



SmartGen
ideas for power

HGM4100LT GENSET CONTROLLER USER MANUAL



SMARTGEN (ZHENGZHOU) TECHNOLOGY CO., LTD.



Chinese trademark

SmartGen English trademark

SmartGen – make your generator *smart*

SmartGen Technology Co., Ltd.

No.28 Jinsuo Road

Zhengzhou

Henan Province

P. R. China

Tel: +86-371-67988888/67981888/67992951

+86-371-67981000(overseas)

Fax: +86-371-67992952

Web: www.smartgen.com.cn

www.smartgen.cn

Email: sales@smartgen.cn

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Table 1 Software Version

Date	Version	Note
2019-01-28	1.0	Original release.
2019-12-19	1.1	Fix CAN terminal description.
2021-11-24	1.2	Add "Crank Failure Output" in output ports.



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1 OVERVIEW

HGM4100LT Power Station Automatic Controller is designed especially for adapting extremely low/high temperature (-40~+70)°C, which integrates digital, intelligent and network technology, and are used for single genset automation and monitoring control system, in order to achieve automatic start/stop, data measurement, alarm protection etc. functions. It applies LCD display, optional interface operation with eight languages (Chinese, English, Spanish, Russian, Turkish, French, Portugal, and Polish). It is simple to operate and reliable to work.

HGM4100LT Power Station Automatic Controller employs micro-processor technology, which makes these functions come true, including precise parameter measuring, fixed value adjustment, time setting and integer limit value adjusting etc. All parameters can be configured from the front panel. They can also be adjusted and monitored through programmable interfaces (USB or RS485 interface) via PC. Because of the characteristics of compact structure, simple wiring connection and high reliability, it can be widely used in all types of automatic genset control system.

2 PERFORMANCE AND CHARACTERISTICS

HGM4100LT: it is used for single unit automation and genset auto start/stop control by remote start signals.

Main characteristics:

- LCD display with backlight, 132x64 size, and eight language display (Chinese, English, Spanish, Russian, Turkish, French, Portugal, and Polish), push-button operation;
- Hard acrylic screen material with great wear-resisting and scratch-resisting performance, which are used to protect the screen;
- Silicone panel and pushbuttons which can better adapt extreme temperature environment;
- RS485 communication interface, which enables “Three remote” (remote control, remote measuring and remote communication) functions by MODBUS protocol;
- CANBUS port, which can connect with J1939-equipped electronic injection engine. Not only can it monitor frequently-used data (such as water temperature, oil pressure, speed, fuel consumption and so on) of ECU machine, but also control start-up, shutdown, speed raising and speed dropping etc. (the controller with CANBUS interface is needed);
- 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;
- Collecting and displaying 3-phase voltage, 3-phase current, frequency, and power parameters;

Generator

Line voltage (Uab, Ubc, Uca)

Phase voltage (Ua, Ub, Uc)

Frequency (Hz)

Phase sequence

Load

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

Accumulated total generator power W kWh, kvarh, kVAh (unit)

Output percentage with loading %



- Overvoltage, undervoltage, overfrequency, underfrequency, overcurrent, overpower functions for generating;
- Precisely collecting all kinds of parameters for the generator:

Temp.	°C / °F	
Oil Pressure	kPa/psi/bar	all be displayed
Fuel Level	% (unit)	Fuel Quantity Left L (unit)
Speed	r/min (RPM)	
Voltage of Battery	V (unit)	
Voltage of Charger	V (unit)	
Hour count accumulation		
Start times accumulation		
- Control and protection function: automatic start/stop of the diesel genset, ATS (Auto Transfer Switch) control and perfect fault indication and protection functions;
- ETS (energize to stop), idle control, pre-heating control and speed raise/drop control functions, which are all relay outputs;
- Parameter setting function: it allows users to change and set parameters and meanwhile they shall be stored in the internal FLASH. They shall not be lost even in case of power outage; All of them can be adjusted from the front panel of the controller and also can be modified on PC via USB or RS485 port;
- Two multiplex input port 4 and 5; Input port 4 can be configured as digital input port or fuel level sensor; input port 5 can be set as digital input port or programmable sensor. It can be flexibly applied on different occasions.
- Multiple temperature, pressure, oil level sensors can be used directly and their parameters can be self-defined;
- One programmable sensor; it can be configured as temperature, pressure or liquid level sensor, which achieves the detection for double temperature, double pressure or double liquid level;
- Optional crank disconnection conditions (speed sensor, oil pressure, generating);
- Emergency start function;
- Automatic recognition function for flywheel tooth number;
- Wide power supply range (8~35)VDC, which is suitable for different starting battery voltage environment;
- All parameters apply digital adjustment, getting rid of conventional analog modulation of normal potentiometer, improving the reliability and stability of the whole device;
- Maintenance function; maintenance types can choose date or running time, maintenance actions can be configurable (inactive, warning, or alarm shutdown);
- Event log, real-time clock, and scheduled start & stop function (start once each day/week/month and loading or not can be set); Maximum event logs are 99 items;
- Rubber seal designed between the shell and the screen with protection level IP65;
- Metal fixing clips are used to fix the controller;
- Modular structure design, anti-flaming ABS plastic enclosure, pluggable connection terminals and embedded installation way with compact structure and 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 \leq 2W)
AC Gen Voltage Input:	
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)
AC Gen Frequency	50Hz/60Hz
Speed Sensor Voltage	1.0V to 24.0V (RMS)
Speed Sensor Frequency	10,000 Hz (max.)
Starter Relay Output	5A DC28V power supply output
Fuel Relay Output	5A DC28V power supply output
Programmable Relay Output 1	1A DC28V power supply output
Programmable Relay Output 2	1A DC28V power supply output
Programmable Relay Output 3	1A DC28V power supply output
Programmable Relay Output 4	1A DC28V power supply output
Case Dimension	135mm x 110mm x 44mm
Panel Cutout	116mm x 90mm
CT Secondary Current	5A rated
Working Temperature	Temperature: (-40~+70) $^{\circ}$ C When reaches -40 $^{\circ}$ C, the controller is powered on for 50 seconds, but there is double image, and the display can be normal after 1.5 minutes.
Working Humidity	(20~93)%RH
Storage Temperature	(-45~+80) $^{\circ}$ C
Protection Level	IP65: rubber seal installed between the controller enclosure and panel window.
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	0.32kg

4 OPERATION

4.1. KEY FUNCTION DESCRIPTION

Table 3 Key Function Descriptions

Icon	Function	Description
	Stop/ Reset	Stop the running generator in auto/manual mode; Under alarm status, press the button can remove the alarm; In stop mode, press and hold the button for 3 seconds and it can test the indicator lights (lamp test); During stop process, press this button again and generator shall stop immediately.
	Start	Under manual mode, press this button and the genset shall start; during the start process, press this button and the genset shall jump to next status and start quickly.
	Manual	Press this key and the controller shall be in manual mode.
	Auto	Press this key and the controller shall be in auto mode.
	C/O	The switchover key for breaker close and open; press this key and the C/O page and main page shall display alternately; When C/O page displays and the controller is in manual mode, press Up/Down keys and breaker open and close can be controlled.
	Set/Confirm	Press this key and it shall enter into Menu List; During parameter setting, it is used to move the cursor and confirm setting information.
	Up/Increase	Scrolls the screen up; during parameter setting, it is used to move the cursor up and add the value of the place where the cursor is; When the C/O page displays and the controller is in manual mode, it can control Gen breaker close.
	Down/Decrease	Scrolls the screen down; during parameter setting, it is used to move the cursor down and reduce the value where the cursor is; When the C/O page displays and the controller is in manual mode, it can control Gen breaker open.

4.2. CONTROLLER PANEL

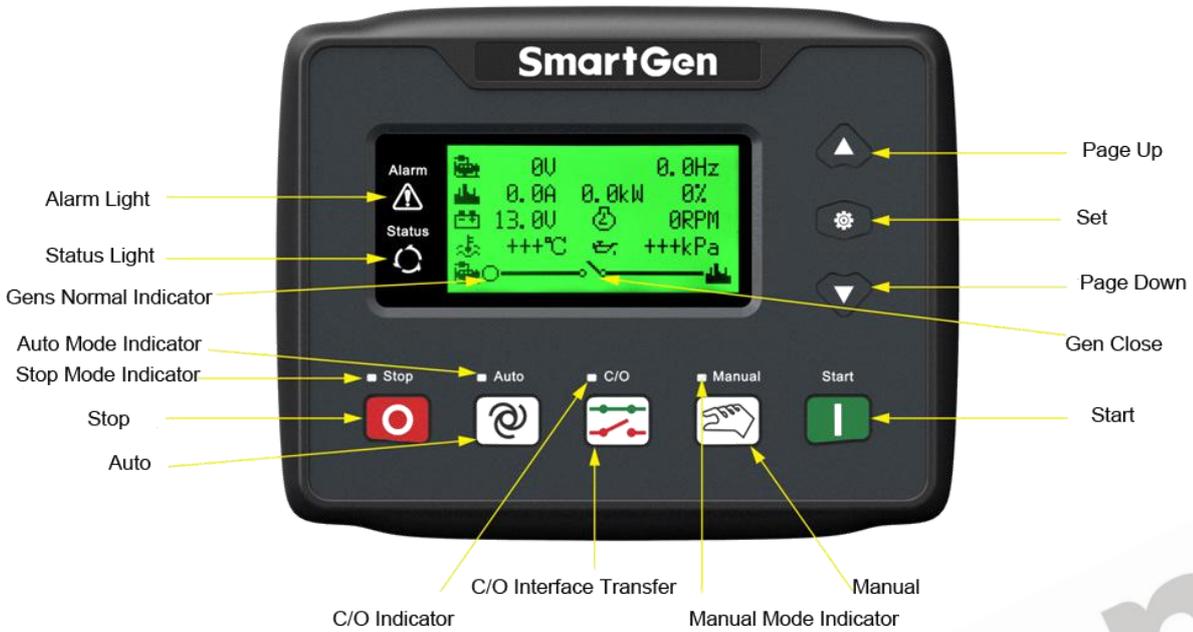


Fig.1 HGM4100LT Front Panel Indication

▲NOTE: Illustration for some of indicator lights:

Alarm Indicators: slowly flash when warning alarms; fast flash when shutdown alarms; light is off when none alarms.

Status Indicators: Light is off when genset is standby; flash once per second during startup or shutdown; it is always on when it is normal running.

4.3. AUTO START/STOP OPERATION

Press , and the indicator besides is on, which means the genset is in auto start mode.

Auto Start Sequence:

- 1) When the remote start input is active, LCD displays countdown and it enters "Start Delay";
- 2) LCD displays "Start Delay" countdown;
- 3) When start delay is over, preheating relay outputs (if configured), LCD displays "preheat start delay XX s";
- 4) When preheating delay is over, fuel relay outputs for 1s and then starter relay outputs; during the start time if the genset does not start successfully, the fuel relay and starter relay stop outputting and enter "crank rest time" for waiting for next start;
- 5) During the set starting attempts, if the genset does not start successfully, the fifth line of LCD display window turns black, and at the same time it displays start failure alarm;
- 6) If the genset starts successfully in any of the start attempts, "safety on delay" starts. During this period, low oil pressure, high water temperature, under speed, charging failure and auxiliary inputs (if configured) alarm types are disabled. As soon as this delay is over, "start idle delay" is initiated (if configured);
- 7) During the process of "start idle delay", under speed, under frequency, under voltage alarms are inhibited. When this delay is over, "warming up delay" starts (if configured);
- 8) When "warming up delay" is over, if generator state normal, the indicator will be illuminated. If genset voltage and frequency has reached loading requirements, the Gen close relay will be energized, generator will work with loading, generator power indicator will turn on, and generator will enter Normal Running state; if the voltage and frequency are abnormal, the controller will initiate shutdown alarm (Gen alarm type will be displayed on LCD).

Auto Stop Sequence:

- 1) When the remote start input is invalid, "Stop Delay" starts;
- 2) When the stop delay is over, high-speed cooling delay starts, Gen close relay is disconnected, and Gen power indicator is off;
- 3) When stop idling speed delay (if configured) starts, idling speed relay is energized and outputs;
- 4) When "ETS hold delay" starts, ETS relay is energized and outputs, and the fuel relay output is disconnected;
- 5) When genset "Fail to stop time" starts, it shall judge whether it stops completely automatically;
- 6) When the genset stops completely, it enters standby status; if the genset cannot stop, the controller shall alarm (LCD displays stop failure warning.).

4.4. MANUAL START/STOP OPERATION

- 1) Press , and the controller shall enter "Manual mode". The manual mode indicator is on. Then press

 and start the genset. It can automatically judge whether crank disconnection is successful and it can accelerate to high speed running automatically. It can effectively protect and stop if high water temperature, low oil pressure, over speed, abnormal voltage etc. circumstances occur in the diesel genset running process (for details please refer to the auto start process 4~8). When genset high-speed

running goes normal, press  and it comes the C/O interface. By  key Gen breaker close can be controlled; and by  Gen breaker open can be controlled. At this time the generator is working

with loading.

- 2) Manual stop: press  key and it can stop the running genset (for detail procedures please refer to No.3~7 of Auto stop sequence).

4.5. EMERGENCY START UP

Under manual mode, simultaneously press  and , and the genset can be started forcibly. At this time, the controller shall not judge whether the genset has started by crank disconnection conditions. The starter disconnection is controlled by the operator. When the operator observes the genset has started, let go of the buttons and start output is stopped. The controller enters safe running delay.

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5 PROTECTION

5.1 WARNINGS

When the controller detects the warning signals, it shall only give alarm and not stop the genset. Besides, LCD displays the warning information.

Table 4 Warnings

No.	Type	Description
1	High Temperature	When the sample temperature got by the temperature sensor is higher than the set temperature value and it is not allowed to stop the genset, or input port temperature high alarm is detected and it is not allowed to stop the genset, the controller shall initiate the warning alarm signal and LCD displays High Temperature Warning at the same time.
2	Low Oil Pressure	When the sample oil pressure got by the pressure sensor is lower than the set pressure value and it is not allowed to stop the genset, or input port pressure low alarm is detected and it is not allowed to stop the genset, the controller shall initiate the warning alarm signal and LCD displays Low Oil Pressure Warning at the same time.
3	Gen Over Current	When the controller detects that the genset current has exceeded the pre-set value and the over current delay has expired, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
4	Fail to Stop	After "fail to stop delay"/ "ETS delay" has expired, if genset does not stop completely, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
5	Low Fuel Level	When the controller detects that the fuel level has fallen below the pre-set value while shutdown is prohibited, or it detects that the Aux. input fuel low warning is active, while shutdown is prohibited, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
6	Charge Alt Failure	When the controller detects that charger voltage has fallen below the battery voltage and the difference value exceeds pre-set charging voltage difference value, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
7	Battery Under Volt	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.
8	Battery Over Volt	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.
9	Auxiliary Input	When the controller detects that the auxiliary input warning signals are active, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
10	Loss of Speed Signal	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.



No.	Type	Description
11	Low Coolant Level	When the controller detects the low coolant level input is active, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
12	Temp. Sensor Open	When the controller detects that the temperature sensor is open circuit and the open circuit action is set as "Warn" in parameter setting, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
13	Oil Pressure Sensor Open	When the controller detects that the oil pressure sensor is open circuit and the action selects "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
14	Level Sensor Open	When the controller detects that the level sensor is open circuit and the action is selected "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
15	Temp. Sensor 2 Open	If the temperature sensor connected with config. sensor port is open circuit, the open circuit action configured in the parameter configuration is set as "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
16	Oil Pressure Sensor 2 Open	If the pressure sensor connected with config. sensor port is open circuit, open circuit action configured in the parameter configuration is set as "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
17	Coolant Level Sensor Open	If the level sensor connected with config. sensor port is open circuit, the open circuit action configured in the parameter configuration is set as "Warn", it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
18	High Temperature 2	When the controller detects that config. sensor temperature (sensor type: temperature sensor) has exceeded the pre-set value while shutdown is prohibited, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
19	Low Oil Pressure 2	When the controller detects that config. sensor oil pressure (sensor type: oil pressure sensor) has fallen below the pre-set value while shutdown is prohibited, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
20	Low Coolant Level	When the controller detects that config. sensor coolant level (sensor type: level sensor) has fallen below the pre-set value while shutdown is prohibited, it will initiate a warning alarm and the corresponding alarm information will be displayed on LCD.
21	Maintenance Due	When genset running time has exceeded the users-set maintenance time and the maintenance action is "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 is selected "Inactive".
22	Gen Over Voltage	When controller detects the voltage is higher than the set warning value, it will send warning signals and the corresponding alarm information will be displayed on LCD.



No.	Type	Description
23	Gen Under Voltage	When controller detects the voltage is lower than the set warning value, it will send warning signals and the corresponding alarm information will be displayed on LCD.
24	Gen Over Frequency	When controller detects the frequency is higher than the set warning value, it will send warning signals and the corresponding alarm information will be displayed on LCD.
25	Gen Under Frequency	When controller detects the frequency is lower than the set warning value, it will send warning signals and the corresponding alarm information will be displayed on LCD.
26	Charger Failure Alt	When controller detects the charger alt failure warning input is active, it will send alarm signals and the corresponding alarm information will be displayed on LCD.
27	Over Power	When controller detects the power value (power is positive) is higher than the set value and the action selects "Warn", it will send warning signals and the corresponding alarm information will be displayed on LCD.
28	ECU Warn	When controller gets the warning signals from the engine via J1939, it will send warning signals and the corresponding alarm information will be displayed on LCD.

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5.2 SHUTDOWN ALARM

When the controller detects shutdown alarm, it will open the breaker immediately and stop. At the same time alarm type shall be displayed.

Table 5 Shutdown Alarms

No.	Type	Description
1	Emergency Stop	When the controller detects emergency stop signals, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
2	Over Speed	When controller detects the speed value is higher than the set over speed stop value, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
3	Under Speed	When the controller detects the speed value is lower than the set value, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
4	Loss of Speed Signal	When the controller detects speed value equals 0, and delay value isn't 0, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
5	Over Frequency	When the controller detects the frequency value is higher than the set over frequency stop value, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
6	Under Frequency	When the controller detects the frequency value is lower than the set value, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
7	Over Voltage	When the controller detects the voltage value is higher than the set overvoltage stop value, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
8	Under Voltage	When the 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	Over Current	When the controller detects the current value is higher than the set overcurrent stop value and the delay value is not 0, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
10	Fail to Start	If genset fails to start within the set start times, the controller will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
11	High Temp. Shutdown	When the controller detects water/cylinder temperature is higher than the set stop value, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
12	Low Oil Pressure	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 Generate Electricity	When the controller detects genset frequency is 0, it will send stop alarm signals and the corresponding alarm information will



No.	Type	Description
		be displayed on LCD.
14	Low Fuel Level	When the controller detects fuel level value is lower than the pre-set value or the low fuel level stop input is active, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
15	Low Coolant Level	When the controller detects low coolant level stop input is active, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
16	Temp. Sensor Open	When the sensor connected to temperature sensor, is open circuit, and the open circuit action in parameter configuration is selected "shutdown", it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
17	Oil Pressure Sensor Open	When the sensor connected to oil pressure sensor, is open circuit, and the open circuit action in parameter configuration is selected "shutdown", it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
18	Fuel Level Sensor Open	When the sensor connected to fuel level sensor, is open circuit, and the open circuit action in parameter configuration is selected "shutdown", it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
19	Temp. Sensor 2 Open	When the temperature sensor connected to the programmable sensor port, is open circuit, and the open circuit action in parameter configuration is selected "shutdown", it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
20	Pressure Sensor 2 Open	When the pressure sensor connected to the programmable sensor port, is open circuit, and the open circuit action in parameter configuration is selected "shutdown", it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
21	Coolant Level Sensor Open	When the liquid level sensor connected to the programmable sensor port, is open circuit, and the open circuit action in parameter configuration is selected "shutdown", it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
22	High Temp. 2 Shutdown	When the sample value adopted by the programmable sensor (sensor type: temperature sensor), is higher than the pre-set value, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
23	Low Pressure 2 Shutdown	When the sample value adopted by the programmable sensor (sensor type: pressure sensor), is lower than the pre-set value, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
24	Low Coolant Level	When the sample value adopted by the programmable sensor



No.	Type	Description
	Shutdown	(sensor type: liquid level sensor), is lower than the pre-set value, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
25	Maintenance Due	When genset operation time exceeds the users-set maintenance time and the maintenance action is set "shutdown", it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
26	Over Power	When the controller detects the power value (power is positive) is higher than the set limit value and the over power action type is set "shutdown", it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
27	Auxiliary Input	When the controller detects external shutdown alarm signals are active, it will send stop alarm signals and the corresponding alarm information will be displayed on LCD.
28	ECU Alarm Shutdown	When the controller receives the stop alarm signals by J1939, it will send stop alarm signals.
29	ECU Comm. Failure	When the controller does not receive data by J1939 when it starts the engine, it will send stop alarm signals for communication failure.

▲NOTE: ECU warning and shutdown alarms illustration: if there are detailed alarms display, check the engine according to the information; otherwise refer to the engine manual to obtain information according to SPN alarm code.

6 WIRING CONNECTION

HGM4100LT controller back panel is as below:

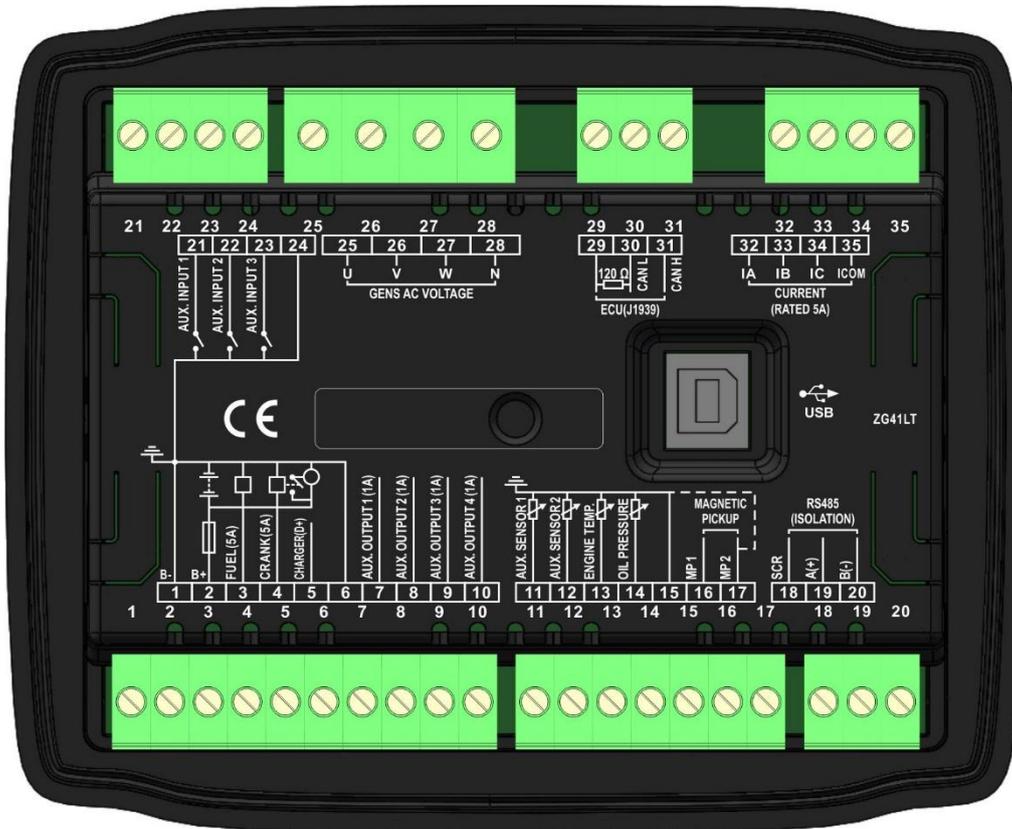


Fig.3 HGM4100LT Back Panel

Table 6 Terminal Wiring Connection

No.	Function	Cable Size	Remarks
1	B-	2.5mm ²	Connected with negative of starter battery;
2	B+	2.5mm ²	Connected with positive of starter battery; If wire length is over 30m, it is better to double wires in parallel; Max. 20A fuse is recommended.
3	Fuel relay output	1.5mm ²	B+ output is supplied by terminal 2 with rated 5A; It is "programmable relay output 5" in parameter setting.
4	Starter relay output	1.5mm ²	B+ output is supplied by terminal 2 with rated 5A.
5	Charger (D+)	1.0mm ²	Connected with charger starter's terminal D+ (WL); Let it hang up if there is not the terminal in charger.
6	COM GND	1.5 mm ²	Internally connected with B-.
7	Aux. Output 1	1.0mm ²	B+ output is supplied by terminal 2 with rated 1A.
8	Aux. Output 2	1.0mm ²	B+ output is supplied by terminal 2 with rated 1A.
9	Aux. Output 3	1.0mm ²	B+ output is supplied by terminal 2 with rated 1A.
10	Aux. Output 4	1.0 mm ²	B+ output is supplied by terminal 2 with rated 1A.
			For setting items please refer to Table 8.



No.	Function	Cable Size	Remarks	
11	Aux. Sensor 1	1.0mm ²	Used as liquid level sensor or digital input port 4.	
12	Aux. Sensor 2	1.0mm ²	Used as programmable sensor or digital input port 5.	
13	Temperature sensor input	1.0mm ²	Connected with water/cylinder temperature resistor sensor.	For setting items please refer to Table 10.
14	Oil pressure sensor input	1.0mm ²	Connected with oil pressure resistor sensor.	
15	COM GND connected	1.5 mm ²	Internally connected with B-.	
16	Speed sensor input	0.5mm ²	Connected with speed sensor; Shielding line is recommended.	
17	Speed sensor input; connected with battery negative inside controller	0.5mm ²		
18	RS485 COM GND	/	Impedance-120Ω shielding wire is recommended; One end is ground-connected.	
19	RS485+	0.5mm ²		
20	RS485-	0.5mm ²		
21	Aux. Input 1	1.0mm ²	Ground-connected is active (B-).	For setting items please refer to Table 9.
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	Input COM	1.0mm ²	Internally connected with B-.	
25	Genset U-phase voltage monitoring input	1.0mm ²	Connected to U-phase of genset output (2A fuse recommended).	
26	Genset V-phase voltage monitoring input	1.0mm ²	Connected to V-phase of genset output (2A fuse recommended).	
27	Genset W-phase voltage monitoring input	1.0mm ²	Connected to W-phase of genset output (2A fuse recommended).	
28	Genset N wire input	1.0mm ²	Connected to N-wire of genset output.	
29	CAN TR	0.5mm ²	Shielding wire of 120Ω impedance is recommended with single end GND connected. For short connecting TR and H terminals, please put 120Ω terminal resistor in.	
30	CAN L	0.5mm ²		
31	CAN H	0.5mm ²		
32	CT A-phase monitoring input	1.5mm ²	Externally connected to CT secondary coil (5A rated).	
33	CT B-phase monitoring input	1.5mm ²	Externally connected to CT secondary coil (5A rated).	
34	CT C-phase monitoring input	1.5mm ²	Externally connected to CT secondary coil (5A rated).	
35	CT COM	1.5mm ²	Refer to the following <i>Installation Instruction</i> .	

NOTE: USB ports in controller back panel are programmable parameter ports, and users can directly configure the controller via PC.

7 SCOPES AND DEFINITIONS OF PROGRAMMABLE PARAMETERS

7.1. CONTENTS AND SCOPES OF PARAMETER SETTINGS

Table 7 Contents and Scopes of Parameter Settings

No	Items	Range	Default	Description
1	Start Delay	(0-3600)s	1	From time when remote start signal is active to the time when the genset starts.
2	Stop Delay	(0-3600)s	1	From time when remote start signal is inactive to time when the genset stops.
3	Start Attempts	(1-10)times	3	The max. crank attempts for start failure; when it reaches the crank times, the controller shall send start failure signal.
4	Preheat Delay	(0-300)s	0	Power-on time of heater plug before starter is powered up.
5	Cranking Time	(3-60)s	8	Power-on time of starter every time.
6	Crank Rest Time	(3-60)s	10	The waiting time before the second power on when engine fails to start.
7	Safety Idle Time	(1-60)s	10	During this period, low oil pressure, high temperature, under speed, under frequency, under voltage, charge alt failure alarms are all inactive.
8	Start Idle Time	(0-3600)s	0	Running time at idling speed when genset starts.
9	Warming Up Time	(0-3600)s	10	Warming up time before breaker close and after high speed running.
10	Cooling Time	(3-3600)s	10	Radiating time before genset stop, after it unloads.
11	Stop Idle Time	(0-3600)s	0	Idle running time when genset stop.
12	ETS Solenoid Hold	(0-120)s	20	Power-on time for stop coil after genset unloads.
13	Fail to Stop Delay	(0-120)s	5	Time from end of idling speed delay to complete stop when ETS output time is set "0"; Time from end of ETS delay to complete stop when ETS output time is not "0".
14	Switch Close Time	(0-10)s	5.0	Width of generator close pulse; Continuous output when it is 0.
15	Flywheel Teeth	(10.0-300.0)	118.0	Flywheel teeth of engine; which is used for judging starter disconnection conditions and detecting engine speed.
16	Gen Abnormal Delay	(0-20.0)s	10.0	Alarm delay for generating voltage over high/low.
17	Gen Over Voltage Shutdown	(30-620)V	276	When generator voltage has exceeded the set value and the "Gen abnormal delay" has expired, Gen Over Voltage is active and Gen abnormal stop alarm occurs; when it is set 620V, the controller does not detect over voltage signal.
18	Gen Under Voltage	(30-620)V	184	When generator voltage has fallen below the set



No	Items	Range	Default	Description
	Shutdown Value			value and the "Gen abnormal delay" has expired, Gen Under Voltage is active and Gen abnormal stop alarm occurs; when it is set 30V, the controller does not detect under voltage signal.
19	Under Speed Shutdown Value	(0-6000) r/min	1200	When engine speed has fallen below the set value for 10s, Under Speed is active. It will initiate a shutdown alarm signal.
20	Over Speed Shutdown Value	(0-6000) r/min	1710	When engine speed has exceeded the set value for 2s, Over Speed is active. It will initiate a shutdown alarm signal.
21	Under Frequency Value	(0-75.0)Hz	40.0	When generator frequency has fallen below the set value but is Not equal to 0 for 10s, Under Frequency is active. It will initiate a shutdown alarm signal.
22	Over Frequency Value	(0-75.0)Hz	57.0	When generator frequency has exceeded the set value for 2s, Over Frequency is active. It will initiate a shutdown alarm signal.
23	High Temperature Shutdown Value	(80-300)°C	98	When the temperature value of the external temperature sensor exceeds the set value, the controller sends High Temperature Signal. It starts to detect only after end of Safe Delay and it is only for the temperature sensor externally connected to the temperature sensor input port. If the set value is 300, high temperature signal will not be sent (this is only for external temperature sensor, but not the high temperature signal via digital input port).
24	Low Oil Pressure Shutdown Value	(0-400)kPa	103	When the external pressure sensor value falls below this set value, Low Oil Pressure Delay starts. It starts to detect only after end of safe running delay. If the set value is 0, low oil pressure signal will not be sent (this only concerns pressure sensor and does not concern low oil pressure warning signal via configurable input port.).
25	Low Fuel Level Value	(0-100)%	10	When the fuel level of the external sensor falls below the set value for 10s, "Low Fuel Level" signal is initiated. This action is only warning and not shutdown of the generator.
26	Flexible Sensor Values	(80-300)°C (0-400)kPa (0-100)%	98	The values correspond to the function settings of 23 (Temperature sensor), 24 (Oil pressure sensor) and 25 (Level sensor) respectively.
27	Loss of Speed Signal Delay	(0-20.0)s	5.0	Shutdown delay of loss of speed signal; If the set value is 0, it is only warning and not shutdown.



No	Items	Range	Default	Description
28	Voltage Difference of Charge Alt Failure	(0-30)V	6.0	During the normal running process, when the voltage difference between alternator D+(WL) and B+ exceeds the set value and remains for 5s, It will initiate a "charge alt failure" shutdown alarm signal.
29	Battery Voltage Over	(12-40)V	33.0	When battery voltage has exceeded the set value and remains for 20s, it will initiate a warning alarm signal. It is only warning and not shutdown.
30	Battery Voltage Under	(4-30)V	8.0	When battery voltage goes under the set value and remains for 20s, it will initiate a warning alarm signal. It is only warning and not shutdown.
31	CT Ratio	(5-6000)/5	500	The ratio of external CT.
32	Full Load Current	(5-6000)A	500	Generator's rated current; it is used for over current loading calculation.
33	Over Current Percentage	(50-130)%	120	When the load current has exceeded the set value, "over current delay" is initiated.
34	Over Current Delay	(0-3600)s	30	Definite time over current delay; When load current has exceeded the set value and lasts for the set time, over current alarm is initiated. When the delay value is 0, it is only warning and not shutdown.
35	Fuel Pump On	(0-100)%	25	When fuel level has fallen below the set value for 10s, "Fuel Pump On" signal outputs;
36	Fuel Pump Off	(0-100)%	80	When fuel level has exceeded the set value for 10s, "Fuel Pump Off" signal outputs;
37	Relay Output 1	(0-31)	6	Factory default: Reserved; For details please see Table 8 .
38	Relay Output 2	(0-31)	2	Factory default: ETS control; For details please see Table 8 .
39	Relay Output 3	(0-31)	3	Factory default: Idling speed control; For details please see Table 8 .
40	Relay Output 4	(0-31)	5	Factory default: Gen breaker close; For details please see Table 8 .
41	Relay Output 5	(0-31)	14	Factory default: Fuel relay output; For details please see Table 8 .
42	Digital Input 1	(0-31)	1	Factory default: High Temperature Alarm input; For details please see Table 9 .
43	Digital Input 1 Active	(0-1)	0	Factory default: Active when it is closed.
44	Digital Input 1 Delay	(0-20.0)s	2.0	
45	Digital Input 2	(0-31)	2	Factory default: Low Oil Pressure Alarm input.



No	Items	Range	Default	Description
				For details please see Table 9 .
46	Digital Input 2 Active	(0-1)	0	Factory default: Active when it is closed.
47	Digital Input Delay 2	(0-20.0)s	2.0	
48	Digital Input 3	(0-31)	10	Factory default: Remote Start input; for details please see Table 9 .
49	Digital Input 3 Active	(0-1)	0	Factory default: Active when it is closed.
50	Digital Input Delay 3	(0-20.0)s	2.0	
51	Digital Input 4	(0-31)	11	Factory default: Low Fuel Level Warning input; For details please see Table 9 .
52	Digital Input 4 Active	(0-1)	0	Factory default: Active when it is closed.
53	Digital Input Delay 4	(0-20.0)s	2.0	
54	Digital Input 5	(0-31)	12	Factory default: Low Coolant Level Warning input. For details please see Table 9 .
55	Digital Input 5 Active	(0-1)	0	Factory default: Active when it is closed.
56	Digital Input Delay 5	(0-20.0)s	2.0	
57	Power On Mode	(0-2)	0	0: Stop Mode 1: Manual Mode 2: Auto Mode.
58	Module Address	(1-254)	1	Communication address of controller.
59	Password Setting	(0-9999)	0318	For details please see NOTE 6 .
60	Crank Disconnection Conditions	(0-6)	2	Conditions for successful start of starter; they are Generating, Speed and Oil pressure. Their aim is to make the motor disconnect with the engine as soon as possible.
61	Engine Speed at successful start	(0-6000) r/min	360	When engine speed is higher than the set value, the starter will be disconnected.
62	Generator Freq. at successful start	(10.0-30.0)Hz	14.0	When generator frequency is higher than the set value, the starter will be disconnected.
63	Oil Pressure at successful start	(0-400)kPa	200	When generator oil pressure is higher than the set value, the starter will be disconnected.
64	Enable High Temperature Inhibit Stop	(0-1)	0	Factory default: when high temperature occurs, shutdown alarm is initiated. For function details please see NOTE 2 .
65	Enable Low Oil Pressure Inhibit Stop	(0-1)	0	Factory default: when low oil pressure occurs, shutdown alarm is initiated. For function details please see NOTE 3 .
66	Enable Low Fuel Level Inhibit Stop	(0-1)	1	Factory default: when low fuel level occurs, shutdown alarm is initiated. For function details



No	Items	Range	Default	Description
				please see <i>NOTE 4</i> .
67	Aux. Sensor Inhibit Stop Selection	(0-1)	1	Factory default: when Aux. sensor value is higher/lower than the set value (which depends on the sensor type), warning alarm is initiated. For details please see 69, 70, 71 setting items.
68	Voltage Input	(0-3)	0	0: 3P4W; 1: 2P3W; 2: 1P2W; 3: 3P3W
69	Temp. Sensor Curve	(0-12)	8	SGX; For details please see <i>Table 10</i> .
70	Pressure Sensor Curve	(0-12)	8	SGX; For details please see <i>Table 10</i> .
71	Multiplex Input Liquid Level Sensor	(0-1)	0	0: Aux. Input 4 Configuration 1: Liquid Level Sensor For details please see <i>NOTE 5</i> .
72	Level Sensor Curve	(0-7)	3	SGD; For details please see <i>Table 10</i> .
73	Multiplex Input Programmable Sensor	(0-3)	0	0: Aux. Input 5 Configuration 1: Temperature Sensor 2: Pressure Sensor 3: Liquid Level Sensor For details please see <i>NOTE 5</i> .
74	Flexible Sensor Curve	(0-9) (0-9) (0-5)	8 8 3	SGX; SGX; SGD.
75	Generator Poles	(2-64)	4	Number of generator magnetic poles; it can be used to calculate the engine speed when speed sensor is not installed.
76	Temp. Sensor Open Circuit Action	(0-2)	1	0: Indication 1: Warning; 2: Shutdown "Indication" means "+++" shall be displayed on LCD at the position of corresponding sensor.
77	Oil Pressure Sensor Open Circuit Action	(0-2)	1	
78	Level Sensor Open Circuit Action	(0-2)	1	
79	Flexible Sensor Open Circuit Action	(0-2)	1	
80	Air Cooler On Temp.	(0-255)°C	60	When air cooler is configured in an output port, it controls the open and close.
81	Air Cooler Off Temp.	(0-255)°C	40	
82	Low Fuel Level Warning	(0-100)%	20	When the liquid level of the external sensor falls below the set value, "Low Fuel Level" delay is initiated. (this only concerns fuel level sensor and does not concern low fuel level warning signal via configurable input port.)
83	Gen Over Volt Warning	(30-620)V	253	When generator voltage exceeds pre-set value, gen over voltage warning alarm will be sent. (No detection for over volt signal if the value is set



No	Items	Range	Default	Description
				620V.)
84	Gen Under Volt Warning	(30-620)V	193	When the sample voltage is below pre-set value, gen under voltage warning alarm will be sent. (No detection for under volt signal if the value is set 30V.)
85	Gen Over Freq Warning	(0-75.0)Hz	55.0	When generator frequency exceeds the pre-set value, gen over frequency warning signals will be sent.
86	Gen Under Freq Warning	(0-75.0)Hz	42.0	When generator frequency is below the pre-set value, gen under frequency warning signals will be sent.
87	Gen Over Current Warning Percentage	(50-130)%	110	When generator current exceeds the pre-set value, gen over current warning signal will be sent. (No warning alarm is sent if the value is set 0.)
88	High Water Temp. Warning	(80-300)°C	95	When the value of external temperature sensor exceeds the pre-set value, high temperature signal shall be sent. It is only for the temperature sensor externally connected; No warning alarm is sent if the value is set 300 (it is only for temp. sensor, and the signal of digital inputs are not included).
89	Low Oil Pressure Warning	(0-400)kPa	124	When the value of external pressure sensor is below the pre-set value, low oil pressure delay starts; it only judges after end of Safe Running delay; No warning alarm is sent if the value is set 0 (it is only for pressure sensor, and signal of digital inputs are not included).
90	Flexible Sensor Warning	(80-300)°C (0-400)kPa (0-100)%	95	Respectively corresponding to 88(Temperature Sensor set), 89(Pressure Sensor set), 82(Level Sensor set) in this table.
91	Gen Over Volt Delay	(0-20.0)s	10.0	When generator volt is higher than the pre-set shutdown value and the "over volt" delay has expired, then it can be considered as gen over volt shutdown.
92	Gen Over Frequency Delay	(0-20.0)s	2.0	When generator frequency is higher than the pre-set shutdown value and the "over frequency" delay has expired, then it can be considered as gen over frequency shutdown.
93	Crank Disconnect Oil Pressure Delay	(0-20.0)s	0.0s	When crank disconnection condition contains oil pressure, and oil pressure of engine exceeds the preset crank disconnection value, and the delay has expired, then it can be considered as genset successful start and starter will be



No	Items	Range	Default	Description
				disconnected.
94	Scheduled Run Set	(0-1) (0-1)	0 0	0: Enabled inhibit 1: Enabled 0: Off load 1: On load
95	Cycle Scheduled Run Set	(0-2) (1-31) (0-7) (1-23)h (1-59)min (0-30000)min	0 1 0 0 0 30	Cycle options: 0: Monthly 1: Weekly 2: Daily Day (Cycle options: 0: monthly active) Week (Cycle options: 0: weekly active) Start time (hour) Start time (minute) Lasting time
96	Auto Start Inhibit Set	(0-1)	0	0: Enabled disabled 1: Enabled
97	Cycle Auto Start Inhibit Set	(0-2) (1-31) (0-7) (1-23)h (1-59)min (0-30000)min	0 1 0 0 0 30	Cycle options: 0: Monthly 1: Weekly 2: Daily Day (Cycle options: 0: monthly active) Week (Cycle options: 0: weekly active) Start prohibition time (hour) Start prohibition time (minute) Duration time
98	Over Power Setting	(0-2) (0-6000)kW (0-6000)kW (0-3600)s	0 304 290 5	0: Not used 1: Warn 2: Shutdown Over power set value Over power warn return value Over power delay value When power value exceeds preset value and delay has expired, over power alarm is active. Both return value and delay value can be set.
99	Date Setting	Set controller's date.		
100	Custom Sensor Curve Input	(0-3)	0	0: Custom temperature sensor 1: Custom pressure sensor 2: Custom fuel level sensor 3: Custom flexible sensor Choose sensor needed to set and input the resistance value (current/voltage) of every point and the corresponding value of sensor curve. 8 points are needed to be inputted.
101	Engine Type	(0-39)	0	Conventional genset.
102	SPN Alarm Version	(1-3)	1	Alarm Version 1.
103	Manual Close Enable Selection	(0-1)	1	0: Disabled; 1: Enabled; When enabled, switch by pressing button; when disabled, switch automatically.
104	Raise Speed Pulse Time	(0-20.0)s	0.2	Output time for speed raising pulse when genset enters into warming up period.
105	Drop Speed Pulse Time	(0-20.0)s	0.2	Output time for speed dropping pulse when genset enters into stop idling period.
106	Rated Power	(0-6000)kW	276	Genset rated power.

▲NOTES:

- 1) If High Temperature Stop Inhibit is set in the parameter setting item, or High Temperature Stop Inhibit input is set in the digital input port and the port is active, then when the temperature value is higher than the set high temperature stop value, or high temperature alarm input signal is active, the controller shall only send high temperature warning signal and not shutdown the genset;
- 2) If Low Oil Pressure Stop Inhibit is set in the parameter setting item, or Low Oil Pressure Stop Inhibit input is set in the digital input port and the port is active, then when the oil pressure value is higher than the set low oil pressure stop value, or low oil pressure alarm input signal is active, the controller shall only send low oil pressure warning signal and not shutdown the genset;
- 3) If Low Level Stop Inhibit is set in the parameter setting item, or Low Level Stop Inhibit input is set in the digital input port and the port is active, then when the fuel level value is higher than the set low level stop value, or low fuel level alarm input signal is active, the controller shall only send low fuel level warning signal and not shutdown the genset;
- 4) Multiplex input port can choose any one of digital input type and sensor and it is active after configuration. e.g. multiplex input 4: when it is configured to digital input, the related configuration options of digital input 4 are active; if it is configured to level sensor, then the related level sensor options are active;
- 5) When parameter configuration is done via PC software, there is no need to input password if default password (0318) isn't changed; otherwise, if default password has been changed or it is the first time to set parameters via PC, password is needed to write on the password interface;
- 6) After the correct password is entered and before the LCD backlight goes dark, if users try to enter password input interface, they can input the parameter No. directly and enter the setting interface;
- 7) On the flywheel teeth configuration interface, when the generating frequency is over 20Hz, press the Start key, and it can calculate the teeth number automatically. Press Confirm key and the teeth number can be changed.

7.2. DEFINABLE CONTENTS OF AUXILIARY OUTPUT PORTS

Table 8 Definable Contents of Auxiliary Output Ports 1~5

No	Items	Description
0	Not Used	Output port is deactivated when "Not Used" is selected.
1	Common Alarm	It includes all shutdown 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	Energize to Stop	Suitable for genset with electromagnet; it shall pull in after end of "stop idle delay". It is deactivated when the "ETS Solenoid delay" expires.
3	Idle Control	Used for engine with idling speed; it shall pull in when the genset starts; it disconnects when the genset enters warming up time; it shall pull in the process of stop idling speed; it shall open when the genset stops completely.
4	Preheat Control	Close before the genset starts and open before the starter is energized.
5	Close Generator Output	When the close time is 0, it's continuous output.
6	Reserved	
7	Open Breaker	When the close time is 0, it's disabled.
8	Raise Speed Control	Close when the generator enters into Warming Up time; the pull-in time is the warming up time.
9	Drop Speed Control	Close when the generator enters into idling speed stop process or ETS stop process (shutdown alarm time); the pull-in time is the idling speed stop delay time.
10	Generator Run Output	Act when genset is normal running; disconnect when the speed is lower than the crank disconnection speed.
11	Fuel Pump Control	Close when the fuel level is lower than the "Fuel Pump On" value or the low fuel level warning input is active; Open when the fuel level is higher than the "Fuel Pump Off" and the low fuel level warning input is deactivated.
12	High Speed Control	Close when the generator enters into Warming Up time; Open after cooling time.
13	In Auto Mode	The controller is in automatic mode.
14	Fuel Relay Output	Act when generator starts; disconnect when the generator is waiting for a complete stop.
15	Excite Generator	Output when the generator starts; Output for 2s if there is no generator frequency during safe running period.
16	Cooler Output	Control air cooler's start\stop according to cooler temperature.
17	Louver Control	Act in genset starting and disconnect when genset stops completely.
18	Shutdown Alarm Output	Output when shutdown alarms appear.
19	Audible Alarm	When warning and shutdown alarms appear, audible alarm output is fixed as 300s, during the time, press any key on the panel or Alarm Mute input is active, it can remove the alarm.



No	Items	Description
20	Coolant Heating Control	Controlled by the temp. sensor by heating according to the upper and lower limit.
21	Reserved	
22	Crank Relay	Output when genset is in start status; and disconnect in other status.
23	ECU Stop	Used for ECU engine to control its stop.
24	ECU Power	Used for ECU engine to control the power.
25	ECU Warning	Indicate ECU sends a warning signal.
26	ECU Shutdown	Indicate ECU sends a shutdown signal.
27	ECU Communication Failure	Indicate controller cannot communicate with ECU.
28	Speed Raise Pulse	Speed rise time when genset enters into high-speed warming up period.
29	Speed Drop Pulse	Speed drop time when genset enters into stop idle period.
30	Crank Failure Output	Output when genset fails to start and inactive for other statuses.
31	Reserved	

7.3. DEFINED CONTENTS OF AUXILIARY INPUT PORTS

Table 9 Defined Contents of Auxiliary Inputs 1~5 (All GND(B-) active.)

No	Items	Description
0	Not Used	
1	High Temperature Shutdown	If these signals are active after safety on delay, shutdown alarm will be immediately initiated.
2	Low Oil Pressure Shutdown	
3	External Warning Input	If it is active, it is only warning, not shutdown.
4	Emergency Stop Alarm	Shutdown alarm will be immediately initiated if this input is active.
5	Water Temp. High Stop by Cool	When the genset is running normally and this signal is activated, if there is a high temperature situation, the controller will first cool down the gen-set and then stop it; if the signal is deactivated and a high temperature situation occurs, the controller will shut down the genset without cooling down.
6	Generator Closed Status Input	Connected to the auxiliary switch of the generator with loading.
7	Reserved	
8	Inhibit Temp. High Stop	When it is active, prohibit stopping when high temperature occurs. Details to see Parameter Setting <i>NOTE 2</i> .
9	Inhibit Oil Pressure Low Stop	When it is active, prohibit stopping when low oil pressure occurs. Details to see Parameter Setting <i>NOTE 3</i> .
10	Remote Start	When this input is active in auto mode, genset starts automatically and loads after running. Otherwise, genset will stop automatically if it is inactive.
11	Fuel Level Low Warning	Connected to digital input port of sensor, if this input is active,



No	Items	Description
12	Coolant Level Low Warning	controller will send warning alarm signal.
13	Fuel Level Low Shutdown	Connected to digital input port of sensor, if this input is active, controller will send shutdown alarm signal.
14	Coolant Level Low Shutdown	
15	Inhibit Auto Start	In Auto mode, if this input is active, whether remote start input is active or not, the controller will not give a start command to the generator. If generator is normal running, stop command won't be executed. When this input is deactivated, genset will automatically start or stop according to remote start input (active or inactive).
16	Remote Control Mode	When the input is active, keys on the panel are locked except for    and remote mode will be displayed on the LCD. Remote control module pattern can be switched by the key on the panel.
17	Charge Alt Fail Input	Connected to charge alt failure output port.
18	Panel Lock	When input is active, all keys except the    buttons are inactive. The right of 4 th row of the LCD displays the icon  .
19	Manual/Auto Switch	When input is active, it enters auto mode automatically, panel buttons are unavailable; When input is inactive, it enters manual mode automatically, control buttons are recovered.
20	Alarm Mute	When the input is active, it prohibits "Audible Alarm" output.
21	Idle Input	Idling speed control outputs when it is active.
22	Raise Speed Pulse	Used for ECU genset with CANBUS interface.
23	Drop Speed Pulse	Used for ECU genset with CANBUS interface.
24	Return Idle Pulse Input	Used for ECU genset with CANBUS interface.
25	60Hz Select	Used for ECU genset with CANBUS interface. When it is active, the frequency is 60Hz.
26	External Shutdown Alarm	Genset will alarm and shutdown immediately if the signal is active.
27	Reserved	
28	Reserved	
29	Reserved	
30	Reserved	
31	Reserved	

7.4. SELECTION OF SENSORS

Table 10 Sensor Selection

No.	Item	Description	Remark
1	Temperature Sensor	0 Not used 1 User Configured (Resistor type Curve) 2 VDO 3 SGH 4 SGD 5 CURTIS 6 DATCON 7 VOLVO-EC 8 SGX 9 Reserved 10 Reserved 11 Digital Closed 12 Digital Open	Users-defined resistance type range is 0Ω-999.9Ω; default is SGX sensor.
2	Pressure Sensor	0 Not used 1 User Configured (Resistor type Curve) 2 VDO 10Bar 3 SGH 4 SGD 5 CURTIS 6 DATCON 10Bar 7 VOLVO-EC 8 SGX 9 Reserved 10 Reserved 11 Digital Closed 12 Digital Open	Users-defined resistance type range is 0Ω-999.9Ω; default is SGX sensor.
3	Fuel Level Sensor	0 Not used 1 User Configured (Resistor type Curve) 2 SGH 3 SGD 4 Reserved 5 Reserved 6 Digital Closed 7 Digital Open	Users-defined resistance type range is 0Ω-999.9Ω; default is SGD sensor.

7.5. SELECTION OF CRANK DISCONNECTION CONDITION

Table 11 Crank Disconnection Condition Selection

No.	Set Contents
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

▲NOTES:

- 1) There are 3 conditions to make starter separate with engine; speed, generator frequency and oil pressure. All can be used separately. It is suggested that oil pressure shall be used together with speed and generator frequency. The aim is to disconnect the starter motor as soon as possible.
- 2) Speed stands for the real rotation speed detected by the speed sensor. Speed sensor is the magnetic equipment which is installed in the starter for detecting flywheel teeth.
- 3) When speed is chosen, make sure that the number of flywheel teeth is the same as the set value, otherwise, "over speed shutdown" or "under speed shutdown" may be caused.
- 4) If genset is without speed sensor, please don't select corresponding items, otherwise, "start fail" or "loss speed signal" maybe caused.
- 5) If genset is without oil pressure sensor, please don't select corresponding items.
- 6) If generator frequency is not chosen in crank disconnection setting, the controller will not collect and display the relative power quantity (can be used in water pump set); if speed is not chosen in crank disconnection setting, the engine speed displayed is converted by generator frequency and generator poles.

8 PARAMETER SETTING

8.1. CONTROLLER PARAMETER SETTING

Start the controller, and then press  to enter the parameter setting menu. Menu items are as follows:

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

When password “0318” is inputted, all parameter items can be set. If the password “0318” has been changed, when users conduct parameter setting via PC, they have to input the same password as the controller. If it is needed to set more items or the password is forgotten, for example, voltage/current calibration, please contact the factory.

NOTES:

- a) Please change the controller parameters when generator is in standby mode only (e. g. Crank disconnection condition selection, auxiliary input, auxiliary output, various delays), otherwise, shutdown and other abnormal conditions may occur.
- b) Over voltage set value must be higher than under voltage set value, otherwise over voltage and under voltage conditions may occur simultaneously.
- c) Over speed set value must be higher than under speed set value, otherwise over speed and under speed conditions may occur simultaneously.
- d) Please set the generator frequency value as low as possible at the moment of cranking. It is supposed to make the starter be separated quickly as soon as possible.
- e) Auxiliary inputs 1~5 could not be set as the same item; otherwise, there are abnormal functions. However, the auxiliary outputs 1~5 can be set as the same item.
- f) Auxiliary sensor 1 input port can be set as fuel level sensor or digital input port 4; programmable sensor 2 input port can be set as temperature sensor, pressure sensor, coolant level sensor or digital input port 5. Either the sensor or the digital input port is Ok, and if digital input port is selected, the corresponding set parameters shall be functional and sensor parameters are inactive and reserved; otherwise, if the sensor is selected, the corresponding sensor parameters shall be functional and digital input port parameters are deactive and reserved.
- g) If it is needed to shut down after cooling, please set any auxiliary input as “High Temperature Stop Input”, then connect this input port to GND or set “High Temperature Stop Input” action as “Cooling Stop”.

8.2. CONTROLLER INFORMATION

- a) This item shall display information about software version, hardware version, release date.

▲NOTE: In this interface, press  and it shall display the digital inputs and outputs status.

- b) LCD contrast ratio control

Press  and  ( and ) simultaneously and adjust LCD contrast ratio to make LCD character display much more clear. Contrast ratio adjustment range: 0-7.

8.3. LANGUAGE SELECTION

This item can set display languages: Chinese, English, Spanish, Russian, Turkish, French, Portuguese and Polish.

8.4. EVENT LOG

Through this item event log information can be checked, including start/stop information and shutdown alarm information log. The maximum is up to 99 pieces for records and logs.

8.5. MAINTENANCE

Password is needed to be inputted at the moment of entering maintenance interface. Default value is 0 (this password is changeable, but it is needed to contact with SmartGen service personnel or sales personnel.). Setting maintenance parameters will refresh maintenance time.

▲NOTE: After Maintenance Due alarm occurs, refresh maintenance time and the next maintenance period after entering maintenance interface.

9 SENSOR SETTING

- If a sensor is needed to be changed again, the sensor curve will be transferred into the standard value. For example, if the default temperature sensor is SGH (120°C resistor type), the sensor curve is SGH curve (120°C resistor type); if it is set SGD (120°C resistor type), the temperature sensor curve is SGD curve.
- If there is difference between standard sensor curve and the used sensor, users can choose “defined sensor”, and input “defined sensor curve”.
- At the time of inputting the sensor curve, X value (resistor) must be inputted from small to large, otherwise, any mistake may occur.
- If there is not an oil pressure sensor, and there is only a low oil pressure alarm switch, then the pressure sensor must be set “None”, otherwise, low oil pressure shutdown alarm may occur.
- It is applicable to set the headmost and backmost values in the vertical coordinate as the same as the Figure 3.

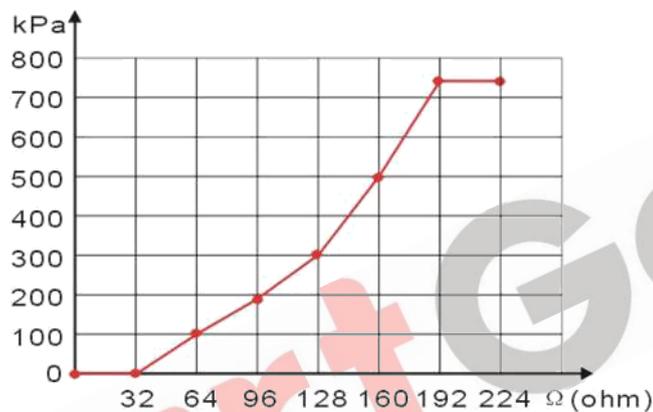


Fig. 3 Sensor Curve

Table 12 Common Pressure 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:

- Check and make sure that all connections are correct and wire diameter is suitable.
- Check and make sure that the controller DC power has fuse, and controller's positive and negative connections with the start battery are correct.
- Check and make sure that emergency stop input is connected to the positive pole of starter battery via emergency stop button's normally closed point and fuse.
- Take proper action to prevent engine to crank successfully (e. g. remove the connecting wire of the fuel valve). If everything is correct, connect power with the start battery; choose manual mode and the controller will execute the routine.
- Set the controller under manual mode; press "start" button, and the genset will start. After the set cranking times, the controller will send Start Failure signal, and then press "stop" to reset the controller.
- Recover the action to prevent engine to crank successfully (e. g. connect the wire of the fuel valve). Press start button again, the genset will start. If everything goes well, the genset will go to normally running after idling speed running (if configured). During this time, please observe engine's running situation and AC generator's voltage and frequency. If there is something abnormal, stop the genset and check all wire connections according to this manual.
- Select the **AUTO** mode on controller's panel, and make the remote start input active. The engine shall enter normal running status automatically and then sends Gen close signal to control ATS to transfer to genset loading. If this is not the case, please refer to this manual and check ATS control wire connections.
- If there is any other question, please contact SmartGen's service as soon as possible.

11 TYPICAL APPLICATION

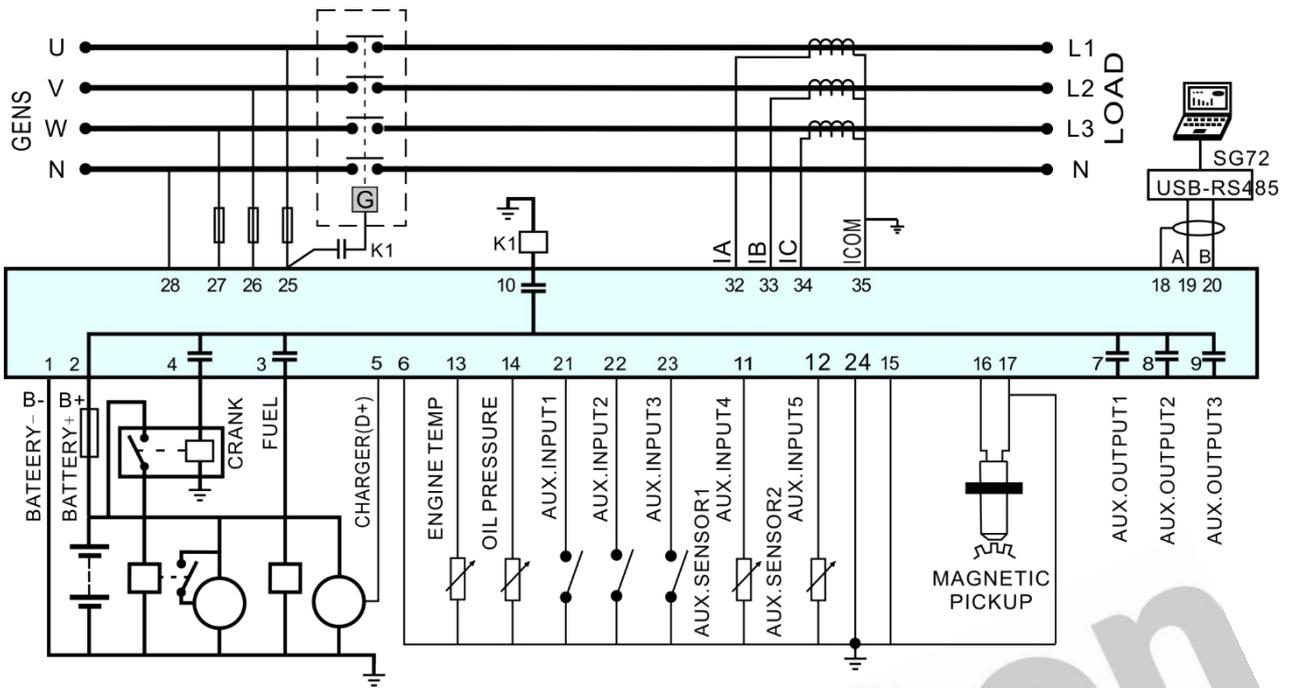


Fig. 4 HGM4100LT General Genset Application

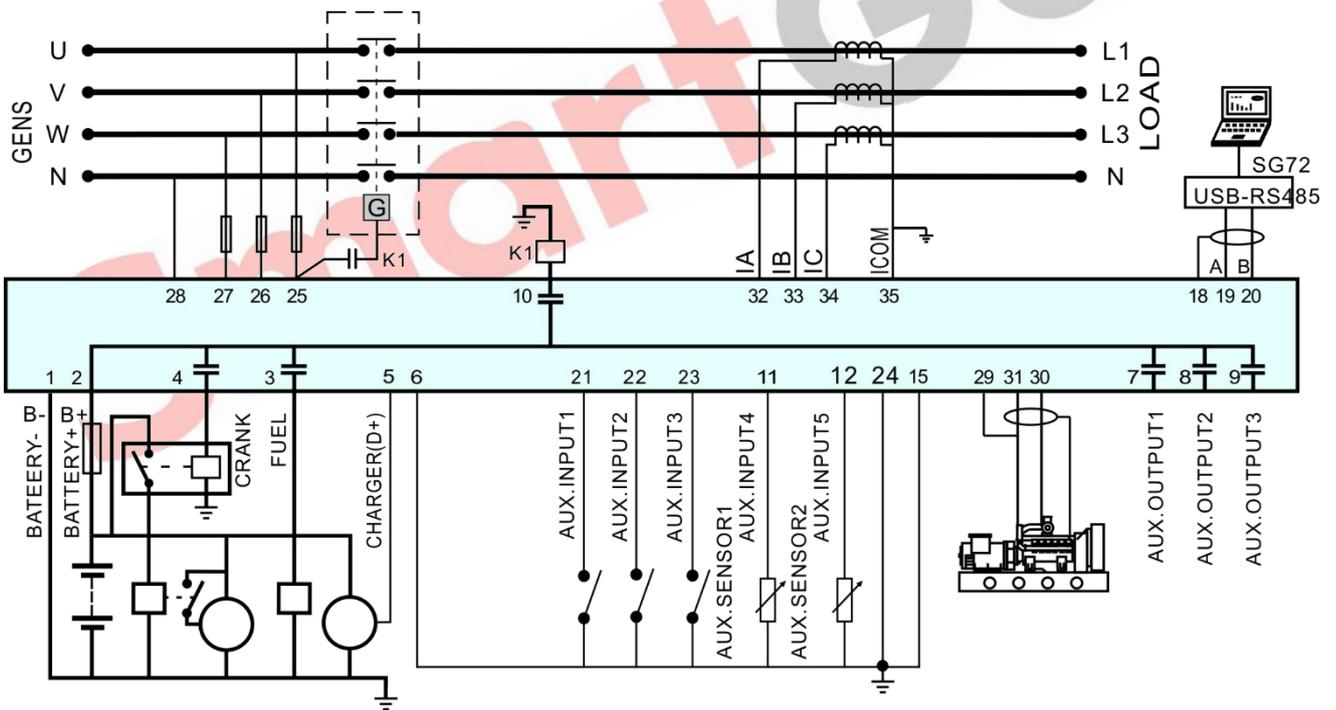


Fig. 5 HGM4100LT ECU Genset Application

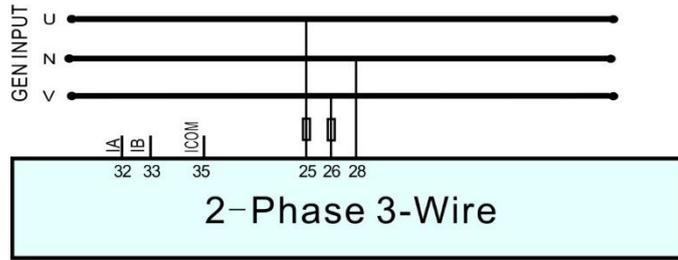


Fig. 6 2-Phase 3-Wire Connection Diagram

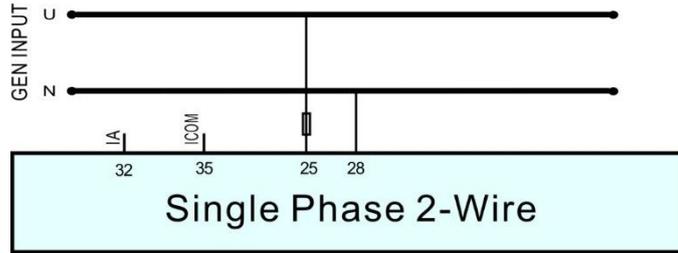


Fig. 7 Single Phase 2-Wire Connection Diagram

NOTE: Expansion relays with high capacity in start and fuel outputs are recommended.

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12 INSTALLATION

12.1. FIXING CLIPS

- 1) The controller is panel built-in design; and it is fixed by clips for installation.
- 2) Withdraw the fixing clip screws (anticlockwise) until they reach proper position.
- 3) Pull the fixing clips backwards (towards the back of the module) and ensure two clips are inside their allotted slots.
- 4) Turn the fixing clip screws clockwise steady until they are fixed on the panel.

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

12.2. OVERALL DIMENSION AND PANEL CUTOUT

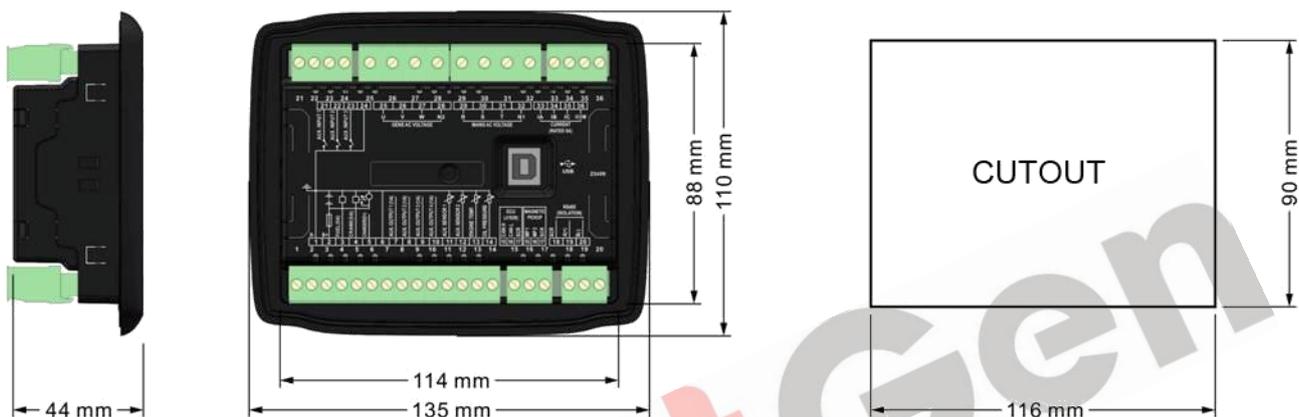


Fig. 8 Overall Dimensions and Panel Cutout

HGM4100LT controller can suit wide range of battery voltage DC(8~35)V. Negative of battery must be connected with the engine shell. Diameter of wire which connects power supply with battery must be over 2.5mm². If floating charger is configured, please firstly connect output wires of the charger to battery's positive and negative directly, then connect wires from battery's positive and negative to controller's positive and negative input ports in order to prevent charger disturbing the controller's normal working.

— SPEED SENSOR INPUT

Speed sensor is the magnetic equipment which is installed on the engine for detecting flywheel teeth. The connection wires with controller should apply 2-core shielding line. The shielding layer should be connected to No. 15 terminal in the controller and another side is hanging in the air. The else two signal wires are connected to No.16 and No.17 terminals. The output voltage of speed sensor should be within AC (1~24)V (RMS) during the full speed range. AC12V is recommended (at rated speed). When speed sensor is installed, let the sensor spun to contacting flywheel first, then, port out 1/3 lap, and lock the nuts of sensor at last.

— OUTPUT AND EXPAND RELAYS

All controller outputs are relay contact output type. If expansion relay is needed, please add freewheel diode to both ends of expansion relay's coils (when relay coils have DC current) or, increase resistance-capacitance circuit (when relay coils have AC current), in order to prevent disturbance to the controller or other equipment.

— AC INPUT

Current input of HGM4100LT controller must be connected to external current transformer. And the current transformer's secondary side current must be 5A. At the same time, the phases of current transformer and input voltage must be correct. Otherwise, the collected current and active power may be not correct.



▲NOTES:

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

— WITHSTAND VOLTAGE TEST

When the controller has been installed in the control screen, if it is needed to do the high voltage test, please disconnect controller's all terminals, in order to prevent high voltage entering the controller and damaging it.

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13 CONNECTIONS OF CONTROLLER WITH ENGINE J1939

13.1. CUMMINS ISB/ISBE

Table 13 Connector B

Terminals of controller	Connector B	Remark
Auxiliary output 1	39	Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	-	Connected with starter coil directly;
Auxiliary output 2	Expand 30A relay, providing battery voltage for terminal 01, 07, 12, 13.	ECU power; Set auxiliary output 2 as "ECU power".

Table 14 9 Pins Connector

Terminals of controller	9 pins connector	Remark
CAN_SCR	SAE J1939 shield	CAN communication shielding line (connected to ECU terminal only);
CAN(H)	SAE J1939 signal	Using impedance 120Ω connecting line;
CAN(L)	SAE J1939 return	Using impedance 120Ω connecting line.

Engine type: Cummins ISB.

13.2. CUMMINS QSL9

It is suitable for CM850 engine control module.

Table 15 50 Pins Connector

Terminals of controller	50 pins connector	Remark
Auxiliary output 1	39	Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	-	Connected to starter coil directly.

Table 16 9 Pins Connector

Terminals of controller	9 pins connector	Remark
CAN_SCR	SAE J1939 shield-E	CAN communication shielding line (connected to ECU terminal only);
CAN(H)	SAE J1939 signal-C	Using impedance 120Ω connecting line;
CAN(L)	SAE J1939 return-D	Using impedance 120Ω connecting line.

Engine type: Cummins-CM850.

13.3. CUMMINS QSM11 (IMPORT)

It is suitable for CM570 engine control module. Engine type is QSM11 G1, QSM11 G2.

Table 17 C1 Connector

Terminals of controller	C1 connector	Remark
Auxiliary output 1	5&8	Set auxiliary output 1 as "Fuel Relay Output"; Outside expand relay; when fuel relay outputs, make port 5 and port 8 of C1 be connected;
Starter relay output	-	Connected to starter coil directly.

Table 18 3 Pins Data Link Connector

Terminals of controller	3 pins data link connector	Remark
CAN_SCR	C	CAN communication shielding line (connected to ECU terminal only);
CAN(H)	A	Using impedance 120Ω connecting line;
CAN(L)	B	Using impedance 120Ω connecting line.

Engine type: Cummins ISB.

13.4. CUMMINS QSX15-CM570

It is suitable for CM570 engine control module. Engine type is QSX15.

Table 19 50 Pins Connector

Terminals of controller	50 pins connector	Remark
Auxiliary output 1	38	Oil spout switch; Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	-	Connected to starter coil directly.

Table 20 9 Pins Connector

Terminals of controller	9 pins connector	Remark
CAN_SCR	SAE J1939 shield-E	CAN communication shielding line (connected to ECU terminal only);
CAN(H)	SAE J1939 signal-C	Using impedance 120Ω connecting line;
CAN(L)	SAE J1939 return-D	Using impedance 120Ω connecting line.

Engine type: Cummins QSX15-CM570.

13.5. CUMMINS GCS-MODBUS

It is suitable for GCS engine control module. Read engine information by using RS485-MODBUS. Engine types are QSX15, QST30, QSK23 / 45/60/78 and so on.

Table 21 D-SUB Connector 06

Terminals of controller	D-SUB connector 06	Remark
Auxiliary output 1	5&8	Set auxiliary output 1 as "Fuel Relay Output". Outside expand relay; when fuel outputs, make port 05 and 08 of the connector 06 be connected;
Starter relay output	-	Connected to starter coil directly.

Table 22 D-SUB Connector 06

Terminals of controller	D-SUB connector 06	Remark
RS485 GND	20	CAN communication shielding line (connected to ECU terminal only);
RS485+	21	Using impedance 120Ω connecting line;
RS485-	18	Using impedance 120Ω connecting line.

Engine type: Cummins QSK-MODBUS, Cummins QST-MODBUS, Cummins QSX-MODBUS.

13.6. CUMMINS QSM11

Table 23 Engine OEM Connector

Terminals of controller	Engine OEM connector	Remark
Auxiliary output 1	38	Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	-	Connected with starter coil directly;
CAN_SCR	-	CAN communication shielding line;
CAN(H)	46	Using impedance 120Ω connecting line;
CAN(L)	37	Using impedance 120Ω connecting line.

Engine type: common J1939.

13.7. CUMMINS QSZ13

Table 24 Engine OEM Connector

Terminals of controller	Engine OEM connector	Remark
Auxiliary output 1	45	
Starter relay output	-	Connected to starter coil directly;
Auxiliary output 2	16&41	Set it as idling speed, normal close output; making 16 connected to 41 during high-speed running via external expansion relay;
Auxiliary output 3	19&41	Set it as pulse speed raise control, normal open output; making 19 connected with 41 for 0.1s during high-speed warming via external expansion relay;
CAN_SCR	-	CAN communication shielding line;
CAN(H)	1	Using impedance 120Ω connecting line;
CAN(L)	21	Using impedance 120Ω connecting line.

Engine type: Common J1939.

13.8. DETROIT DIESEL DDEC III / IV

Table 25 Engine CAN Port

Terminals of controller	CAN port of engine	Remark
Auxiliary output 1	Expand 30A relay; supplying battery voltage for ECU.	Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	-	Connected to starter coil directly;
CAN_SCR	-	CAN communication shielding line;
CAN(H)	CAN(H)	Using impedance 120Ω connecting line;
CAN(L)	CAN(L)	Using impedance 120Ω connecting line.

Engine type: Common J1939.

13.9. DEUTZ EMR2

Table 26 F Connector

Terminals of controller	F connector	Remark
Auxiliary output 1	Expand 30A relay, providing battery voltage for terminal 14; Fuse is 16A.	Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	-	Connected to starter coil directly;
-	1	Connected to battery negative pole;
CAN_SCR	-	CAN communication shielding line;
CAN(H)	12	Using impedance 120Ω connecting line;
CAN(L)	13	Using impedance 120Ω connecting line.

Engine type: Volvo EDC4.

13.10. JOHN DEERE

Table 27 21 Pins Connector

Terminals of controller	21 pins connector	Remark
Auxiliary output 1	G, J	Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	D	
CAN_SCR	-	CAN communication shielding line;
CAN(H)	V	Using impedance 120Ω connecting line;
CAN(L)	U	Using impedance 120Ω connecting line.

Engine type: John Deere.

13.11. MTU MDEC

It is suitable for MTU engines, 2000 series, 4000 series.

Table 28 X1 Connector

Terminals of controller	X1 connector	Remark
Auxiliary output 1	BE1	Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	BE9	
CAN GND	E	CAN communication shielding line (connected to one terminal only);
CAN(H)	G	Using impedance 120Ω connecting line;
CAN(L)	F	Using impedance 120Ω connecting line.

Engine type: MTU-MDEC-303.

13.12. MTU ADEC (SMART MODULE)

It is suitable for MTU engine with ADEC (ECU8) and SMART module.

Table 29 ADEC (X1 Port)

Terminals of controller	ADEC (X1 port)	Remark
Auxiliary output 1	X1 10	Set auxiliary output 1 as "Fuel Relay Output"; X1 Terminal 9 is connected to battery negative;
Starter relay output	X1 34	X1 Terminal 33 is connected to battery negative.

Table 30 SMART (X4 Port)

Terminals of controller	SMART (X4 port)	Remark
CAN_SCR	X4 3	CAN communication shielding line;
CAN(H)	X4 1	Using impedance 120Ω connecting line;
CAN(L)	X4 2	Using impedance 120Ω connecting line.

Engine type: MTU-ADEC.

13.13. MTU ADEC (SAM MODULE)

It is suitable for MTU engine with ADEC (ECU7) and SAM module.

Table 31 ADEC (X1 Port)

Terminals of controller	ADEC (X1 port)	Remark
Auxiliary output 1	X1 43	Set auxiliary output 1 as "Fuel Relay Output"; X1 Terminal 28 is connected to battery negative;
Starter relay output	X1 37	X1 Terminal 22 is connected to battery negative.

Table 32 SAM (X23 Port)

Terminals of controller	SAM (X23 port)	Remark
CAN_SCR	X23 3	CAN communication shielding line;
CAN(H)	X23 2	Using impedance 120Ω connecting line;
CAN(L)	X23 1	Using impedance 120Ω connecting line.

Engine type: Common J1939.

13.14. PERKINS

It is suitable for ADEM3/ ADEM4 engine control module. Engine type is 2306, 2506, 1106, and 2806.

Table 33 Connector

Terminals of controller	Connector	Remark
Auxiliary output 1	1, 10, 15, 33, 34	Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	-	Connected to starter coil directly;
CAN_SCR	-	CAN communication shielding line;
CAN(H)	31	Using impedance 120Ω connecting line;
CAN(L)	32	Using impedance 120Ω connecting line.

Engine type: Perkins.

13.15. SCANIA

It is suitable for S6 engine control module. Engine type is DC9, DC12, and DC16.

Table 34 B1 Connector

Terminals of controller	B1 connector	Remark
Auxiliary output 1	3	Set auxiliary output 1 as "Fuel Relay Output";
Starter relay output	-	Connected to starter coil directly;
CAN_SCR	-	CAN communication shielding line;
CAN(H)	9	Using impedance 120Ω connecting line;
CAN(L)	10	Using impedance 120Ω connecting line.

Engine type: Scania.

13.16. VOLVO EDC3

It is suitable for engine type TAD1240, TAD1241, and TAD1242.

Table 35 “Stand alone” Connector

Terminals of controller	“Stand alone” connector	Remark
Auxiliary output 1	H	Set auxiliary output 1 as “Fuel Relay Output”;
Starter relay output	E	
Auxiliary output 2	P	ECU power; Set auxiliary output 2 as “ECU power”.

Table 36 “Data bus” Connector

Terminals of controller	“Data bus” connector	Remark
CAN_SCR	-	CAN communication shielding line;
CAN(H)	1	Using impedance 120Ω connecting line;
CAN(L)	2	Using impedance 120Ω connecting line.

Engine type: Volvo.

▲NOTE: When this engine type is selected, preheating time should be set at least 3 seconds.

13.17. VOLVO EDC4

It is suitable for engine types TD520, TAD520 (optional), TD720, TAD720 (optional), TAD721, TAD722, and TAD732.

Table 37 Connector

Terminals of controller	Connector	Remark
Auxiliary output 1	Expand 30A relay, and relay offers battery voltage to terminal 14. Fuse is 16A.	Set auxiliary output 1 as “Fuel Relay Output”;
Starter relay output	-	Connected to starter coil directly;
	1	Connected to negative of battery;
CAN GND	-	CAN communication shielding line;
CAN(H)	12	Using impedance 120Ω connecting line;
CAN(L)	13	Using impedance 120Ω connecting line.

Engine type: Volvo EDC4.

13.18. VOLVO-EMS2

It is suitable for Volvo Engine types: TAD734, TAD940, TAD941, TAD1640, TAD1641, and TAD1642.

Table 38 Engine CAN Port

Terminals of controller	Engine's CAN port	Remark
Auxiliary output 1	6	ECU stop; Set auxiliary output 1 as "ECU stop";
Auxiliary output 2	5	ECU power; Set auxiliary output 2 as "ECU power";
	3	Negative power;
	4	Positive power;
CAN_SCR	-	CAN communication shielding line;
CAN(H)	1(Hi)	Using impedance 120Ω connecting line;
CAN(L)	2(Lo)	Using impedance 120Ω connecting line.

Engine type: Volvo-EMS2.

NOTE: When this engine type is selected, preheating time should be set for at least 3 seconds.

13.19. YUCHAI

It is suitable for Yuchai BOSCH common rail electronic-controlled engine.

Table 39 Engine 42 Pins Port

Terminals of controller	Engine 42 pins port	Remark
Auxiliary output 1	1.40	Set auxiliary output 1 as "Fuel Relay Output"; Connected to engine ignition lock;
Starter relay output	-	Connected to starter coil directly;
CAN_SCR	-	CAN communication shielding line.
CAN(H)	1.35	Using impedance 120Ω connecting line;
CAN(L)	1.34	Using impedance 120Ω connecting line.

Table 40 Engine 2 Pins Port

Battery	Engine 2 pins port	Remark
Battery negative	1	Wire diameter 2.5mm ² .
Battery positive	2	Wire diameter 2.5mm ² .

Engine type: BOSCH.



13.20. WEICHAI

It is suitable for Weichai BOSCH common rail electronic-controlled engine.

Table 41 Engine Port

Terminals of controller	Engine port	Remark
Auxiliary output 1	1.40	Set auxiliary output 1 as "Fuel Output"; Connected to engine ignition lock;
Starter relay output	1.61	
CAN_SCR	-	CAN communication shielding line;
CAN(H)	1.35	Using impedance 120Ω connecting line;
CAN(L)	1.34	Using impedance 120Ω connecting line.

Engine type: GTSC1.

▲NOTE: If there is any question of connection between controller and ECU communication, please feel free to contact SmartGen service.

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14 FAULT FINDING

Table 42 Fault and Solutions

Symptoms	Possible Solutions
Controller no response with power	Check starter batteries; Check controller connection wirings; Check DC fuse;
Genset shutdown	Check whether water/cylinder temperature is too high or not; Check AC genset voltage; Check DC fuse;
Low oil pressure alarm after crank disconnection	Check the oil pressure sensor and its connections;
High water temp. alarm after crank disconnect	Check the water temperature sensor and its connections;
Shutdown alarm in running	Check related switch and its connections according to the information on LCD; Check digital inputs;
Crank failure	Check fuel oil circuit and its connections; Check starter batteries; Check speed sensor and its connections; Refer to engine manual;
None response for starter	Check starter connections; Check starter batteries;
Genset running but none ATS transfer	Check ATS; Check the connection wirings between ATS and controller;
Abnormal RS485 communication	Check connections wirings; Check whether COM port setting is correct or not; Check RS485's connections between A and B is reversely connected or not; Check communication port on PC is damaged or not; It is suggested to add 120Ω resistor between A and B of RS485.