



SmartGen
ideas for power

HGM4020T
GENSET CONTROLLER
(Communication base station dedicated)
USER MANUAL



SMARTGEN (ZHENGZHOU) TECHNOLOGY CO., LTD.



Chinese trademark

SmartGen English trademark

SmartGen — make your generator *smart*

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Table 1 - Software Version

Date	Version	Note
2018-04-18	1.0	Original Release
2018-09-15	1.1	Adding input port functions: "Emergency Stop", "Low Oil Level Warn"; Adding output port function:"Tele. Open Door"; Adding frequency of generator configuration items and mains abnormal trip configuration items; Adding "Stop Conditions Selection" after mains abnormal and pile low volt start, and also adding stop description; Adding "Load Current Protection" delay.
2018-11-30	1.2	Adding relay outputs to 50 pieces; Adding "Advance Oil Output" and "Pre-Oil" relay output functions; Adding "Louver Hold Open" time and changing the logic of "Louver Control" relay output; Adding decimal place setting in power configuration; Adding"Reset Maintenance Time" input port function.

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1 OVERVIEW

HGM4020T genset controller is specially designed for mobile communication base station, and its functions are completely followed by the actual situation of the mobile station. It not only fits with auto start/stop genset function in multiple boot conditions, data measurement function, alarm protection function and etc, but also can monitor machine room temperature and voltage of battery packs to realize dual power ATS function between mains and load or mains and air conditioner.

HGM4020T genset controller adopts micro-processor technology with precision parameters measuring, fixed value adjustment, time setting and set value adjusting and etc functions. All parameters can be configured from front panel or through programmable interface (USB or RS485 interface) via PC. It can be widely used in all types of automatic genset control system with compact structure, advanced circuits, simple connections and high reliability.

2 PERFORMANCE AND CHARACTERISTICS

- 132x64 LCD with backlight, selectable language interface (Chinese and English), push-button operation;
- Hard-screen acrylic material been used to protect screen with great wear-resisting and scratch-resisting functions.
- Silicone panel and pushbuttons can be used in extreme temperature environment.
- RS485 communication interface enable “Three remote functions” (remote control, remote measuring and remote communication) according to MODBUS protocol.
- 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;
- Collects and shows mains 3-phase voltage/frequency, generator 3-phase voltage/frequency, generator 3-phase current, and generator 3-phase power parameters.

Mains

Line voltage (Uab, Ubc, and Uca)

Phase voltage (Ua, Ub, and Uc)

Frequency Hz

Phase sequence

Generator

Line voltage (Uab, Ubc, and Uca)

Phase voltage (Ua, Ub, and Uc)

Frequency Hz

Phase sequence

Gen

Current Ia, Ib, Ic

A (unit)

Each phase and total active power P

kW (unit)

Reactive power Q

kvar (unit)

Apparent power S

kVA (unit)

Power factor PF

Accumulate total generator power W

kWh (unit)

Output percentage with load

%

- For Mains, controller has over and under voltage and loss of phase detection functions, and mains have rules can be selected; for generator, controller has over/ under voltage, over/under frequency, over current and over power protection functions.

- Precision measure and display parameters about Engine.
 - Oil Pressure (OP) kPa/psi/bar all be displayed
 - Fuel Level (FL) %(unit) Fuel Quantity Left L(unit)
 - Speed (RPM) r/min (RPM)
 - Voltage of Battery V (unit)
 - Voltage of Charger V (unit)
 - Hour count accumulation
 - Start times accumulation
- Machine room temperature can be collected, if temperature is too high, air conditioner in the machine will be started;
- Battery pack voltage(48V) can be collected, if battery pack is under voltage, generator will be started to charge the battery;
- 6 start conditions can be grouped at random: mains abnormal signal, remote start signal, mains abnormal and temperature of machine room is high, mains abnormal and battery pack voltage is low, scheduled start, and cycle start/stop;
- 6 relay output ports, including 1 start output, 1 fuel output (programmable), 4 programmable outputs, in which programmable output port 4 shares the same port with input port 5 (can be set);
- 7 digital input ports, in which input port 6 and input port 7 can be multiplexed as flexible sensor 1 and flexible sensor 2;
- 2 flexible sensors, which can be selected as temperature sensor, pressure sensor or fuel level sensor; flexible sensor 1 also can be configured as machine room temperature sensor;
- Multiple temperature, pressure and fuel level sensors can be used directly and its parameter can be user-defined;
- Able to control 2 ATS;
- Multiple crank disconnect conditions (speed sensor, gen frequency and oil pressure) can be selected;
- Access monitoring function, which can provide security for the machine room;
- With emergency start function;
- With scheduled not run function(monthly, weekly, daily, duration time can be set);
- With flywheel tooth number automatic recognition function;
- With event log and real-time clock. Maximum 99 event logs can be memorized (loop save);
- Parameter setting function: users can configure parameters and user-defined parameters will be stored in the internal FLASH to avoid lose parameters in case of power dropout. All parameters can be configured from front panel or through programmable interface (USB or RS485 interface) via PC;
- Widely power supply range DC(8~35)V, suitable for different starting battery voltage environment;
- Waterproof security level IP65 due to rubber seal installed between the controller enclosure and panel fascia;
- With metal fixing clips;
- Modular design, anti-flaming ABS plastic enclosure, pluggable connection terminals and embedded installation way; compact structure with easy mounting.

3 SPECIFICATION OPERATION










Table 2 – Technical Parameters

Items	Contents
Operating Voltage	DC8.0V to DC35.0V, continuous power supply.
Power Consumption	<3W (standby ≤2W)
Alternator Volt Input Range	
3Phase 4Wire	15V AC - 360 V AC (ph-N)
3Phase 3Wire	30V AC - 620 V AC (ph-ph)
Single Phase 2Wire	15V AC - 360 V AC (ph-N)
2Phase 3Wire	15V AC - 360 V AC (ph-N)
Alternator Frequency	50Hz/60Hz
Speed sensor voltage	1.0V to 24.0V (RMS)
Speed sensor Frequency	10,000 Hz (max.)
Start Relay Output	5 A DC28V DC B+ power supply output
Fuel Relay Output	5 A DC28V DC B+ power supply output
Programmable Relay Output 1	1 A DC28V DC B+ power supply output
Programmable Relay Output 2	1 A DC28V DC B+ power supply output
Programmable Relay Output 3	1A DC28V DC B+ power supply output
Programmable Relay Output 4	1A DC28V DC B+ power supply output
Battery Pack Volt Input	0V DC - 100 V DC
RS485 Interface	Baud rate 9600bps; 1 stop bit; no parity check Communication protocol MODBUS
Case Dimension	135mm x 110mm x 44mm
Panel Cutout	116mm x 90mm
CT Secondary Current	5A rated
Working Conditions	Temperature: (-25~+70)°C; Relative Humidity: (20~93)%RH
Storage Condition	Temperature: (-25~+70)°C
Protection Level	Front panel: IP65
Insulating Intensity	Apply AC2.2kV voltage between high voltage terminal and low voltage terminal; The leakage current is not more than 3mA within 1min.
Net Weight	0.32kg

4 OPERATION

4.1 KEY FUNCTION

Table 3 - Key Function Description

Icon	Function	Description
	Stop/ Reset	Stop running generator in Auto/Manual mode; In case of alarm condition, pressing the button will reset alarms; In stop mode, pressing and holding the button for 3 seconds will test indicator lights (lamp test); During stopping process, press this button again to stop generator immediately.
	Start	Under manual mode, press this button will start genset; press this button during genset start up, genset will jump to next status and genset can fast-boot.
	Manual	Pressing this key will set the module into manual mode.
	Auto	Pressing this key will set the module into auto mode.
	Close/Open	Pressing this key causes the controller to switch the display between C/O page and the main page. Press Up or Down key to control switch close or open in C/O page under manual mode, and confirm the action by pressing 
	Set/Confirm	Pressing this key will enter into Main Menu; In setting parameter status, press this key will shift cursor or confirm setting value.
	Up/Increase	Scrolls the screen up; Shift the cursor up or increase the set value in parameter setting menu.
	Down/Decrease	Scrolls the screen down; Shift the cursor down or decrease the set value in parameter setting menu.

4.2 CONTROLLER PANEL

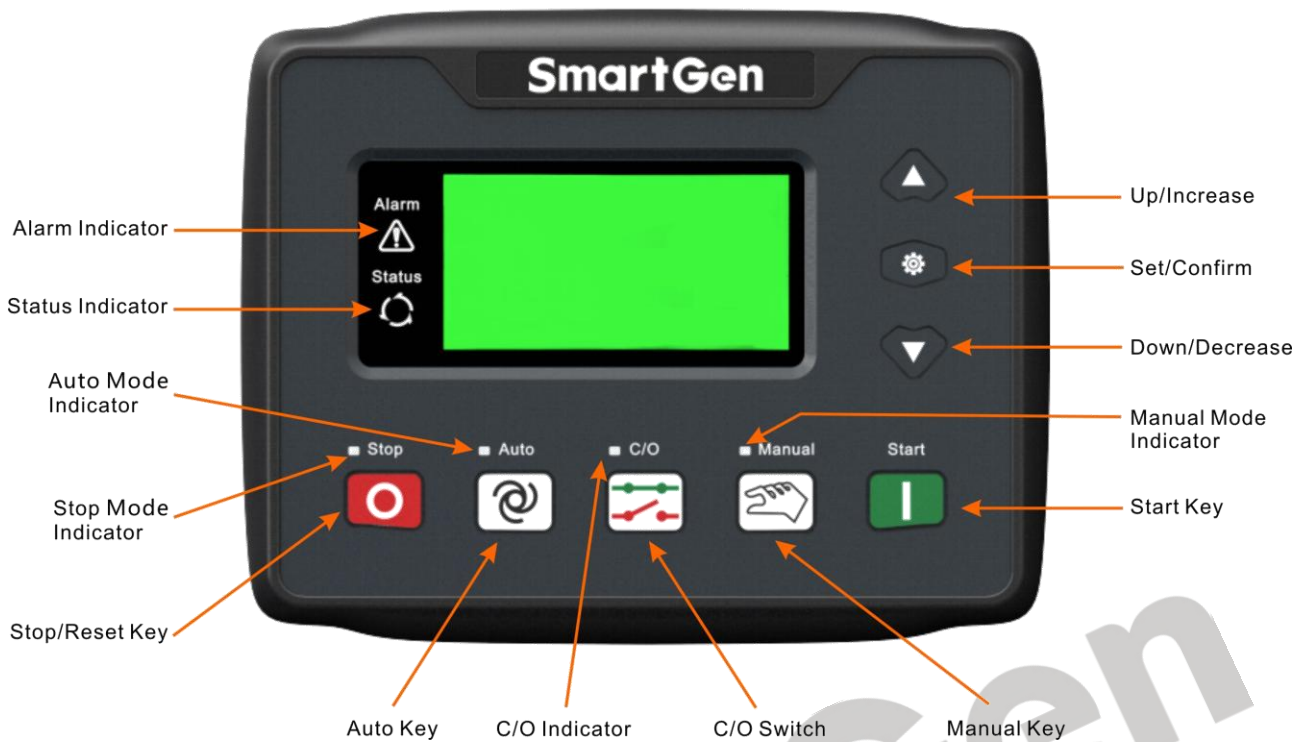


Fig.1 - HGM4020T Front Panel Indication

▲NOTE: Part of indicator lights illustration:

Alarm Indicators: slowly flash when warn alarms; fast flash when shutdown alarms; light is off when no alarms.

Status Indicators: Light is off when genset is standby; flash once per second during start up or shut down; always on when normal operation.

4.3 AUTO START/STOP OPERATION

4.3.1 ILLUSTRATION

Press , its indicator lights up, and controller enters **Auto Start** mode.

4.3.2 AUTO START SEQUENCE








- When meet with pre-set start conditions, auto mode indicator flashes and meanwhile “start delay” displayed on LCD starts countdown;
- When start delay is over, preheat relay outputs (if this be configured), “preheat start delay XX s” is shown on LCD.
- When preheat delay is over, fuel relay outputs 1s and then start relay output; if engine crank fails during “cranking time”, the fuel relay and start relay deactivated and enter into “crank rest time” to wait for next crank.
- If engine crank fails within setting times, the fifth line of LCD turn black and “Failed to Start” message appears on fifth line of LCD display at the same time.
- In case of successful crank attempt, “safety on timer” starts. During this period, low oil pressure, under speed, charge failure alarms and auxiliary inputs (if configured) are disabled. As soon as this delay is over, “start idle delay” is initiated (if configured).
- During “start idle delay”, under speed, under frequency, under voltage alarms are inhibited. When this delay is over, “warming up delay” starts (if configured).
- When “warming up delay” is over, if generator state is normal, its indicator will be illuminated. If voltage and frequency has reached on-load requirements, the closing relay will be energized, generator will

take on load, generator power indicator will turn on, and generator will enter “Normal Running” state; if voltage and frequency are abnormal, the controller will initiate shutdown alarm (shutdown alarm will be displayed on LCD alarm page).



4.3.3 AUTO STOP SEQUENCE

- a) If pre-set start conditions cannot be satisfied, “stop delay” will be started.
- b) When stop delay is over, close generator relay is un-energized; generator enters into “cooling down time”. After “transfer rest time”, close mains relay is energized. Mains on load and generator indicator extinguished while mains indicator lights.
- c) Idle relay is energized as soon as entering “stop idle delay” (if configured).
- d) If enter “ETS hold delay”, ETS relay is energized. Fuel relay is deactivated.
- e) Then enter gen-set “Fail to stop time”, auto decides whether generator is stopped or not automatically.
- f) Enter “generator at rest” as soon as “after stop time” is over. If genset fail to stop, controller will initiate alarms(fail to stop warning shown on LCD).

4.4 MANUAL START/STOP OPERATION

- a) **Manual Start:** Manual mode is selected by pressing the  button; a LED besides the button will illuminate to confirm the operation; press  button to start the genset, it can automatically judge crank success and accelerate to high speed running. If low oil pressure, over speed and abnormal voltage occur during genset running, controller can effectively protect genset to stop (detail procedures please refer to No.b~g of Auto start sequence). Under **Manual Mode**, load breaker won't transfer automatically and  C/O key should be pushed to enter into the C/O interface. Through  key and  key to select 1#ATS close/open mains and 2#ATS close/open generator, and then press  to execute corresponding actions.
- b) Manual stop: pressing  key can stop the running genset. (detail procedures please refer to No.b~f of Auto stop sequence)

4.5 EMERGENCY START UP

Simultaneously press  and  in manual mode will force generator to crank. Successful start will not be judged according to crank disconnect conditions, operator will have to crank the starter motor manually; when operator decides that the engine has fired, he/she should release the button and start output will be deactivated, safety on delay will be initiated.

4.6 GENERATOR AUTO START CONDITIONS

There are 6 generator auto start conditions. Genset will startup in case any one condition is satisfied; after genset is started automatically, if corresponding stop condition is reached, genset will stop.

Table 4 – Start Conditions

No.	Conditions	Description	Corresponding Stop Conditions
1	Mains Abnormal Start	Genset will start when mains is abnormal.	Genset will stop when mains is normal.
2	Remote Start	Genset will start when remote start signal is active.	Genset will stop when remote start signal is deactivated.
3	Cycle Run Start	Genset will start when cycle running start timer is due (single cycle).	Genset will stop when cycle running stop timer is due (single cycle).
4	Scheduled Run	Genset will start when scheduling start timer is due.	Genset will stop when scheduling running timer is due.



No.	Conditions	Description	Corresponding Stop Conditions
5	Mains Abnormal And Pile Low Volt Start	Genset will start when mains is abnormal and battery voltage is lower than the pre-set limit of battery pack.	If mains is normal, battery pack charging time reaches to charge complete time or complied with selected stop conditions, genset will stop.
6	Mains Abnormal And Room Temp High Start	Genset will start when mains is abnormal and machine room temperature is higher than the setting temperature upper limit.	Genset will stop when mains is normal and machine room temperature is under the setting temperature lower limit.

4.7 STOP CONDITIONS SELECTION

After mains is abnormal and pile low voltage start the genset, If mains is back to normal and battery pack charging time reaches to charge complete time or complied with selected stop conditions, genset will stop.

Stop contions can be selected are as below,

- 0: Pile Volt Normal and Current Low
- 1: Pile volt Normal
- 2: Current Low
- 3: Pile Volt Normal or Current Low

▲NOTE: Load current lower limit detection is active only while genset is normal running and meanwhile ATS1 gen closed and ATS2 gen opened. And genset will stop when load current detection time is reached.

4.8 MAINS HAVE RULES

Mains have rules suit for 3P4W/3P3W AC system.

Table 5 – Mains Have Rules

No.	Rules Description	
1	phase A must be electrified	phase B/C phase can not be missing;
2		phase B/C can be missing one phase;
3		phase B/C can be missing two phases;
4	phase A can not be electrified	Three phases can be missing one phase
5		Three phases can be missing two phases

4.9 ATS CONTROL

4.9.1 MANUAL CONTROL

When controller is in manual mode, both switches execute manual control process.





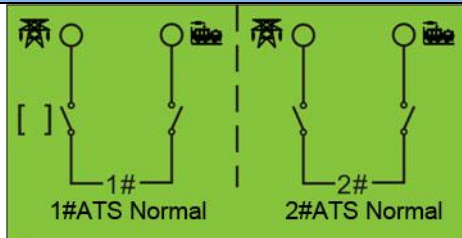

Press  to enter into C/O page, and then select  or  to control its breaker to open or close. When “[]” selects the related object, press  to execute corresponding actions. For example, transfer 1#ATS transfer from open to close, operation process is as below,

Table 6 – ATS Manual Control Operation

No.	Display Contents	Operation
1	 <p>The diagram shows two ATS units, 1#ATS Normal and 2#ATS Normal, each with a switch and a breaker symbol. A dashed vertical line separates the two units. The left unit is labeled '1#ATS Normal' and the right unit is labeled '2#ATS Normal'. A bracket on the left unit is labeled '[]'.</p>	<p>Press  to enter into C/O page, as showing in the left picture.</p>



No.	Display Contents	Operation
2		Press twice and select 1#ATS GCB open icon; Press to execute 1#ATS GCB close action.
3		1#ATS close GCB completely; Press again to exit C/O page.

4.9.2 AUTO CONTROL

In auto mode, ATS will execute auto control process.

a) Allowing 1#ATS and 2#ATS close GCB simultaneously.

It suits for gensets with big power, allowing two ATSs to be loaded at the same time.

- When two ATSs need to transferred from mains on-load to gen on-load, firstly, 1#ATS will execute close GCB action after opening MCB and transfer delay expired; secondly, 2s later after 1#ATS close GCB completely delay, 2#ATS will execute close GCB action.
- When two ATSs need to transferred from gen on-load to mains on-load, firstly, 2#ATS will execute close MCB action after opening GCB and transfer delay expired; secondly, 2s later after 2#ATS close MCB completely delay, 1#ATS will execute close MCB action.

b) Not allowing 1#ATS and 2#ATS close GCB simultaneously.

It suits for gensets with small power, only one ATS is allowed to be loaded at the same time.

- If genset start up because mains is abnormal and voltage of battery pack is low, 1#ATS will execute close GCB action after opening MCB and transfer delay expired, but 2#ATS will not close GCB;
- If genset start up because mains is abnormal and temperature of machine room is high, when battery pack charging time reaches minimum charge time or current of switch power is below load current lower limit, 1#ATS will execute close GCB action(or close MCB action), and 2s after delay 2#ATS close GCB.
- For other situations, it should be followed by the ATS close GCB configuration in current power-on condition, act on the principle of 1#ATS priority close GCB.

4.9.3 SWITCH CONTROL DESCRIPTION

a) If input port is configured as Close Status Auxiliary

- If “Open breaker detect” is select “Enable”

Load is transferred from mains to generator, when detecting time out, if open failed, it will wait for breaker opened. Otherwise, breaker open is completed. While close signal is outputting, when detecting time out (NOTE1), if close failed, it will wait for breaker closed. Otherwise, breaker close is completed. If transfer failed and warning select “Enable”, there is alarming signal whatever breaker open or close failure.

- If “Open breaker detect” is select “Disable”

While open signal is outputting, when detecting time out, breaker open is completed.

While close signal is outputting, when detecting time out (NOTE1), if close failed, it will wait for breaker closed. Otherwise, breaker close is completed. If transfer failed and warning select "Enable", there is alarming signal whatever breaker open or close failure.

- b) If input port is not configured as Close Mains Auxiliary

Load transferred from mains to gen, after open MCB delay and transfer delay, GCB is closed.

Load transferred from gen to mains, after open GCB delay and transfer delay, MCB is closed.

▲NOTE1: for the impulse type signals, close breaker detecting time is "Close Breaker Time"; for the constant close signals, breaker close detecting time is "Close Check Time".

▲NOTE2: in manual mode, failed to transfer warning is deactivated.

▲NOTE3: when using ATS of no interposition, "Open breaker detect" should "Disable".

▲NOTE4: When using AC contactor, "Open breaker detect" should select "Enable".

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5 PROTECTION

5.1 WARNINGS

When controllers detects the warning signals, alarm only and not stop the genset, besides, the LCD displays the warning information.

Table 7 - Warning Alarms Types

No.	Type	Description
1	Low Oil Pressure Warn	When the controller detects that the oil pressure has fallen below the pre-set value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
2	Failed to Stop Warn	After "Wait for Stop" delay/ ETS delay has expired, if gen-set does not stop completely, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
3	Low Fuel Level Warn	When the controller detects that the fuel level has fallen below the pre-set value, or detects that the low fuel level warning input is active, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
4	Failed to Charge Warn	When the controller detects that charger voltage has fallen below the battery voltage and the difference value exceed pre-set charging voltage difference value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
5	Battery Under Volt Warn	When the controller detects that battery voltage has fallen below the pre-set value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
6	Battery Over Volt Warn	When the controller detects that battery voltage has exceeded the pre-set value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
7	Input Warn	When the controller detects that the auxiliary input warning signals, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
8	Loss Of Speed Signal Warn	When the controller detects that the engine speed is 0 and the delay is 0, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
9	Room Temp. High Warn	When the controller detects that the temperature of machine room has exceeded pre-set temp. value (including sensor open circuit), it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
10	Oil Pressure Sensor Open Warn	When the controller detects that the oil pressure sensor is open circuit and the action select "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
11	Fuel Level Sensor Open Warn	When the controller detects that the fuel level sensor is open circuit and the action select "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
12	Gen Over Voltage Warn	When controller detects the genset voltage is higher than the set value, it will send warning signals and the corresponding alarm information will be displayed on LCD.



No.	Type	Description
13	Gen Under Voltage Warn	When controller detects the voltage is lower than the set value, it will send warning signals and the corresponding alarm information will be displayed on LCD.
14	Gen Over Frequency Warn	When controller detects the frequency is higher than the set value, it will send warning signals and the corresponding alarm information will be displayed on LCD.
15	Gen Under Frequency Warn	When controller detects the frequency is lower than the set value, it will send warning signals and the corresponding alarm information will be displayed on LCD.
16	Gen Over Current Warn	When controller detects the genset current is higher than the set value, it will send warning signals and the corresponding alarm information will be displayed on LCD.
17	Over Power Warn	When controller detects the genset power (positive) is higher than the set value, and action select "Warn", it will send warning signals and the corresponding alarm information will be displayed on LCD.
18	Maintenance Time Warn	When genset running time has exceeded the user setting maintenance time and the action select "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD. The maintenance alarm will reset if the action select "Inactive".
19	Failed to Charge IN	When the controller detects that external battery failed to charge input is active, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
20	Pile Under Voltage Warn	When the controller detects that battery pack voltage has fallen below the pre-set lower limit value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
21	Door Inhibit Warn	When the controller detects that door inhibit input is active, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
22	1#ATS Fail Warn	When the controller detects that 1#ATS failed to close and ATS transfer fail warning is enabled, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
23	2#ATS Fail Warn	When the controller detects that 2#ATS failed to close and ATS transfer fail warning is enabled, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
24	Temp. Sensor 1 Open Warn	If the config. sensor 1 set as temperature sensor, when the controller detects that the temperature sensor 1 is open circuit and the action select "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
25	Oil Pressure Sensor 2 Open Warn	If the config. Sensor 1 set as oil pressure sensor, when the controller detects that the oil pressure sensor is open circuit and the action select "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.



No.	Type	Description
26	Fuel Level Sensor 2 Open Warn	If the config. sensor 1 set as level sensor, when the controller detects that the level sensor is open circuit and the action select "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
27	Temp. Sensor 2 Open Warn	If the config. sensor 2 set as temperature sensor, when the controller detects that the temperature sensor is open circuit and the action select "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
28	Oil Pressure Sensor 3 Open Warn	If the config. Sensor 2 set as oil pressure sensor, when the controller detects that the oil pressure sensor is open circuit and the action select "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
29	Fuel Level Sensor 3 Open Warn	If the config. sensor 2 set as level sensor, when the controller detects that the level sensor is open circuit and the action select "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
30	High Temp.1 Warn	When the controller detects that config. Sensor 1 temperature (sensor type: temperature sensor) has exceeded the pre-set value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
31	Low Oil Pressure 2 Warn	When the controller detects that config. sensor 1 oil pressure (sensor type: oil pressure sensor) has fallen below the pre-set value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
32	Low Fuel Level 2 Warn	When the controller detects that config. Sensor 1 fuel level (sensor type: level sensor) has fallen below the pre-set value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
33	High Temp.2 Warn	When the controller detects that config. Sensor 2 temperature (sensor type: temperature sensor) has exceeded the pre-set value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
34	Low Oil Pressure 3 Warn	When the controller detects that config. sensor 2 oil pressure (sensor type: oil pressure sensor) has fallen below the pre-set value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
35	Low Fuel Level 3 Warn	When the controller detects that config. Sensor 2 fuel level (sensor type: level sensor) has fallen below the pre-set value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
36	Low Oil Level Warn	When any one input configured as "Low Oil Level Warn", and input port is active, controller will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.

5.2 SHUTDOWN ALARMS

When controller detects shutdown alarm, it will send signals to stop the generator and the corresponding alarm information will be displayed on LCD.

Table 8 – Shutdown Alarms

No.	Type	Description
1	Emergency Stop Shutdown	When controller detects emergency stop input is active, it will send stop signals and the corresponding alarm information will be displayed on LCD.
2	Over Speed Shutdown	When controller detects the engine speed value is higher than the set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
3	Under Speed Shutdown	When controller detects the speed value is lower than the set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
4	Loss Of Speed Signal Shutdown	When controller detects speed value equals to 0, and delay value isn't 0, it will send stop signals and the corresponding alarm information will be displayed on LCD.
5	Gen Over Frequency Shutdown	When controller detects the generator frequency value is higher than the set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
6	Gen Under Frequency Shutdown	When controller detects the generator frequency value is lower than the set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
7	Gen Over Voltage Shutdown	When controller detects the generator voltage value is higher than the set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
8	Gen Under Voltage Shutdown	When controller detects the voltage value is lower than the set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
9	Gen Over Current Shutdown	When controller detects the current value is higher than the set value and duration time is over than over current delay, it will send stop signals and the corresponding alarm information will be displayed on LCD.
10	Failed To Start	If genset started failure within setting of start times, controller will send stop signals and the corresponding alarm information will be displayed on LCD.
11	High Temp. Shutdown	When controller detects temperature of water/cylinder is higher than the set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
12	Low Oil Pressure Shutdown	When controller detects oil pressure is lower than the set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
13	No Gen Frequency Shutdown	When controller detects frequency of genset is 0, it will send stop signals and the corresponding alarm information will be displayed on LCD.
14	Input Shutdown	When controller detects external active shutdown alarm signals, it will send stop signals and the corresponding alarm information will be



No.	Type	Description
		displayed on LCD.
15	Low Fuel Level Shutdown	When controller detects the sample value, which adopted by the programmable fuel level sensor, is lower than the pre-set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
16	Oil Pressure Sensor Open Shutdown	When controller detects sensor, which connected to oil pressure sensor, is open circuit, and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
17	Fuel Level Sensor Open Shutdown	When controller detects sensor, which connected to fuel level sensor, is open circuit, and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
18	Over Power Shutdown	When controller detects the power value (power is positive) is higher than the max. set value and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
19	Maintenance Time Shutdown	When genset operation time exceeds maintenance time that user pre-set and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
20	Temp. Sensor 1 Open Shutdown	When controller detects temp. sensor, which connected to programmable sensor 1, is open circuit, and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
21	Pressure Sensor 2 Open Shutdown	When controller detects pressure sensor, which connected to programmable sensor 1, is open circuit, and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
22	Fuel Level Sensor 2 Open Shutdown	When controller detects fuel level sensor, which connected to programmable sensor 1, is open circuit, and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
23	Temp. Sensor 2 Open Shutdown	When controller detects temp. sensor, which connected to programmable sensor 2, is open circuit, and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
24	Pressure Sensor 3 Open Shutdown	When controller detects pressure sensor, which connected to programmable sensor 2, is open circuit, and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
25	Fuel Level Sensor 3 Open Shutdown	When controller detects fuel level sensor, which connected to programmable sensor 2, is open circuit, and the action select "shutdown", it will send stop signals and the corresponding alarm information will be displayed on LCD.
26	High Temp. 1 Shutdown	When controller detects the sample value, which adopted by the programmable sensor 1(sensor type is temp. sensor), is higher than the pre-set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.



No.	Type	Description
27	Low Pressure 2 Shutdown	When controller detects the sample value, which adopted by the programmable sensor1(sensor type is pressure sensor), is lower than the pre-set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
28	Low Fuel Level 2 Shutdown	When controller detects the sample value, which adopted by the programmable sensor 1 (sensor type is level sensor), is lower than the pre-set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
29	High Temp. 2 Shutdown	When controller detects the sample value, which adopted by the programmable sensor 2(sensor type is temp. sensor), is higher than the pre-set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
30	Low Pressure 3 Shutdown	When controller detects the sample value, which adopted by the programmable sensor2(sensor type is pressure sensor), is lower than the pre-set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.
31	Low Fuel Level 3 Shutdown	When controller detects the sample value, which adopted by the programmable sensor 2 (sensor type is level sensor), is lower than the pre-set value, it will send stop signals and the corresponding alarm information will be displayed on LCD.

5.3 TRIP AND STOP ALARMS

When controller detects trip and stop alarms, it will send signals to stop the generator after hi-speed cooling, and then the corresponding alarm information will be displayed on LCD.

Table 9 – Trip and Stop Alarms

No.	Type	Description
1	Over Power	When controller detects the power value (power is positive) is higher than the set value and the action select “trip and stop”, it will send alarm signals and the corresponding alarm information will be displayed on LCD.
2	Gen Over Current	When controller detects the genset current is over than the pre-set value (delay time is expired) and the action select “trip and stop”, it will send alarm signals and the corresponding alarm information will be displayed on LCD.

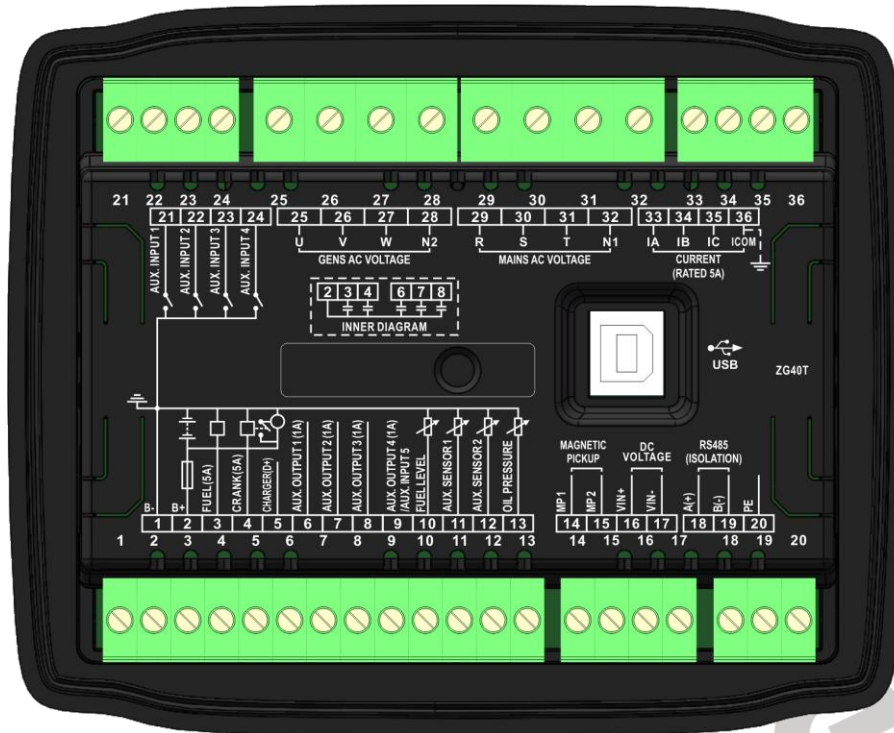
6 WIRING CONNECTION


Fig.2 – Rare Panel Drawing

Table 10 –Terminal Wire Connection

No.	Function	Cable Size	Remark
1	B-	2.5mm ²	Connected with negative of starter battery
2	B+	2.5mm ²	Connected with positive of starter battery. If wire length is over 30m, better to double wires in parallel. Max. 20A fuse is recommended.
3	Fuel relay output	1.5mm ²	B+ is supplied by 2 terminal, rated 5A Parameter set as “programmable relay output 5”.
4	Start relay output	1.5mm ²	B+ is supplied by No.2 terminal, rated 5A.
5	Charger(D+) input	1.0mm ²	Connected with charger starter’s D+ (WL) terminals. Being hang up If there is no this terminal.
6	Aux. output 1	1.0mm ²	B+ is supplied by No.2 terminal, rated 1A
7	Aux. output 2	1.0mm ²	B+ is supplied by No.2 terminal, rated 1A
8	Aux. output 3	1.0mm ²	B+ is supplied by No.2 terminal, rated 1A
9	Aux. output 4/Aux. input 5	1.0mm ²	Output: B+ is supplied by No.2 terminal, rated 1A Input: active when grounded(B-). According to “T9 Output/Input Select”, users can defined this port as input port or output port (default as Aux. output 4)
10	Fuel level sensor input	1.0mm ²	Connected with fuel level resistor

 Setting items
 please to see
 Table 12

Setting items



No.	Function	Cable Size	Remark	
			type sensor.	please to see Table 14
11	Aux. sensor 1 input	1.0mm ²	It is can be configured as configurable sensor 1 or Aux. input 6.	
12	Aux. sensor 2 input	1.0mm ²	It is can be configured as configurable sensor 2 or Aux. input 7.	
13	Oil pressure sensor input	1.0mm ²	Connected with oil pressure resistor type sensor.	
14	MP1	0.5mm ²	Connected with speed sensor; shielding wire is recommended. MP2 internal has connected with B-.	
15	MP2	0.5mm ²		
16	Battery voltage input (VIN+)	1.0mm ²	Connected with positive of 48V battery pack.	
17	Battery voltage input (VIN-)	1.0mm ²	Connected with negative of 48V battery pack.	
18	RS485+	0.5mm ²	120Ω shielding wire is recommended with single end earthed.	
19	RS485-	0.5mm ²		
20	PE	1.0mm ²	Lightning ground terminal	
21	Aux. input 1	1.0mm ²	Ground connected is active (B-)	Setting items please to see Table 13
22	Aux. input 2	1.0mm ²	Ground connected is active (B-)	
23	Aux. input 3	1.0mm ²	Ground connected is active (B-)	
24	Aux. input 4	1.0mm ²	Ground connected is active (B-)	
25	Genset U-phase voltage monitoring input	1.0mm ²	Connected to U-phase output of genset (2A fuse recommended).	
26	Genset V-phase voltage monitoring input	1.0mm ²	Connected to V-phase output of genset (2A fuse recommended).	
27	Genset W-phase voltage monitoring input	1.0mm ²	Connected to W-phase output of genset (2A fuse recommended).	
28	Genset line N2 input	1.0mm ²	Connected to N-line output of genset.	
29	Mains R-phase voltage monitoring input	1.0mm ²	Connected to R-phase of mains (2A fuse recommended).	
30	Mains S-phase voltage monitoring input	1.0mm ²	Connected to S-phase of mains (2A fuse recommended).	
31	Mains T-phase voltage monitoring input	1.0mm ²	Connected to T-phase of mains (2A fuse recommended).	
32	Mains line N1 Input	1.0mm ²	Connected to line N of mains	
33	CT A-phase monitoring input	1.5mm ²	Outside connected to secondary coil of CT (5A rated).	
34	CT B-phase monitoring input	1.5mm ²	Outside connected to secondary coil of CT (5A rated).	
35	CT C-phase monitoring input	1.5mm ²	Outside connected to secondary coil of CT (5A rated).	
36	CT COM	1.5mm ²		

7 SCOPES AND DEFINITIONS OF PROGRAMMABLE PARAMETERS

7.1 CONTENTS AND SCOPES OF PARAMETERS

Table 11 - Parameters Settings and Scope

No.	Items	Range	Default	Description
Mains				
1	Mains AC System	(0-3)	0	0: 3 Phase, 4 Wire(3P4W); 1: 2 Phase, 3 Wire (2P3W); 2: 1 Phase, 2 Wire (1P2W); 3: 3 Phase, 3 Wire (3P3W).
2	Mains Normal Delay	(0-3600)s	10	The time from mains abnormal to normal or from normal to abnormal; suitable for ATS (automatic transfer switch).
3	Mains Abnormal Delay	(0-3600)s	5	
4	Mains Over Voltage	(30-620)V	276	When mains voltage has exceeded the set value, Mains Over Voltage is active. When set the value as 620V, the controller does not detect over voltage signal. Back lash: 10V.
5	Mains Under Voltage	(30-620)V	184	When mains voltage has fallen below the set value, Mains Under Voltage is active. When set the value as 30V, the controller does not detect under voltage signal. Back lash: 10V.
6	Mains Have Rules	(0-4)	0	0: phase A must be electrified, phase B/C cannot be missing; 1: phase A must be electrified, phase B/C can be missing one phase; 2: phase A must be electrified, phase B/C can be missing two phases; 3: phase A cannot be electrified, phase A/B/C can be missing one phase; 4: phase A cannot be electrified, phase A/B/C can be missing two phases;
Timers				
1	Start Delay	(0-3600)s	1	Time from auto start signal active to genset started.
2	Stop Delay	(0-3600)s	1	Time from auto start signal deactivated to genset stopped.
3	Pre-heat Delay	(0-300)s	0	Power-on time of heater plug before starter is powered up.
4	Cranking Time	(3-60)s	8	Power-on time of starter for each time.
5	Crank Rest Time	(3-60)s	10	The waiting time before second power up when engine starts fail.
6	Safety On Time	(1-60)s	10	Alarms for low oil pressure, under speed, under frequency/voltage, charge alt failure are inactive.
7	Start Idle Time	(0-3600)s	0	Idle running time of genset when starting.
8	Warming Up Time	(0-3600)s	10	Warming time before genset switch on, after



No.	Items	Range	Default	Description
				high speed running.
9	Cooling Time	(3-3600)s	10	Radiating time before genset stop, after it unloads.
10	Stop Idle Time	(0-3600)s	0	Idle running time while genset stopping.
11	ETS Solenoid Hold	(0-120)s	20	Stop electromagnet's power on time while genset stopping.
12	Stop Duration	(0-120)s	0	When "ETS time" is set as 0, it is time needed between ending of genset idle delay and genset stopped completely; When "ETS time" is not 0, it is time between ending of ETS hold delay and genset stopped completely.
13	Louver Hold Open	(0-3600)s	30	After genset stopped completely, it is louver keeps opening time.
Engine				
1	Flywheel Teeth	(10.0-300.0)	118.0	Tooth number of the engine, it is for judging of starter crank disconnect conditions and inspecting of engine speed.
2	Under Speed Shutdown	(0-6000)r/min	1200	When engine speed has fallen below the set value and delay time expired, "Under Speed Shutdown" is active. It will initiate a shutdown alarm signal.
3	Over Speed Shutdown	(0-6000) r/min	1710	When engine speed has exceeded the set value and delay time expired, "Over Speed Shutdown" is active. It will initiate a shutdown alarm signal.
4	Loss of Speed Signal Delay	(0-20.0)s	5.0	It is delay time after speed signal lost, if the delay time set as 0s, only warning without shutdown.
5	Battery Over Voltage	(12.0-40.0)V	33.0	When battery voltage has exceeded the set value and remains for 20s, It will initiate a warning alarm signal. Only warning and not to shutdown the generator.
6	Battery Under Voltage	(4.0-30.0)V	8.0	When battery voltage has fallen below the set value and remains for 20s, It will initiate a warning alarm signal. Only warning and not to shutdown the generator.
7	Charge Alternator Fail	(0.0-30.0)V	6.0	During generator is normal running, when voltage difference between alternator D+(WL) and B+ exceeds the set value and remains for 5s, It will initiate a charge alt failure warning alarm signal.
8	Start Attempts	(1-10) times	3	Maximum times of crank attempts. When reach this number, controller will send start failure signal.
9	Crank Disconnect	(0-6)	2	There are 3 conditions of disconnecting



No.	Items	Range	Default	Description
	Conditions			starter with engine: Generate frequency, engine speed and oil Pressure. Aiming at to separating the start motor and genset as soon as possible.
10	Disconnected Engine Speed	(0-3000)r/min	360	During starting process, when engine speed is higher than the set value, starter will be disconnected.
11	Disconnected Gen Frequency	(0-600.0)Hz	14.0	During starting process, when generator frequency is higher than the set value, starter will be disconnected.
12	Disconnected Oil Pressure	(0-400)kPa	200	During starting process, when generator oil pressure is higher than the set value, starter will be disconnected.
13	Disconnected Oil Pressure Time	(0.0-20.0)s	0.0	When crank disconnect condition contains oil pressure, if engine oil pressure is higher than pre-set value and delay time is expired, starter will be disconnected.
Generator				
1	Gen AC System	(0-3)	0	0: 3 Phase, 4 Wire(3P4W); 1: 2 Phase, 3 Wire (2P3W); 2: 1 Phase, 2 Wire (1P2W); 3: 3 Phase, 3 Wire (3P3W).
2	Gen Rated Frequency	(10.0-600.0)Hz	50.0	Rated frequency of generator
3	Gen Poles	(2-64)	4	Numbers of generator poles, which can be used to calculate generator speed (generator with no speed sensor).
4	Gen Over Volt Shutdown	(30-620)V	276	They are generator over voltage shutdown setting value and delay value(No detection for over volt shutdown signals if the value set as 620V).
5		(0-60.0)s	10.0	
6	Gen Under Volt Shutdown	(30-620)V	184	They are generator under voltage shutdown setting value and delay value(No detection for under volt shutdown signals if the value set as 30V).
7		(0-60.0)s	10.0	
8	Gen Over Freq Shutdown	(0-75.0)Hz	57.0	They are generator over frequency shutdown setting value and delay value(No detection for over frequency shutdown signals if the value set as 0).
9		(0-60.0)s	2.0	
10	Gen Under Freq Shutdown	(0-75.0)Hz	40.0	They are generator under frequency shutdown setting value and delay value(No detection for under frequency shutdown signals if the value set as 0).
11		(0-60.0)s	10.0	
12	Gen Over Volt Warn	(30-620)V	253	When generator voltage exceeds pre-set value, gen over voltage warning alarm will be sent. (No detection for over volt signals if the value set as 620V)



No.	Items	Range	Default	Description
13	Gen Under Volt Warn	(30-620)V	193	When generator voltage below pre-set value, gen under voltage warning alarm will be sent. (No detection for under volt signals if the value set as 30V)
14	Gen Over Freq Warn	(0-75.0)Hz	55.0	When generator frequency exceeds the pre-set value, gen over frequency warning signals will be sent. (No detection for over frequency warning signals if the value set as 0).
15	Gen Under Freq Warn	(0-75.0)Hz	42.0	When generator frequency falls below the pre-set value, gen under frequency warning signals will be sent. (No detection for under frequency warning signals if the value set as 0).
Load				
1	Current Transform	(5-6000)/5	500	The ratio of external current transformer.
2	Full Load Current	(5-6000)A	500	It used for load over current calculating.
3	Over Current Protection	(0-3)	2	0: Not used; 1: Warn; 2: Shutdown; 3: ELE Trip.
		(50-130)%	120	Over current delay starts when load current exceeded the setting percentage value.
4	Over Current Delay	(0-1)	0	0: Definite Time; 1: IDMT(Inverse Definite Minimum Time).
		(0-3600)s	30	Definite Time: over current delay value
		(1-36)	36	IDMT: delay multiply value.
5	Over Power Protection	0-3	0	0: Not used; 1: Warn; 2: Shutdown; 3: ELE Trip.
6		(0-6000.0)kW	304.0	Over power setting.
7		(0-6000.0)kW	290.0	Over power warning return value.
8		(0-3600)s	5	Over power delay value.
Switch				
1	Transfer Time	(0-99.9)s	1.0	Time interval from open MCB to close GCB or from open GCB to close MCB.
2	Close Time	(0-10.0)s	5.0	Pulse width of mains/generator switch on. When it is 0, means output constantly.
3	Open Time	(0-10.0)s	5.0	Pulse width of mains/generator switch off, which can be used as breaker open check time at the same time.
4	Close Check Time	(0-20.0)s	5.0	While outputting consistently, it is time used for checking switch auxiliary contacts.
5	Transfer Fail Warn	(0-1)	0	0 : Disable; 1: Enable
6	Open Check Enable	(0-1)	0	0 : Disable; 1: Enable
7	Mains Abnormal Trip	(0-1)	0	0 : Disable; 1: Enable
Analog Sensors				
Oil Pressure Sensor				



No.	Items	Range	Default	Description
1	Curve Type	(0-12)	8	Default as SGX. Details please to see Table 14
2	Open Circuit Action	(0-2)	1	0 : Indication (oil pressure sensor will show “+++”); 1: Warn; 2: Shutdown
3	Low Oil Pressure Shutdown	(0-400)kPa	103	When the oil pressure of the external sensor falls below the set value(only detect after “Safety On delay”), “Low Oil Pressure” shutdown alarm is initiated. If setting configured as 0, “Low Oil Pressure” alarm signal will not be initiated (only suit for oil pressure sensor).
4	Low Oil Pressure Warn	(0-400)kPa	124	When the oil pressure of the external sensor falls below the set value (only detect after “Safety On delay”), “Low Oil Pressure” warning alarm is initiated. If setting configured as 0, “Low Oil Pressure” alarm signal will not be initiated (only suit for oil pressure sensor).
Fuel level Sensor				
1	Curve Type	(0-7)	3	Default as SGD. Details please to see Table 14
2	Open Circuit Action	(0-2)	1	0: Indication (fuel level sensor will show “+++”); 1: Warn; 2: Shutdown
3	Low Level Shutdown	(0-100)%	0	When the fuel level of the external sensor falls below the set value (always detect), “Low Fuel Level” shutdown alarm is initiated. If setting configured as 0, “Low Fuel Level” alarm signal will not be initiated.
4	Low Level Warning	(0-100)%	20	When the fuel level of the external sensor falls below the set value (always detect), “Low Fuel Level” warning alarm is initiated. If setting configured as 0, “Low Fuel Level” alarm signal will not be initiated.
5	Fuel Pump On	(0-100)%	25	If fuel level falls below the pre-set value and lasts for over 10s, “Fuel Pump On” signal will be initiated.
6	Fuel Pump Off	(0-100)%	80	If fuel level exceeds the pre-set value and lasts for over 10s, “Fuel Pump Off” signal will be initiated.
7	Fuel Tank Capacity Enable	(0-1)	0	0: Disable; 1: Enable
8	Fuel Tank Capacity	(0-10000)L	1000	Convert the fuel level percentage display to volume display.
Auxiliary Sensor 1				
1	Sensor Type	(0-4)	4	0: Digital input 6; 1: Temperature sensor;



No.	Items	Range	Default	Description
				2: Pressure sensor; 3: Level sensor; 4: Room temperature sensor.
2	Curve Type	(0-10) (0-10) (0-5) (0-10)	9	Select according to the sensor types, details please to see Table 14.
3	Open Circuit Action	(0-2)	1	0: Indication (related sensor will show “+++”); 1: Warn; 2: Shutdown.
4	Shutdown Value	(0-400)	98	Setting this value need to according the sensor types. For temp. sensor, if sampling value exceeds the pre-set value, controller will initiate shutdown alarms. If set as 140, shutdown alarms will not be sent. For oil pressure sensor and fuel level sensor, if sampling value falls below the pre-set value, controller will initiate shutdown alarms. If set as 0, shutdown alarms will not be sent.
5	Warn Value	(0-400)	95	Setting this value need to according the sensor types. For temp. sensor, if sampling value exceeds the pre-set value, controller will initiate warning alarms. If set as 140, warning alarms will not be sent. For oil pressure sensor and fuel level sensor, if sampling value falls below the pre-set value, controller will initiate warning alarms. If set as 0, warning alarms will not be sent.
6	Room Temp. High Warning	(0-60)°C	40	If temperature of machine room exceeds the pre-set value, controller will initiate warning alarms.
Aux. Sensor 2				
1	Sensor Type	(0-3)	0	0: Digital input 7; 1: Temperature sensor; 2: Oil pressure sensor; 3: Fuel level sensor;
2	Curve Type	(0-10) (0-10) (0-5)	3	Select according to the sensor types, details please to see Table 14.
3	Open Circuit Action	(0-2)	1	0: Indication (related sensor will show “+++”); 1: Warn; 2: Shutdown.
4	Shutdown Value	(0-400)	98	Setting this value need to according the sensor types.



No.	Items	Range	Default	Description
				For temp. sensor, if sampling value exceeds the pre-set value, controller will initiate shutdown alarms. If set as 140, shutdown alarms will not be sent. For oil pressure sensor and fuel level sensor, if sampling value falls below the pre-set value, controller will initiate shutdown alarms. If set as 0, shutdown alarms will not be sent.
5	Warn Value	(0-400)	95	Setting this value need to according the sensor types. For temp. sensor, if sampling value exceeds the pre-set value, controller will initiate warning alarms. If set as 140, warning alarms will not be sent. For oil pressure sensor and fuel level sensor, if sampling value falls below the pre-set value, controller will initiate warning alarms. If set as 0, warning alarms will not be sent.
Digital Input Ports				
1	Input 1 Setting	(0-31)	9	Factory default: Remote Start (on-load), details please to see Table 13
		(0-1)	0	0: close to activate; 1: open to activate.
		(0-20.0)s	2.0	It is time from detection of the input port is active to action confirm.
2	Input 2 Setting	(0-31)	22	Factory default: Control At Gate, details please to see Table 13
		(0-1)	0	0: close to activate; 1: open to activate.
		(0-20.0)s	2.0	It is time from detection of the input port is active to action confirm.
3	Input 3 Setting	(0-31)	0	Factory default: Not Used, details please to see Table 13
		(0-1)	0	0: close to activate; 1: open to activate.
		(0-20.0)s	2.0	It is time from detection of the input port is active to action confirm.
4	Input 4 Setting	(0-31)	0	Factory default: Not Used, details please to see Table 13
		(0-1)	0	0: close to activate; 1: open to activate.
		(0-20.0)s	2.0	It is time from detection of the input port is active to action confirm.
5	Input 5 Setting	(0-31)	0	Factory default: Not Used, details please to see Table 13
		(0-1)	0	0: close to activate; 1: open to activate.
		(0-20.0)s	2.0	It is time from detection of the input port is active to action confirm.



No.	Items	Range	Default	Description
6	Input 6 Setting	(0-31)	0	Factory default: Not Used, details please to see Table 13
		(0-1)	0	0: close to activate; 1: open to activate.
		(0-20.0)s	2.0	It is time from detection of the input port is active to action confirm.
7	Input 7 Setting	(0-31)	0	Factory default: Not Used, details please to see Table 13
		(0-1)	0	0: close to activate; 1: open to activate.
		(0-20.0)s	2.0	It is time from detection of the input port is active to action confirm.
Relay Output Ports				
1	Output 1	(0-36)	12	Factory default: 1#ATS Close Mains. Details please to see Table 12.
2	Output 2	(0-36)	13	Factory default: 1#ATS Close Gen. Details please to see Table 12.
3	Output 3	(0-36)	14	Factory default: 2#ATS Close Mains. Details please to see Table 12.
4	Output 4	(0-36)	15	Factory default: 2#ATS Close Gen. Details please to see Table 12.
5	Output 5	(0-36)	20	Factory default: Fuel Relay Output. Details please to see Table 12.
Module Settings				
1	Power On Mode	(0-2)	0	0: Stop Mode; 1: Manual Mode; 2: Auto Mode.
2	Module Address	(1-254)	1	It is communication address of the controller.
3	Password	(0-9999)	0318	Details please to see Note 2.
4	Date and Time			It is used to set date of controller.
5	T9 Function Set	(0-1)	0	0: Relay output 4 1: Digital Input 5 Select the hardware function of No.9 terminal of the controller.
6	Door Opening Time	(1-20)s	3	Pulse output time of opening door remotely
Inhibit Auto Start				
1	Inhibit Auto Start Set	(0-1)	0	0: Disable; 1: Enable
2	Schedule Period	(0-2)	0	Cycle selection: 0: Monthly; 1: Weekly; 2: Daily.
		(1-31)	1	Day(cycle selection: 0: monthly)
		(0-6)	0	Week(cycle selection: 1: weekly)
		(0-23)h	0	Time(Hour)
		(0-59)min	0	Time(Minute)
		(0-30000)min	30	Duration time
Auto Start				
Mains Abnormal Start				
1	Start Selection	(0-1)	0	0: Not Start; 1: Start



No.	Items	Range	Default	Description
2	1#ATS to Gen Set	(0-1)	1	0: Disable; 1: Enable.
3	2#ATS to Gen Set	(0-1)	0	0: Disable; 1: Enable
Remote Start				
1	Start Selection	(0-1)	1	0: Not Start; 1: Start
2	1#ATS to Gen Set	(0-1)	1	0: Disable; 1: Enable
3	2#ATS to Gen Set	(0-1)	0	0: Disable; 1: Enable
Cycle Run Start				
1	Start Selection	(0-1)	0	0: Not Start; 1: Start
2	1#ATS to Gen Set	(0-1)	1	0: Disable; 1: Enable
3	2#ATS to Gen Set	(0-1)	0	0: Disable; 1: Enable
4	Cycle Run Time	(0-6000)min	0	It is genset running time, if the setting time is arrived, genset will stop.
5	Cycle Stop Time	(0-6000)min	0	It is genset standby time, if the setting time is arrived, genset will start.
Scheduled Run				
1	Start Selection	(0-1)	1	0: Not Start; 1: Start
2	1#ATS to Gen Set	(0-1)	1	0: Disable; 1: Enable
3	2#ATS to Gen Set	(0-1)	0	0: Disable; 1: Enable
4	Scheduled Run	(0-1) (0-1)	0 0	0: Disable; 1: Enable 0: Off-load; 1: On-load
5	Scheduled Period	(0-2) (1-31) (0-6) (0-23)h (0-59)min (0-30000)min	0 1 0 0 0 30	Cycle selection: 0: Monthly; 1: Weekly; 2: Daily. Day(cycle selection: 0: monthly) Week(cycle selection: 1: weekly) Time(Hour) Time(Minute) Duration time
Mains Abnormal And Pile Low Volt Start				
1	Start Selection	(0-1)	1	0: Not Start; 1: Start
2	Stop Condition	(0-3)	0	0: Pile Volt Normal and Current Low 1: Pile volt Normal 2: Current Low 3: Pile Volt Normal or Current Low
3	1#ATS to Gen Set	(0-1)	1	0: Disable; 1: Enable
4	Pile Volt Upper Limit	(0-100.0)V	58.0	It is battery voltage when battery completely charged.
5	Pile Volt Lower Limit	(0-100.0)V	45.0	It is battery pack under voltage limit. If voltage of battery falls below the setting value, genset will be started.
6	Charge Finish Time	(1-6000)min	720	It is the maximum time that battery allowed to charge.
7	Under Current	(1-100)%	15	When load current of switch power is lower than the setting value, and battery voltage is higher than the upper limit value as well, genset will be allowed to stop.
8	Under Current Delay	(10-3600)s	30	When genset is normal running, ATS1 gen



No.	Items	Range	Default	Description
				closed and ATS2 gen opened, if load current is below pre-set lower limit value, this delay will be started.
9	Minimum Charge Time	(0-360)min	30	When battery charging time exceeds the setting value, and if temperature of machine room is high, air conditioner will be started.
Mains Abnormal And Room Temp. High Start				
1	Start Selection	(0-1)	1	0: Not Start; 1: Start.
2	2#ATS to Gen Set	(0-1)	1	0: Disable; 1: Enable
3	Room Temp. Upper Limit	(15-55)°C	28	Genset will start up if machine room is higher than this value.
4	Room Temp. Lower Limit	(15-55)°C	22	After genset started up because of the high temp. of the machine room, if room temp. falls below the setting value, genset will stop.
ATSs Both to Gen				
1	ATSs Both to Gen	(0-1)	0	0: Not Allowed; 1: Allowed;

▲NOTES:

- 1) Both 1#ATS and 2#ATS have the same configuration;
- 2) When doing parameter configuration via PC software, there is no need to input password if default password (0318) isn't change; otherwise, if default password been changed or first time to set parameters via PC, password need to be wrote into the password interface.
- 3) After the correct password is entered, Parameter setting interface can be entered directly by inputting parameter serial when secondary entering the password interface before LCD backlight darken.
- 4) Engine teeth configuration: press start button when generator frequency exceeds 20Hz. Engine teeth number will be calculated automatically and press conform button can change the number of engine teeth.

7.2 ENABLE DEFINITION OF PROGRAMMABLE OUTPUT PORTS

Table 12 – Definition Content of Programmable Outputs 1~5

No.	Items	Function Description
0	Not Used	Output port is deactivated when “Not Used” is selected.
1	Common Alarm	Include all shutdown alarms, trip and stop alarms and warning alarms. When there is warning alarm only, it is not self-lock; when a shutdown alarm occurs, it is self-lock until the alarm is reset.
2	Common ELE Trip	Action when there is a common trip shutdown alarm occurs.
3	Common Shutdown	Output when there is a shutdown alarm occurs.
4	Common Warn Alarm	Action when there is a common warning alarm occurs.
5	Audible Alarm	When warning, trip shutdown and shutdown alarms appear, audible alarm output is fixed as 300s. When “alarm mute” or any keys on the panel is active, it can remove the alarms.
6	Energized to Stop	Suitable for genset with electromagnet and will active after “stop idle delay”. It is deactivated when the “ETS Solenoid delay” expires.
7	Idle Control	Used for engine which has idles. Close before starting and open in warming up delay; Close during stop idle delay and open when genset stopped completely.
8	Preheat Control	Close before starting and open before power up;
9	Raise Speed	Action while in hi-speed warming up.
10	Drop Speed	Action while in the period time from stop idling to wait for stop.



No.	Items	Function Description
11	1#ATS Open	Controlling switch to take off load.
12	1#ATS Close Mains	Controlling mains switch to take on load. When close time set as 0, it is continuously close.
13	1#ATS Close Gen	Controlling generator switch to take on load. When close time set as 0, it is continuously close.
14	2#ATS Close Mains	Controlling mains switch to take on load. When close time set as 0, it is continuously close.
15	2#ATS Close Gen	Controlling generator switch to take on load. When close time set as 0, it is continuously close.
16	2#ATS Open	Controlling switch to take off load.
17	Fuel Pump Control	Close when fuel level is lower than the "Fuel Pump On" value or when low fuel level warning input is active; Open when fuel level is higher than the "Fuel Pump Off" and low fuel level warning input is deactivated;
18	High Speed Control	Close when the generator enters into Warming Up delay while open after cooling delay.
19	Crank Output	Output while engine in cranking period.
20	Fuel Output	Action when generator start; disconnect when wait for stop.
21	Generator Excite	Output in start period. If there is no generator frequency during safety running, output for 2 seconds again.
22	Advance Oil Output	Output while genset is in periods from pre-heat to stop idling.
23	Fan Control	Output according to the upper/lower limit of the engine room temperature.
24	Gen Running Output	Output while genset is in periods from normal running to hi-speed cooling.
25	Timing Start	Output while genset is in timing start period.
26	Charge Alt Fail	Output when charger failed to charge the batteries.
27	In Auto Mode	Action while system is in auto mode.
28	In Manual Mode	Action while system is in manual mode.
29	In Stop Mode	Action while system is in stop mode.
30	High Room Temp Warn	When temperature of machine room reaches the "Room High Temp Warn" limit, alarms will be initiated.
31	Mains Abnormal	Action when mains over/under frequency, over/under voltage or aux. mains abnormal input is active.
32	Louvre Control	Action when genset starts up and disconnect after genset stopped and "Louver Hold Open" time expired.
33	Battery Over Voltage	Output when battery voltage is high warning.
34	Battery Under Voltage	Output when battery voltage is low warning.
35	Tele. Open Door	This output is remote controlled by Modbus-RTU protocol, output time is "Telecontrol Open Door Output Time".
36	Failed to Start	Output when engine failed to start.
37	Pre-Oil	Output while genset is in periods from pre-heat to safety running.
38	Reserved	
39	Reserved	
40	Reserved	
41	Reserved	



No.	Items	Function Description
42	Reserved	
43	Reserved	
44	Reserved	
45	Reserved	
46	Reserved	
47	Reserved	
48	Reserved	
49	Reserved	
50	Reserved	

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7.3 ENABLE DEFINITION OF PROGRAMMABLE INPUT PORTS

Table 13 - Definition Content of Programmable Inputs 1~5

No.	Items	Function Description
0	Not Used	Input port is inactive.
1	Alarm Mute	If input port is active, "Audible Alarm" output will be inhibited.
2	Reset Alarm	If input port is active, shutdown alarms and ELE trip alarms can be reset.
3	Emergency Stop	If input port is active, genset will alarm shutdown immediately.
4	High Temp Shutdown	After safety on delay is expired, if this input is active, genset will alarm shutdown immediately.
5	Low Oil Pressure Shutdown	After safety on delay is expired, if this input is active, genset will alarm shutdown immediately.
6	Fuel Level Warn	If this input is active, controller will send low fuel level warn alarm signal.
7	Warn Input	If this input is active, controller will send external warn alarm signal.
8	Shutdown Input	If this input is active, genset will alarm shutdown immediately.
9	Remote Start On-load	When this input is active in auto mode, genset starts automatically and takes on load after normal running. Otherwise, genset will stop automatically if this input is deactivated.
10	Remote Start Off-load	When this input is active in auto mode, genset starts automatically and without taking load after normal running. Otherwise, genset will stop automatically if this input is deactivated.
11	Reset Maintenance Time	When this input port is valid, reset the maintenance time counts down, it is invalid for the maintenance date.
12	Panel Lock	When input is active, all keys except the    buttons are inactive.  will be displayed on the right side of fifth line of LCD main screen.
13	Inhibit Timing Start	When input port is active in auto mode, genset scheduled run is inhibited.
14	Inhibit Auto Start	When input port is active in auto mode, genset auto start is inhibited.
15	Remote Control	When the input is active, keys on the panel are locked except for    keys and remote mode will displayed on the LCD. Remote module pattern and start/stop operation can be switched by the keys on the panel.
16	Charge Alt Fail IN	When the input is active, controller will send failed to charge warning.
17	Low Oil Level Warn	When input port is active, controller will initiate low oil level warning alarm.
18	Manual/Auto Switch	When input is active, enter into auto mode automatically, panel buttons and local operation are inactive; When input is inactive, enter into manual mode automatically, remote operation is inhibited.
19	Reserved	
20	Idle Input	When the input is active, idle speed control starts output.
21	Reserved	
22	Control At Gate	When the input is active, controller will send access control input warning.
23	Aux. Mains Fail	Simulate mains is abnormal.



No.	Items	Function Description
24	Aux. Mains OK	Simulate mains is normal.
25	Pile Under Voltage	When the input is active, it considers battery pack is under voltage. If crank disconnect conditions are configured, genset will be started in auto mode.
26	Reserved	
27	1#ATS Gen Closed	Connecting with auxiliary contact of 1#ATS gen on-load switch.
28	1#ATS Mains Closed	Connecting with auxiliary contact of 1#ATS mains on-load switch.
29	2#ATS Gen Closed	Connecting with auxiliary contact of 2#ATS gen on-load switch.
30	2#ATS Mains Closed	Connecting with auxiliary contact of 2#ATS mains on-load switch.
31	Reserved	

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7.4 SELECTION OF SENSORS

Table 14 – Sensors Selection

No.	Items	Content	Remark
1	Temperature Sensor	0 Not used 1 User-configured (Resistor type) 2 VDO 3 SGH 4 SGD 5 CURTIS 6 DATCON 7 VOLVO-EC 8 SGX 9 PT100 10 Reserved	Defined resistance's range is 0Ω~999.9Ω.
2	Pressure Sensor	0 Not used 1 User-configured (Resistor type) 2 VDO 10Bar 3 SGH 4 SGD 5 CURTIS 6 DATCON 10Bar 7 VOLVO-EC 8 SGX 9 Reserved 10 Reserved 11 Digital low input active 12 Digital high input active	Defined resistance's range is 0Ω~999.9Ω.
3	Fuel Level Sensor	0 Not used 1 User-configured (Resistor type) 2 SGH 3 SGD 4 Reserved 5 Reserved 6 Digital low input active 7 Digital high input active	Defined resistance's range is 0Ω~999.9Ω.

NOTE: The room temperature sensor's curve type is the same as temperature sensor's.

7.5 CONDITIONS OF CRANK DISCONNECT SELECTION


Table 15 – Crank Disconnect Conditions

No.	Setting Content
0	Speed
1	Gen frequency
2	Speed + Gen frequency
3	Speed + Oil pressure
4	Gen frequency + Oil pressure
5	Speed + Gen frequency + Oil pressure
6	Oil pressure

- a) There are 3 conditions to make starter separate with engine; speed, generator frequency and oil pressure can be used separately while oil pressure suggest be used together with speed and generator frequency. The aim is to disconnect the starter motor as soon as possible.
- b) Speed stands for the real rotation speed detected by the speed sensor. Speed sensor is the magnetic equipment which be installed in starter for detecting flywheel teeth.
- c) When set as speed, must ensure that the number of flywheel teeth is as same as setting, otherwise, “over speed shutdown” or “under speed shutdown” may be caused.
- d) If genset without speed sensor please don't select corresponding items, otherwise, “start fail” or “loss speed signal” maybe caused.
- e) If genset without oil pressure sensor, please don't select corresponding items.
- f) If not select generator frequency in crank disconnect setting, controller will not collect and display the relative power quantity (can be used in water pump set); if not select speed in crank disconnect setting, the engine speed displayed in controller is calculated by generator signal.

8 PARAMETERS SETTING

8.1 CONTROLLER PARAMETER SETTING

Start the controller, then press  to enter into the parameters setting menu, menu items are as follows:






- 1 Set Parameters
- 2 Information
- 3 Language
- 4 Event Log
- 5 Maintenance

When entered password interface, inputting "0318" can set all parameter items in *Table 11*. If the password is changed, only input the password same as controllers', can the parameter be set via PC software. If there is need to set more parameters (e.g. voltage calibration; current calibration), please contact the factory.

▲NOTES:

- a) Please change the controller parameters when generator is in standby mode only (e. g. Crank disconnect conditions selection, auxiliary input, auxiliary output, various delay), otherwise, shutdown and other abnormal conditions may occurs.
- b) Over voltage set value must be higher than under voltage set value, otherwise over voltage and under voltage condition may occur simultaneously.
- c) Over speed set value must be higher than under speed set value, otherwise over speed and under speed condition may occur simultaneously.
- d) Please set the generator frequency value as low as possible when cranking, in order to make the starter be separated quickly as soon as possible.
- e) Auxiliary input 1~7 could not be set as same items; otherwise, there are abnormal functions. However, the auxiliary output 1~5 can be set as same items.
- f) Programmable sensor 1 and sensor 2 both can be set as discrete input or analog input port. Choose either discrete or analog input function, if discrete input port be selected, corresponding discrete input settings be functional; otherwise, if analog value be selected, corresponding sensor parameters settings be functional.
- g) Controller No.9 terminal hardware function can be configured via "T9 Input/Output Selection" settings. It is default as programmable output port 4.

8.2 CONTROLLER INFORMATION

- a) LCD will display develop information of controller, such as software version, hardware and issue date of the controller.
- b) **▲Note:** In this interface, press  will display the auxiliary inputs and outputs status.
- c) LCD contrast control
- d) Press  and  or  and  simultaneously to adjust LCD contrast ratio and make LCD character display more clearly. Contrast ratio adjustment range: 0-7.

8.3 LANGUAGE SELECTION

Chinese and English can be optional.

8.4 EVENT LOG

View event log from this interface, including start/stop information and shutdown alarm information log. It can record and display up to 99 pieces.

8.5 MAINTENANCE

Password need to be input when enter into the maintenance interface, default as 0 (if change this password, please contact with SmartGen service personnel or sales personnel). Setting maintenance parameters will refresh maintenance time.

▲Note: Refresh maintenance time and enter into the next maintenance period in maintenance interface when "Maintenance Due Alarm" occurs.

9 SENSOR SETTING

- When reselect sensors, the sensor curve will be transferred into the standard value. For example, if temperature sensor is SGH (120°C resistor type), its sensor curve is SGH (120°C resistor type); if select the SGD (120°C resistor type), the temperature sensor curve is SGD curve.
- When there is difference between standard sensor curves and using sensor, user can adjust it in “curve type”.
- When input the sensor curve, X value (resistor) must be input from small to large, otherwise, mistake occurs.
- If there is no oil pressure sensor, but there is low oil pressure alarm switch, user must set the oil pressure sensor as “None”, otherwise, maybe low oil pressure shutdown occurs.
- The headmost or backmost values in the vertical coordinates can be set as same as below,

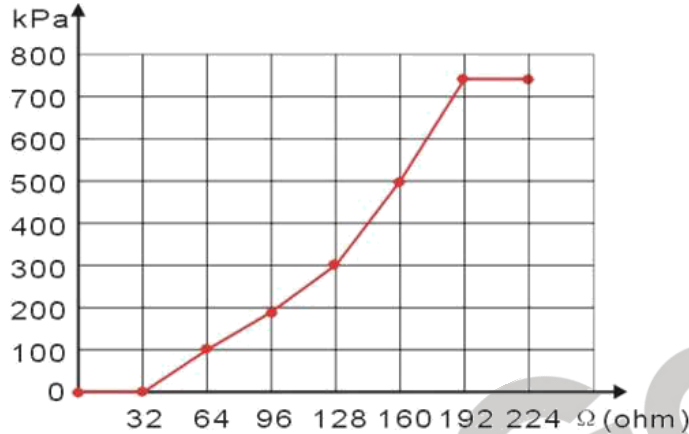


Table 16 - Common unit conversion table

	N/m ² (pa)	kgf/cm ²	bar	(p/in ² .psi)
1Pa	1	1.02x10 ⁻⁵	1x10 ⁻⁵	1.45x10 ⁻⁴
1kgf/cm ²	9.8x10 ⁴	1	0.98	14.2
1bar	1x10 ⁵	1.02	1	14.5
1psi	6.89x10 ³	7.03x10 ⁻²	6.89x10 ⁻²	1

10 COMMISSIONING

Please make sure the following checks are made before commissioning,

- Ensure all the connections are correct and wires diameter is suitable.
- Ensure that the controller DC power has fuse, controller's positive and negative connected to start battery are correct.
- Take proper action to prevent engine to crank success (e. g. Remove the connection wire of fuel valve). If checking is OK, make the start battery power on; choose manual mode and controller will executive routine.
- Set controller under manual mode, press "start" button, genset will start. After the cranking times as setting, controller will send signal of Start Failure; then press "stop" to reset controller.
- Recover the action to prevent engine to crank success (e. g. Connect wire of fuel valve), press start button again, genset will start. If everything goes well, genset will normal running after idle running (if idle run be set). During this time, please watch for engine's running situations and AC generator's voltage and frequency. If abnormal, stop genset and check all wires connection according to this manual.
- Select the **AUTO** mode from controller's panel, connect mains signal. After the mains normal delay, controller will transfer ATS (if fitted) into mains load. After cooling time, controller will stop genset and make it into "at rest" mode until there is mains abnormal situation.
- When mains is abnormal again, genset will be started automatically and enter into normal running, then controller send signal to making generator switch on, and control the ATS transfer into generator load. If not like this, please check ATS' wires connection according to this manual.
- If there is any other question, please contact SmartGen's service.

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11 TYPICAL APPLICATION

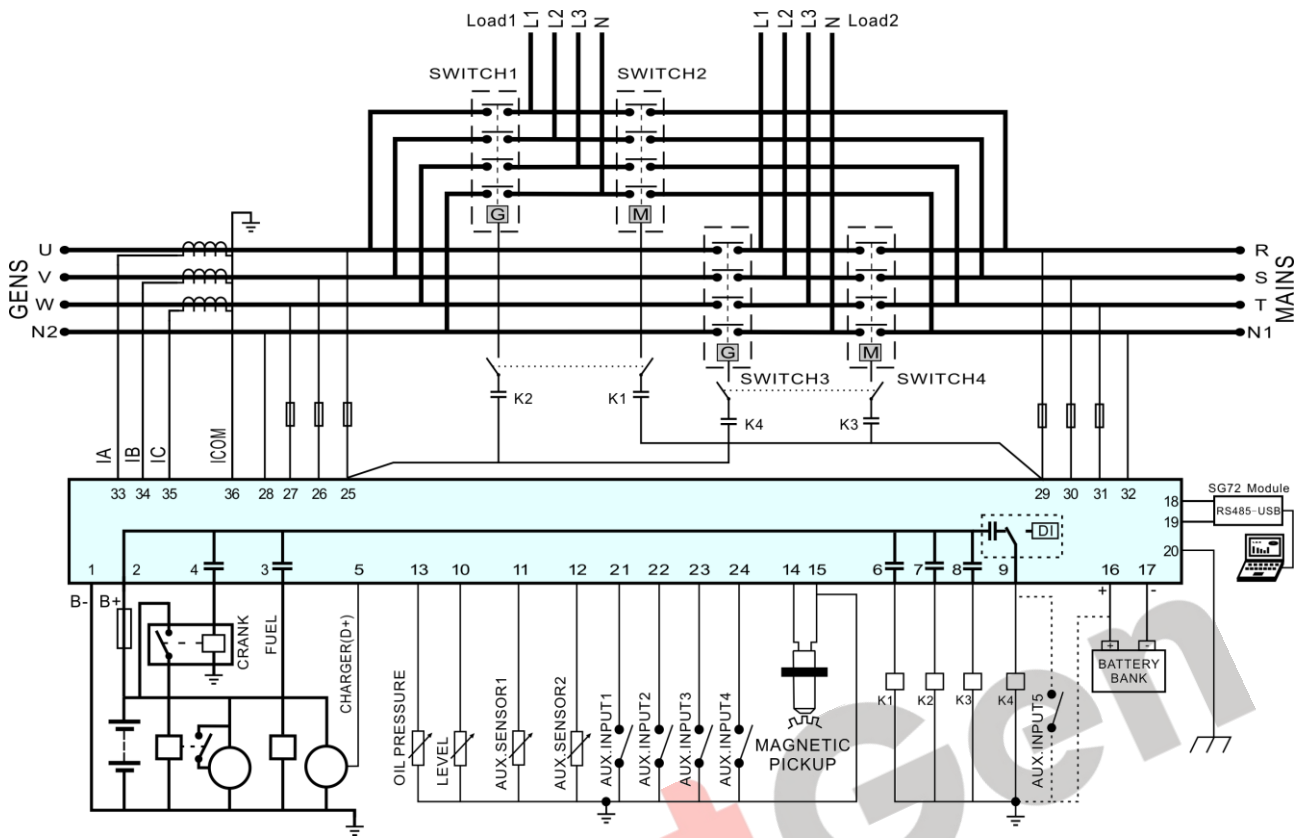


Fig.3 - Typical Application Drawing 1

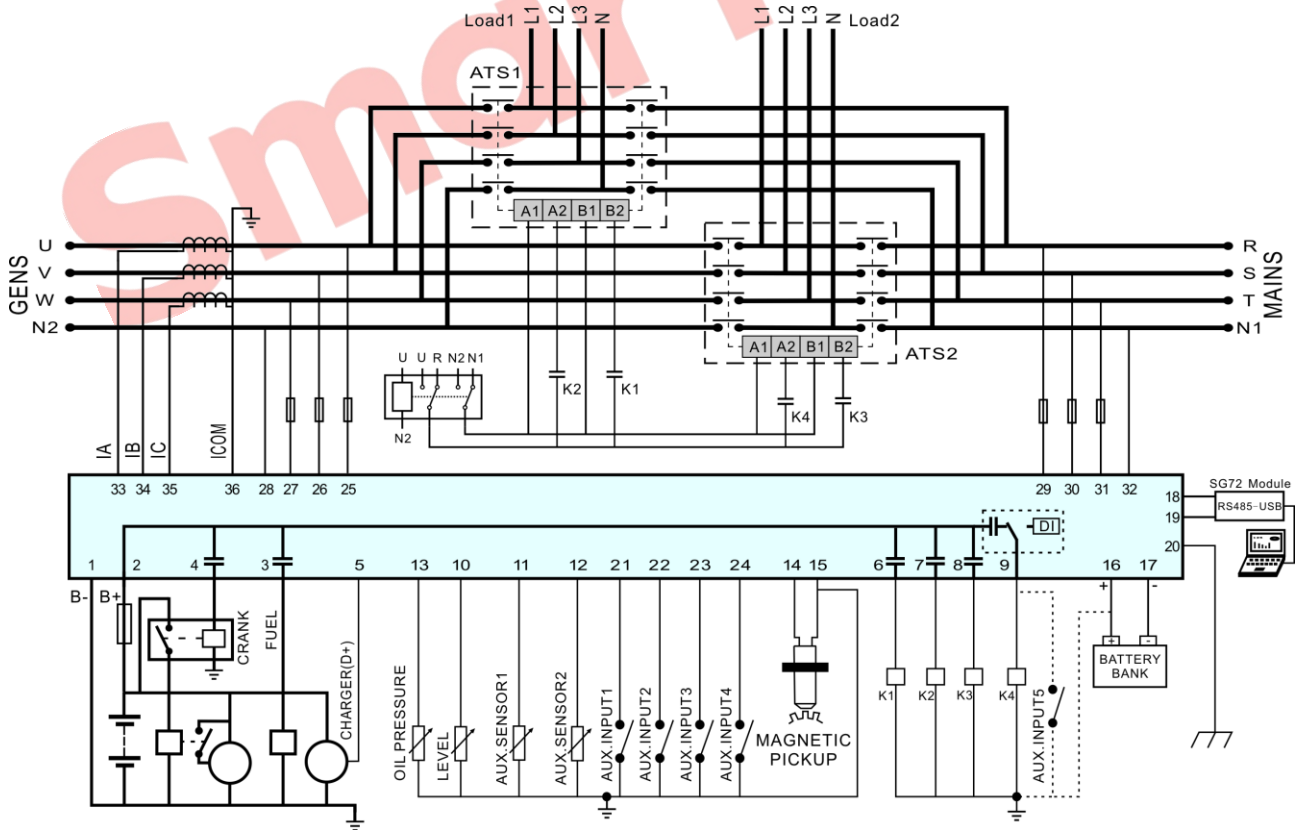


Fig.4 - Typical Application Drawing 2

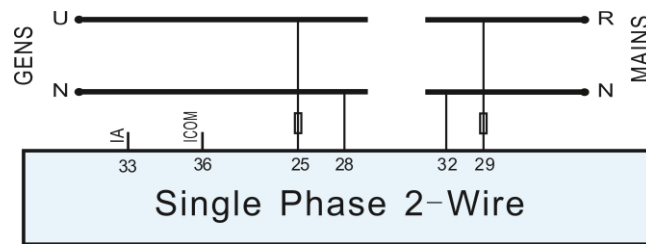


Fig.5 - Single Phase 2-Wire Connection Diagram

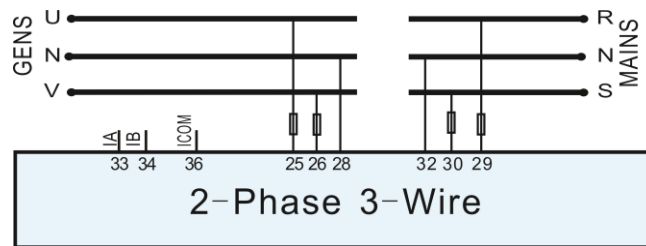


Fig.6 - 2-Phase 3-Wire Connection Diagram

- ▲ **Note:** Expand relay with high capacity in start and fuel output is recommend.
- ▲ **Note:** No.9 terminal is can be configured as input/output port, factory default is output port.

12 INSTALLATION

12.1 FIXING CLIPS

- Controller is panel built-in design; it is fixed by clips when installed.
- Withdraw the fixing clip screw (turn anticlockwise) until it reaches proper position.
- Pull the fixing clip backwards (towards the back of the module) ensuring two clips are inside their allotted slots.
- Turn the fixing clip screws clockwise until they are fixed on the panel.

- ▲ **Note:** Care should be taken not to over tighten the screws of fixing clips.

12.2 OVERALL DIMENSION

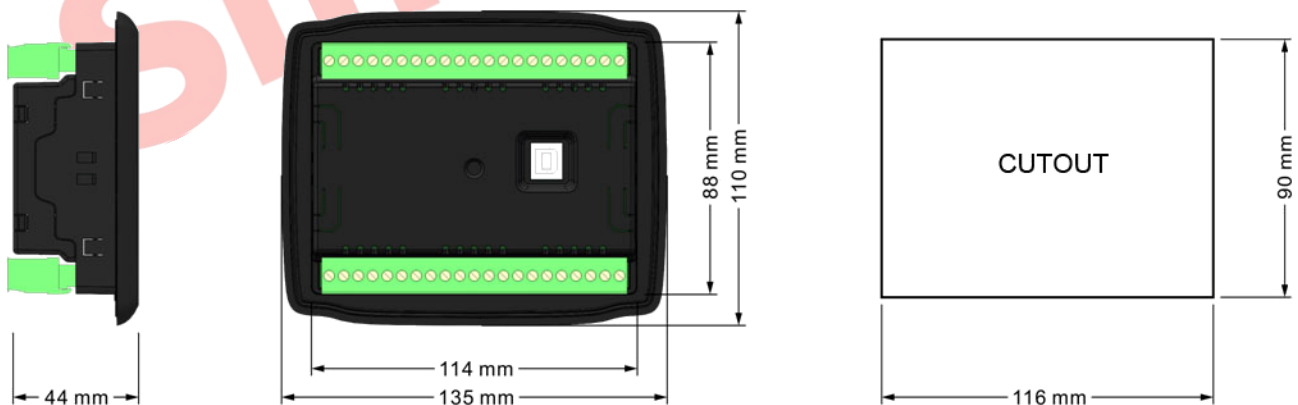


Fig.7 - Overall Dimensions

HGM4020T controller can suit for widely range of battery voltage DC(8~35)V. Negative of battery must be connected with the engine shell. Diameter of wire that connects from power supply to battery must be over 2.5mm². If floating charge configured, please firstly connect output wires of charger to battery's positive and negative directly, then, connect wires from battery's positive and negative to controller's positive and negative input ports in order to prevent charge disturbing the controller's normal working.

— SPEED SENSOR INPUT

Speed sensor is the magnetic equipment which be installed in starter and for detecting flywheel teeth. Its connection wires to controller should apply for 2 cores shielding line. The shielding layer should connect to No. 15 terminal in controller while another side is hanging in air. The else two signal wires are connected

to No.14 and No.15 terminals in controller. The output voltage of speed sensor should be within AC(1~24)V (effective value) during the full speed. AC12V is recommended (in rated speed). When install the speed sensor, let the sensor is spun to contacting flywheel first, then, port out 1/3 lap, and lock the nuts of sensor at last.

— OUTPUT AND EXPAND RELAYS

All outputs of controller are relay contact output type. If need to expand the relays, please add freewheel diode to both ends of expand relay's coils (when coils of relay has DC current) or, increase resistance-capacitance return circuit (when coils of relay has AC current), in order to prevent disturbance to controller or others equipment.

— AC INPUT

Current input of controller must be connected to outside current transformer. And the current transformer's secondary side current must be 5A. At the same time, the phases of current transformer and input voltage must correct. Otherwise, the current of collecting and active power maybe not correct.

▲NOTE:

- 1) ICOM port must be connected to negative pole of battery.
- 2) When there is load current, transformer's secondary side prohibit open circuit.

— WITHSTAND VOLTAGE TEST

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.