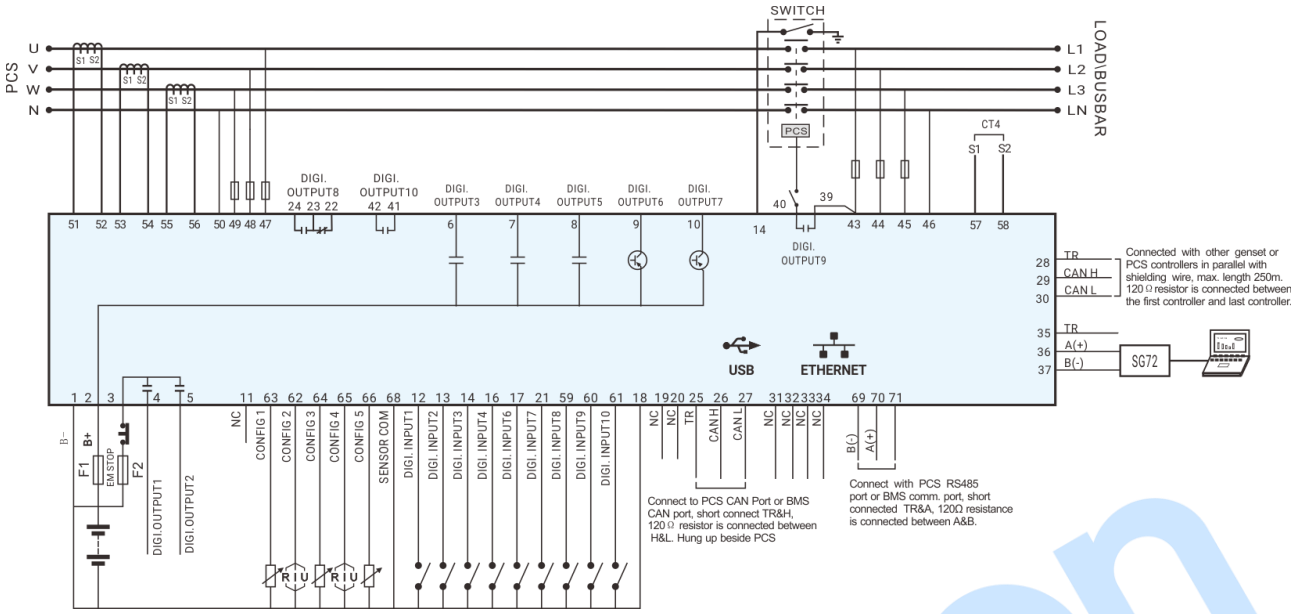


Fig. 6 PCC95 3-Phase 4-Wire Typical Application Diagram 1

NOTE: In PQ mode, PCS AC parameters are collected via AC and bus power are collected by MSC bus.

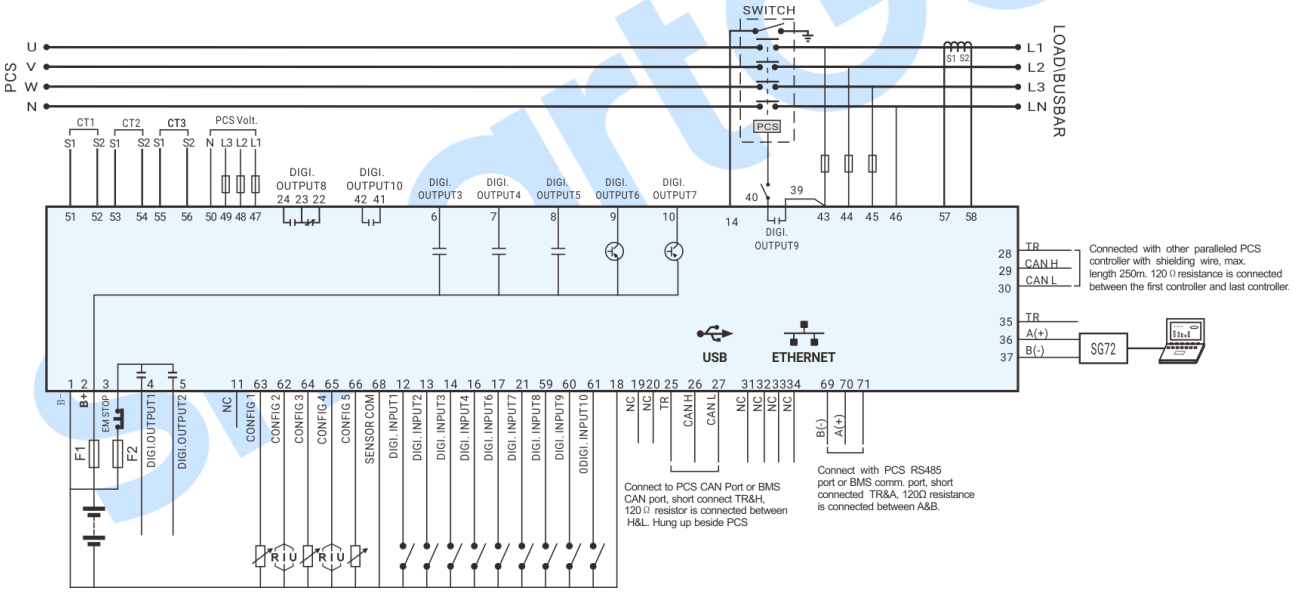


Fig. 7 PCC95 3-Phase 4-Wire Typical Application Diagram 2

NOTE: In PQ mode, PCS AC parameters are collected via communication (Ethernet or RS485) and bus power are collected by bus CT4 sampling and calculation.

NOTE: F1 fuse: min. 2A, max. 20A. F2 fuse: max. 32A. Users should choose the appropriate fuse according to the practical application.

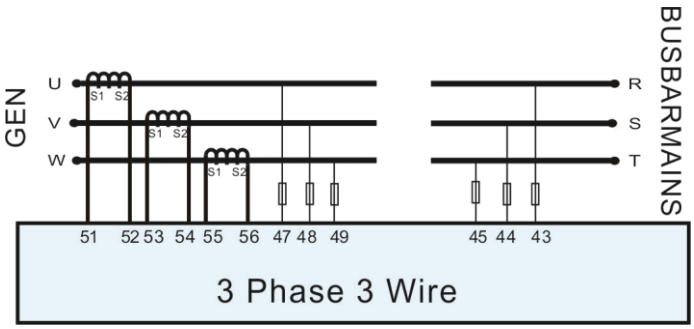


Fig. 8 3-Phase 3-Wire Typical Application Diagram

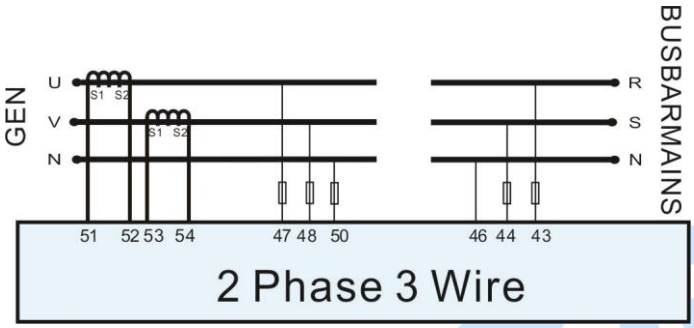


Fig. 9 2-Phase 3-Wire Typical Application Diagram

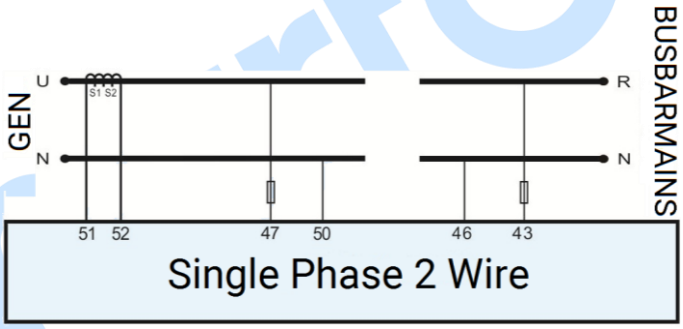


Fig. 10 Single Phase 2-Wire Typical Application Diagram

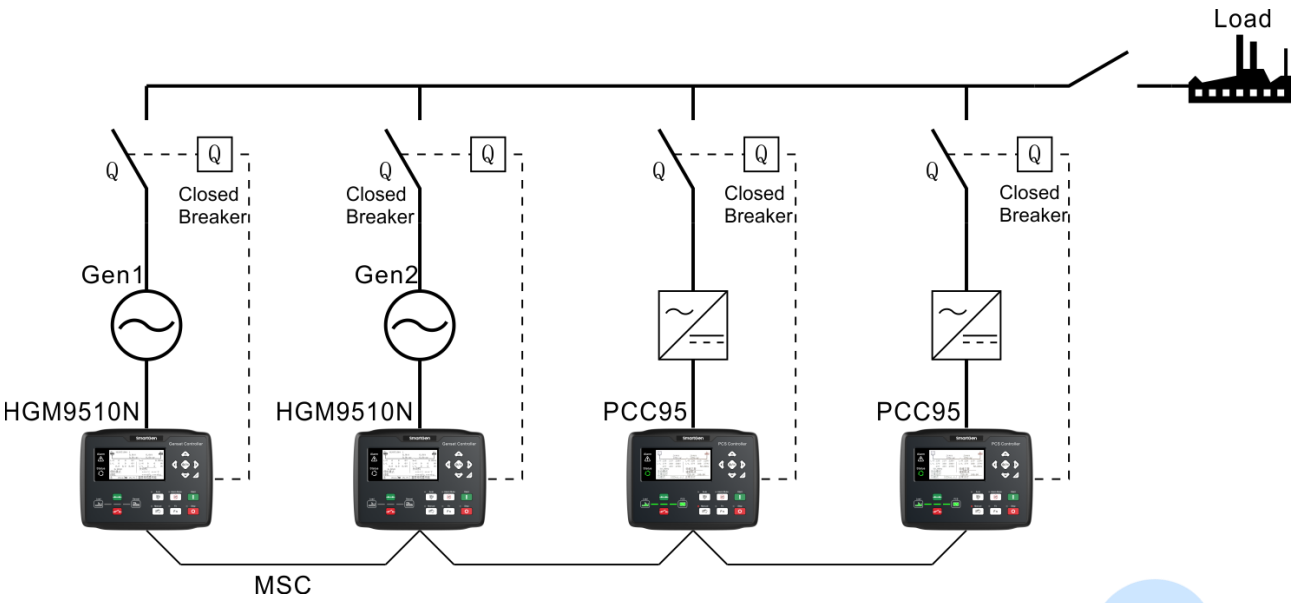


Fig. 11 Multi-PCS & HGM9510N Parallel Application Diagram

12 POWER CONTROL INSTRUCTIONS

- **Power Limit Curve**

  Power limit curve (SOC- kW), which can set the max. discharging/charging power corresponding to 8 SOC values. The target value will not exceed this limit in any condition. The power setting value is the percentage of PCS rated active power.

Power Limit Curve

SOC	0.0	20.0	40.0	60.0	80.0	100.0	100.0	100.0	(0-100.0%)
Max. Dsch.	0.0	0.0	80.0	80.0	100.0	100.0	100.0	100.0	(0-100.0%)
Max. Chg.	-100.0	-100.0	-100.0	-80.0	-40.0	0.0	0.0	0.0	(-100.0-0%)

Fig. 12 Power Limit Curve

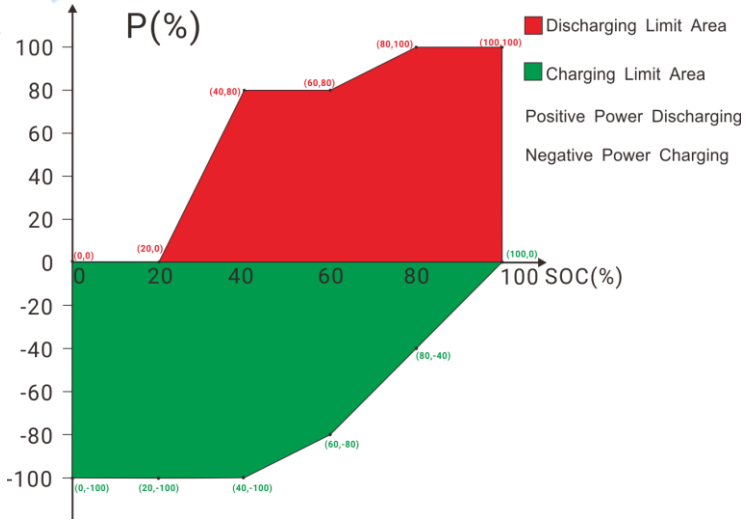


Fig. 13 Power Limit Area

- **Power Control**

VF Mode

PCS does not perform power control when it works in VF mode.

PQ Mode

Constant Power: After normal running, PCS outputs the setting constant active power and reactive power.

Application:

It is applied to the occasions that the bus capacity is large or the load change rate is little, where EMS controls PCS power. It is used to balance output to realize the peak-valley arbitrage.

Adjustment Methods for Output Power:

1. By Fn combined keys.

When the function of combined keys is Fn key , press Fn key, the main screen of controller will display the methods for output power adjustment.

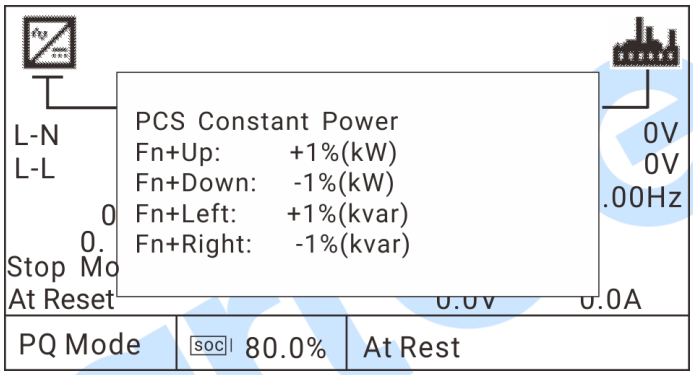


Fig. 14 Adjustment Method Display for Constant Power Mode

Fn+Up: press Fn and ▲ simutaneously for once, the constant active power will increase by 1% of PCS rated active power;

Fn+Down: press Fn and ▼ simutaneously for once, the constant active power will decrease by 1% of PCS rated active power;

Fn+Left: press Fn and ◀ simutaneously for once, the constant reactive power will increase by 1% of PCS rated reactive power;

Fn+Right: press Fn and ▶ simutaneously for once, the constant reactive power will decrease by 1% of PCS rated reactive power;

2: By PC setting.

3: By communication protocol setting (active power address: 4333, reactive power address: 4335).

4: By internal PLC configuration setting (active power address:4333, reactive power address: 4335).

Demand Power: the formula is: y = k*x+b;

y: the power required to output by PCS;

x: the output power shared by PCS, x=(Load Power/Total Rated Power)*PCS Rated Power.

K: Coefficient of power distribution between genset and PCS.

b: Setting adjustment power and it can be fixed value, or obtained by curve of (SOC-b).

Application:

The bus capacity is small while load change rate is great, PCS is required to applied in the transient process of loading and unloading, aiming to improve the bus loading capacity and smooth the bus output.

Adjustment Methods for Adjusted Power b:

1. By Fn combined keys.

When the function of combined keys is Fn key , press Fn key, the main screen of controller will display the methods for setting the adjusted power b to fixed power.

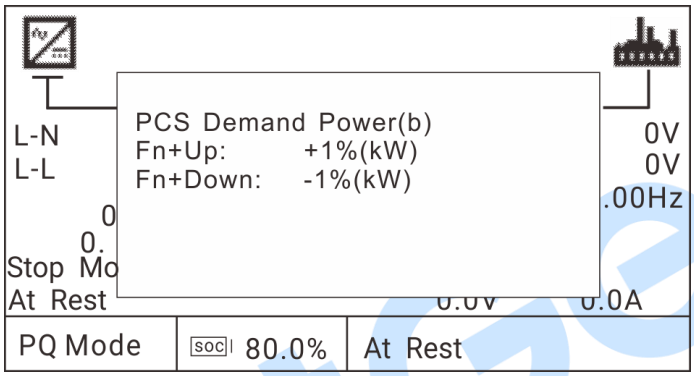


Fig. 15 Adjustment Method Display for Demand Power Mode

Fn+Up: press Fn and ▲ simutaneously for once, the adjusted power b will increase by 1% of PCS rated active power;

Fn+Down: press Fn and ▼ simutaneously for once, the adjusted power b will decrease by 1% of PCS rated active power;

2: By PC setting.

3: By communication protocol setting (adjusted power b address: 4337).

4: By internal PLC configuration setting (adjusted power b address: 4337).

5: By setting SOC-b curve to set adjusted power b automatically.

Table 17 Demand Power Examples for Single PCS

(Unit: kW)

Demand Power / Rated Power / Load Power	Gen 1	Gen 2	Gen 3	PCS	y=k*[(Load Power/Total Rated Power) *PCS Rated Power]+b;
	100	100	200	200	
150	37.5	37.5	75	0①	k=1，b=-50
150	25	25	50	50	k=2，b=-50
150	31.25	31.25	62.5	25	k=1.5，b=-50
300	50	50	100	100	k=1.5，b=-50
50	18.75	18.75	37.5	-25	k=1.5，b=-50

0	12.5	12.5	25	-50	k=1.5，b=-50
500	75	75	150	200②	k=1.5，b=-50

NOTE: ①PCS Output Power= k*[(Load Power/Total Rated Power) *PCS Rated Power]+b

= 1×[((150×200)÷(100+100+200+200))]+(-50)= 0kW

Total power of Gen 1, Gen 2 required to share= Load Power-PCS Output Power

= 150-0 = 150kW

Gen 1 Output Power = (Total load power of Gen required to share × Gen 1Rated Power) ÷Gen Total Power

= (150×100) ÷(100+100+200) = 37.5kW

Gen 2 Output Power = (Total load power of Gen required to share × Gen 2 Rated Power) ÷Gen Total Power

= (150×100) ÷(100+100+200) = 37.5kW

Gen 3 Output Power = (Total load power of Gen required to share × Gen 3 Rated Power) ÷Gen Total Power

= (150×200) ÷(100+100+200) = 75kW

② **PCS Output Power= k*[(Load Power/Total Rated Power) *PCS Rated Power]+b**

= 1.5×((500×200÷(100+100+200+200)))+(-50)= 250kW

Since the rated power of PCS is **200**kW, the max. output power of PCS is 200 kW, the remaining power is shared by genset.

Total power of Gen 1, Gen 2, Gen 3 required to share= Load Power-PCS Output Power

= 500-200 = 300kW

Gen 1 Output Power = (Total load power of Gen required to share × Gen 1Rated Power) ÷Gen Total Power

= (300×100) ÷(100+100+200) = 75kW

Gen 2 Output Power = (Total load power of Gen required to share × Gen 2 Rated Power) ÷Gen Total Power

= (300×100) ÷(100+100+200) = 75kW

Gen 3 Output Power = (Total load power of Gen required to share × Gen 3 Rated Power) ÷Gen Total Power

= (300×200) ÷(100+100+200) = 150kW

Table 18 Demand Power Examples for Two PCS Controllers

(Unit: kW)

Demand / Rated Power / Load Power	Gen 1	Gen 2	PCS 1	PCS 2	y=k*[(Load Power/Total Rated Power) *PCS Rated Power]+b;
	100	100	200	100	
150	80	80	10	-20③	k=1，b=-50
150	35	35	70	10	k=2，b=-50
150	57.5	57.5	40	-5	k=1.5，b=-50
300	65	65	130	40	k=1.5，b=-50

50	52.5	52.5	-20	-35	k=1.5，b=-50
0	50	50	-50	-50	k=1.5，b=-50
500	100	100	200	100④	k=1.5，b=-50

NOTE: ③ PCS 1 Output Power= k*[(Load Power/Total Rated Power) *PCS 1 Rated Power]+b

= 1×[((150×200)÷(100+100+200+100))]+(-50)= 10kW

PCS 2 Output Power= k*[(Load Power/Total Rated Power) *PCS 2 Rated Power]+b

= 1×[((150×100)÷(100+100+200+100))]+(-50)= -20kW

Total power of Gen 1, Gen 2 required to share = Load Power-PCS 1 Output Power- PCS 2 Output Power

= 150-10-(-20) = 160kW

Gen 1 Output Power = (Total load power of Gen required to share × Gen 1Rated Power) ÷Gen Total Power

= (160×100) ÷(100+100) = 80kW

Gen 2 Output Power = (Total load power of Gen required to share × Gen 2 Rated Power) ÷Gen Total Power

= (160×100) ÷(100+100) = 80kW

④ PCS1 Output Power= k*[(Load Power/Total Rated Power) *PCS 1 Rated Power]+b

= 1.5×[((500×200)÷(100+100+200+100))]+(-50)= 250kW

Since the rated power of PCS 1 is **200**kW, the max. output power of PCS is 200 kW.

PCS2 Output Power= k*[(Load Power/Total Rated Power) *PCS2 Rated Power]+b

= 1.5×[((500×100)÷(100+100+200+100))]+(-50)= 100kW

Total power of Gen 1, Gen 2 required to share = Load Power-PCS1 Output Power- PCS2 Output Power

= 500-200-100= 200kW

Gen 1 Output Power = (Total load power of Gen required to share × Gen 1Rated Power) ÷Gen Total Power

= (200×100) ÷(100+100) = 100kW

Gen 2 Output Power = (Total load power of Gen required to share × Gen 2 Rated Power) ÷Gen Total Power

= (200×100) ÷(100+100) = 100kW

Genset Power: Ensure that the genset power is at a constant percentage and calculate the demand power according to the MSC power data.

Application:

As an extended range, the genset is used to ensure the high efficient and economical operation.

Single PCS System: PCS discharges when load is over than the constant power of genset; PCS charges when load is less than the genset power.

Multi PCS System: demand power is shared by PCS, when load is over than the constant power of the genset, PCS discharges evenly according to dischargeable power; when load is less than the genset power, PCS charges evenly according to the chargeable power.

Adjustment Methods for genset power:

1. By Fn combined keys.

When the function of combined keys is Fn key , press Fn key, the main screen of controller will display the methods for genset power adjustment.

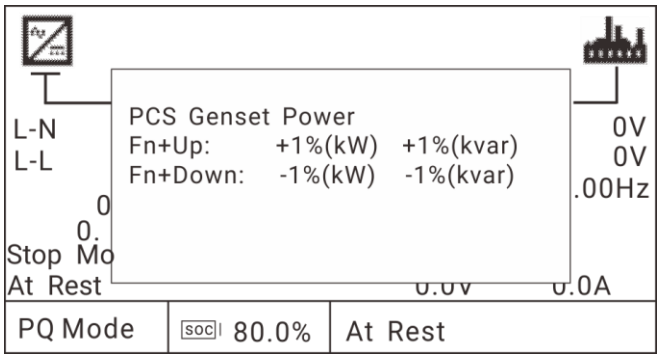


Fig. 16 Adjustment Method Display for Genset Power Mode

Fn+Up: press Fn and ▲ simutaneously for once, the active/reactive power of the genset will increase by 1% of genset rated active/reactive power;

Fn+Down: press Fn and ▼ simutaneously for once, the active/reactive power of the genset will decrease by 1% of genset rated active/reactive power;

2: By PC setting.

3: By communication protocol setting (adjusted genset power address: 4355).

4: By internal PLC configuration setting (adjusted genset power address: 4355).

Table 19 Constant Power Examples for Single PCS

(Unit: kW)

Demand Power / Rated Power / Load Rate	Unit 1	Unit 2	Unit 3	PCS	Genset Constant Power: 50%
	100	100	200	200	
150	50	50	100	-50⑤	PCS Charging
300	50	50	100	100⑥	PCS Discharging
50	50	50	100	-150	PCS Charging
500	75	75	150	200⑦	PCS full power outputs when it exceeds its rated power. The remaining power is shared by genset.

NOTE: ⑤Total power of Gen 1, Gen 2, Gen 3 required to output = Gen Total Rated Power × Gen Constant Power

= (100+100+200) ×50% = 200kW

Gen 1 Output Power = Gen 1 Rated Power × Gen Constant Power

= 100×50% = 50 kW

Gen 2 Output Power = Gen 2 Rated Power × Gen Constant Power

= 100×50% = 50 kW

Gen 3 Output Power = Gen 3 Rated Power × Gen Constant Power

= 200×50% = 100kW

PCS Output Power = Load Power – Gen Total Power

= 150-200=- 50kW (PCS Charging)

⑥Total power of Gen 1, Gen 2, Gen 3 required to output=Gen Total Rated Power× Gen Constant Power

= (100+100+200) ×50% = 200kW

Gen 1 Output Power = Gen 1 Rated Power × Gen Constant Power

= 100×50% = 50 kW

Gen 2 Output Power = Gen 2 Rated Power × Gen Constant Power

= 100×50% = 50kW

Gen 3 Output Power = Gen 3 Rated Power × Gen Constant Power

= 200×50% = 100kW

PCS Output Power = Load Power –Total Power of Gen required to output

= 300-200=100kW (PCS Discharging)

⑦Total power of Gen 1, Gen 2 required to output = Gen Total Rated Power ×Gen Constant Power

= (100+100+200)×50% = 200 kW

PCS Output Power = Load Power –Total Power of Gen required to output

= 500-200=300kW (PCS Discharging)

The rated power of PCS is 200 kW, PCS outputs with full power, the remaining power 100kW(300-200) is shared by genset.

Gen 1 Output Power= Gen 1 Rated Power× Gen Constant Power + Remaining Power × Gen 1 Rated Power ÷ Gen Total Rated Power

= 100×50%+100×100 ÷(100+100+200)=75 kW

Gen 2 Output Power= Gen 2 Rated Power× Gen Constant Power + Remaining Power × Gen 2 Rated Power ÷ Gen Total Rated Power

=100×50%+100×100 ÷(100+100+200)=75 kW

Gen 3 Output Power= Gen 3 Rated Power× Gen Constant Power + Remaining Power × Gen 3 Rated Power ÷ Gen Total Rated Power

= 200×50%+100×200 ÷(100+100+200)=150 kW

Table 20 Constant Power Examples for Two PCS Controllers

(Unit: kW)

Demand Power / Rated Power / Load Power	Gen 1	Gen 2	PCS1	PCS2	Unit Constant Power :50% The parameters of two PCS controllers should be the same.
	100	100	200	100	
350	50	50	166.7	83.3⑧	PCS Discharging
50	50	50	-33.3	-16.7⑨	PCS Charging

450	75	75	200	100⑩	PCS full power outputs when it exceeds its rated power. The remaining power is shared by genset.

NOTE: ⑧Total power of Gen 1, Gen 2 required to output= Gen Total Rated Power ×Gen Constant Power

= (100+100)×50% = 100kW

Gen 1 Output Power= Gen 1 Rated Power× Gen Constant Power

= 100×50% = 50kW

Gen 2 Output Power= Gen 2 Rated Power× Gen Constant Power

= 100×50% = 50kW

Total Power of PCS required to output =Load Power- Total Power of Gen required to output

= 350-100=250kW (PCS discharging)

PCS1 Output Power=Total Power of PCS required to output×PCS1 Rated Power÷(PCS Total Rated Power)

= 250×200÷(200+100) = 166.7kW

PCS2 Output Power=Total Power of PCS required to output×PCS2 Rated Power÷(PCS Total Rated Power)

= 250×100÷(200+100) = 83.3kW

⑨Total power of Gen 1, Gen 2 required to output= Gen Total Rated Power×Gen Constant Power

= (100+100)×50% = 100kW

Gen 1 Output Power= Gen 1 Rated Power× Gen Constant Power

= 100×50% = 50kW

Gen 2 Output Power= Gen 2 Rated Power× Gen Constant Power

= 100×50% = 50kW

Total Power of PCS required to output =Load Power-Total Power of Gen required to output

= 50-100=-50kW (PCS charging)

PCS1 Output Power=Total Power of PCS required to output×PCS1 Rated Power÷(PCS Total Rated Power)

= (-50)×200÷(200+100) = -33.3kW

PCS2 Output Power=Total Power of PCS required to output×PCS2 Rated Power÷(PCS Total Rated Power)

= (-50)×100÷(200+100) = -16.7kW

⑩Total power of Gen 1, Gen 2 required to output = Gen Total Rated Power ×Gen Constant Power

= (100+100)×50% = 100kW

Total Power of PCS required to output =Total Load Power- Total power of Gen 1, Gen 2 required to output

= 450-100=350kW (PCS discharging)

When total power of PCS required to output is over than PCS total rated power, PCS full power outputs and the remaining power is shared by genset.

PCS1 Output Power=200kW

PCS2 Output Power=100kW

Total power of Gen 1, Gen 2 required to output = Load Power- PCS Total Rated Power

= 450-300= 150kW

Gen 1 Output Power=(Total load power of Gen required to output × Gen1 Rated Power) ÷Gen Total Power

= 150×100÷(100+100) = 75kW

Gen 2 Output Power=(Total load power of Gen required to output × Gen 2 Rated Power) ÷Gen Total Power

= 150×100÷(100+100) = 75kW

VSG Mode

The calculation for demand power of VSG mode is the same as PQ mode. After calculating the demand power, the setting power is sent according to VSG droop of PCS.

- Frequency Droop

  Frequency droop should be enabled when PCS works in PQ mode, when load has a transient change, the compensation demand power is calculated via PCS frequency to rapidly change PCS output power and meet the load transient response.

  Example:

1) The rated power of PCS is 100kW, and the rated power of genset is 100kW.
2) The control method is demand power, the coefficient k of genset and PCS power distribution is 1 and adjusted power b is 0.
3) The rated frequency of PCS is 50Hz, enable the frequency droop, the loading droop frequency is 46.0Hz, the cut-off droop frequency of is 49.0Hz, the unloading droop frequency is 54.0Hz, and the unloading cut-off droop frequency is 51.0Hz.

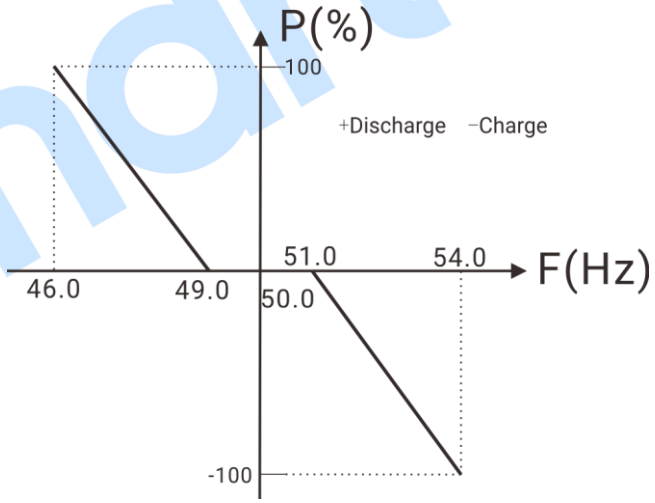


Fig.17 Frequency Droop Curve

4) Transient Curve of Sudden Loading/Unloading 120kW.

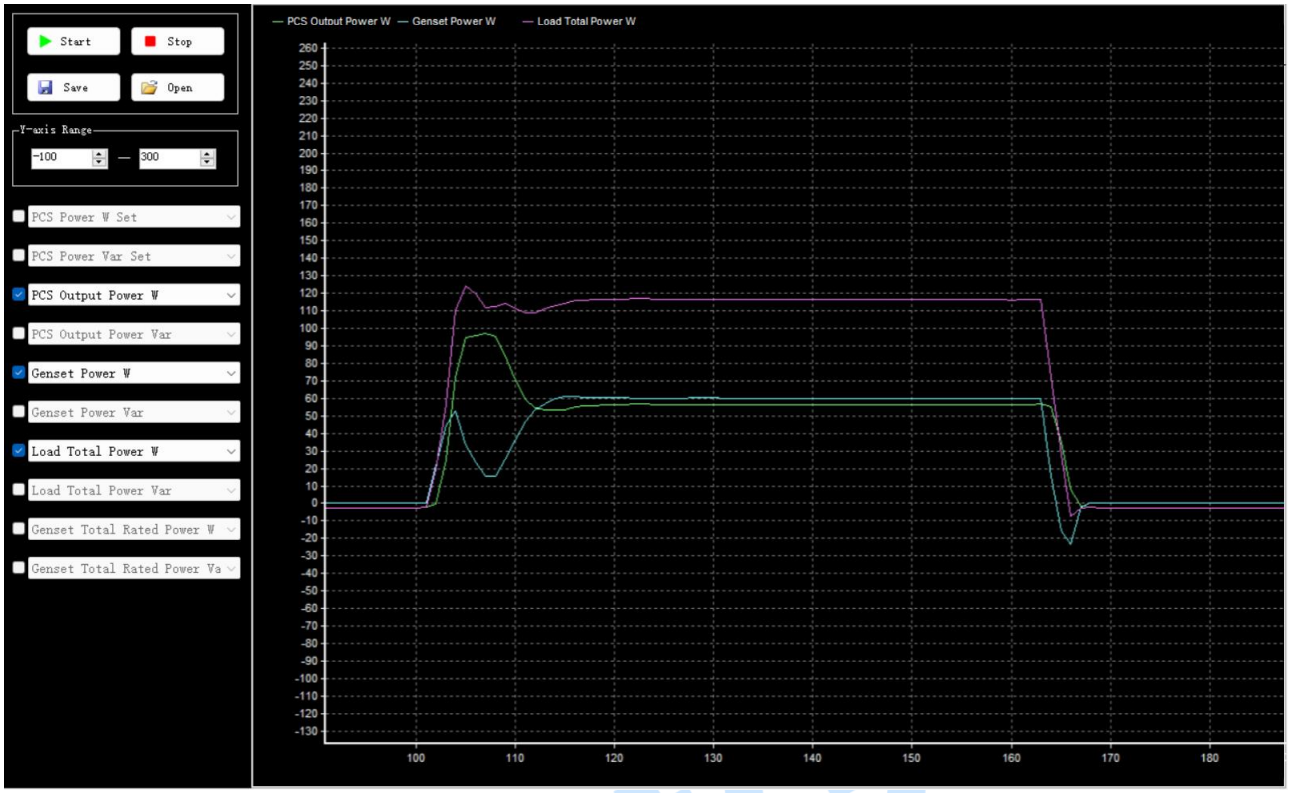


Fig.18 Sudden Loading/Unloading Curve in PQ Mode

13 INSTALLATION

The controller is panel built-in design; it is fixed by clips when installed.

Unit: mm

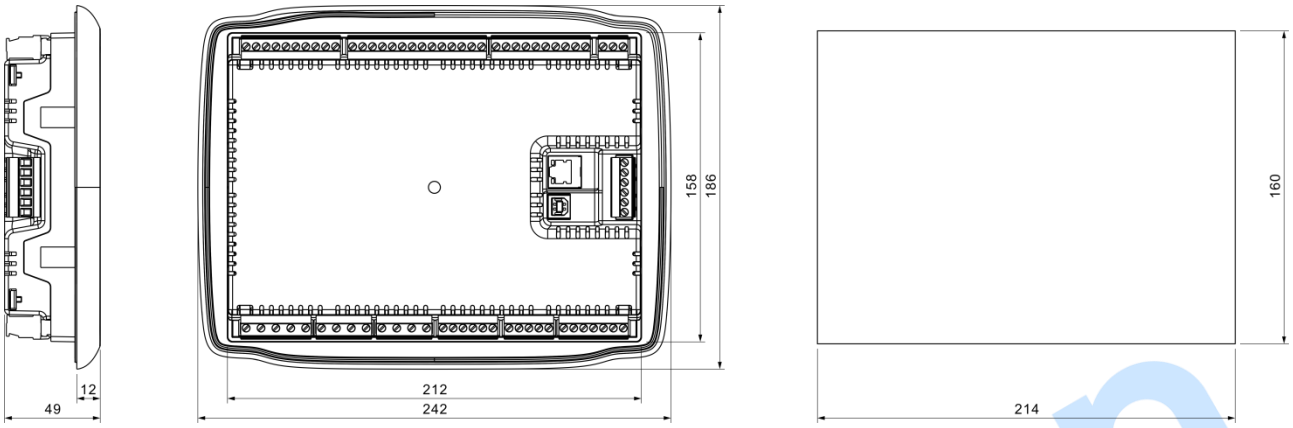


Fig. 19 Dimension and Cutout Size

1) Voltage Input

NOTE: PCC controller can suit for wide range of voltage (8~35) VDC. The wire area connecting controller power B+/B- with negative and positive electrodes must be over 2.5mm^2.

2) Output and Expand Relays

CAUTION: All controller outputs are relay contact outputs. If the expansion relay is needed, freewheel diode (relay coil is DC) and resistor and capacitor circuit (relay coil is AC) shall be added to the two ends of the relay coils in order to prevent disturbing the controller or others equipment.

3) AC Current Input

Controller current input must be connected to outside current transformer. The secondary side current of the current transformer must be 5A and at the same time current transformer phase and input voltage phase must be correct, otherwise the collected current and active power maybe not correct.

NOTE: ICOM port must be connected to negative pole of battery.

WARNING! When there is load current, transformer's secondary side is prohibited open circuit.

4) Withstand Voltage Test

CAUTION! When controller had been installed in control panel, if need the high voltage test, please disconnect controller's all terminal connections, in order to prevent high voltage into controller and damage it.

14 FAULT FINDING

Table 21 Fault Finding

Symptoms	Possible Solutions
Controller no response with power	Check starting batteries; Check controller connection wirings; Check DC fuse.
Controller emergency stop	Check emergence stop button is correct or not; Check whether the starting battery positive is connected with the emergency stop input; Check whether there is open circuit.
PCS communication failure	Check settings of PCS COM port and the connections;
BMS communication failure	Check settings of BMS COM port and the connections;
Start failure alarm	Check whether PCS model is correct, PCS working mode is normal and PCS data is read normally.
Bus/PCS voltage normal but breaker no action	Check the breakers; Check the connections between controller and breaker.
RS485 communication abnormal	Check connections; Check settings of COM port is correct or not; Check RS485's A and B connections is reversely connected or not; Check RS485 conversion module is damaged or not; Check communication port of PC is damaged or not.