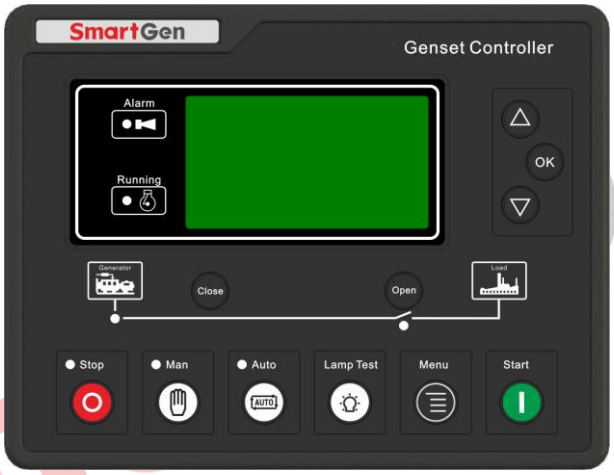
HSC960

GENSET CONTROLLER

USER MANUAL



ZHENGZHOU SMARTGEN TECHNOLOGY CO.,LTD

CONTENT

FOREWORD

Chinese trademark

SmartGen **English trademark**

SmartGen — make your generator ***smart***

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Table 1- Software Version

Date	Version	Note
2014-06-10	1.0	Original release

Table 2- Clarification of notation used within this publication

SIGN	INSTRUCTION
NOTE	Highlights an essential element of a procedure to ensure correctness.
CAUTION!	Indicates a procedure or practice, which, if not strictly observed, could result in damage or destruction of equipment.
WARNING!	Indicates error operation may cause death, serious injury and significant property damage.

1 OVERVIEW

HSC960 genset controllers integrate digitization, intellectualization and network technology which are used for gas genset automation and monitor control system of single unit to achieve automatic start/stop, data measure, alarm protection, three remote: remote control, remote measuring and remote communication and speed regulation. The controller adopts large liquid crystal display (LCD) and selectable Chinese and English interface with easy and reliable operation.

HSC960 genset controllers adopt micro-processor technology with precision parameters measuring, fixed value adjustment, time setting and set value adjusting and etc..All parameters can be configured from front panel, or by configurable port, and also can be configured by RS485 communication interface to adjust and monitor 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

HSC960, used for single automation systems; it regulates the speed simply by adjust the throttle opening via the driving stepper motor; auto start/stop of the unit are performed with the help of remote signal.

Key characteristics,

——132×64 LCD with backlight, multilingual interface (including Chinese and English), pushbutton operation;

——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 3-phase voltage, current, power parameter and frequency of generator.

Generator

Line voltage (Uab, Ubc, and Uca)
Phase voltage (Ua, Ub, and Uc)
Frequency Hz
Current (IA, IB, IC)
Active Power kW
Reactive Power kvar
Apparent Power kVA
Power Factor PF
Electric Energy kWh

——For generator, controller has over and under voltage, over and under frequency, over current functions;

——Speed regulation function (via Driving Stepper Motor);

——Precision measure and display parameters about Engine,

Temperature (WT) ℃/℉ (display simultaneously)
Oil Pressure (OP) **kPa/Psi/bar** (display simultaneously)
Fuel Level (FL) **% (unit)**
Speed (SPD) **r/min (unit)**
Battery Voltage (VB) **V (unit)**
Charger Voltage (VD) **V (unit)**
Hour count (HC) can accumulate to max. 65535 hours.
Start times can accumulate to max. 65535 times.

——Protection: automatic start/stop of the genset, ATS(Auto Transfer Switch) control with perfect failure indication and protection function;

——ETS (Energize to Stop), idle control, preheat control and raise speed/drop speed control; in addition, they are all relay output.

——Parameter setting: parameters can be modified while write in EEPROM storage and cannot be lost even in case of power outage; all parameters can be configured from front panel, or by configurable port (SG72 must be fitted) and RS485 port to adjust via PC.

——Multiple crank disconnect conditions (speed sensor, oil pressure, generating) are optional;

——Widely power supply range DC(8~35)V, suitable to different start battery voltage environment;

——All parameters used digital adjustment, instead of conventional analog modulation with normal potentiometer, more reliability and stability;

——Fixed with metal clips;

——Modular design, self-extinguishing ABS plastic enclosure, pluggable connection terminals and embedded installation way; compact structure with easy mounting.

3 SPECIFICATION

Table 3- Parameters

Items	Contents
Operating Voltage	DC8.0V to DC35.0V, Continuous Power Supply.
Power Consumption	Standby: ≤2W Working: <8W (When driving stepper motor is regulating)
Alternator Input Range 3-Phase 4-Wire 2-Phase 3-Wire Single-Phase 2-Wire 3-Phase 3-Wire	 AC15V - AC360V (ph-N) AC15V - AC360V (ph-N) AC15V - AC360V (ph-N) AC30V - AC620V (ph-ph)
Alternator Frequency	50Hz/60Hz
Speed Sensor Voltage	1.0V to 24.0V (RMS)
Speed Sensor Frequency	10,000 Hz (max.)
Start Relay Output	16A DC28V supply output
Fuel Relay Output	16A DC28V supply output
Auxiliary Relay Output (1)	7A DC28V supply output
Auxiliary Relay Output (2)	7A DC250V supply output
Auxiliary Relay Output (3)	7A DC250V supply output
Auxiliary Relay Output (4)	7A DC250V supply output
Steady-state Speed Governing Rate	<1.5%
Steady-state Speed Fluctuation Rate	<0.5%
Transient Speed Governing Rate	Sudden Load-on <+10% Sudden Load-off >-15%
Recovery Time	<5s
Driving Motor	DC Motor; Drive current ≤6A
Case Dimension	197mm x 152mm x 47mm
Panel Cutout	186mm x 141mm
Common Reactance Secondary Current	Rated: 5A
Working Conditions	Temperature: (-25~+70)°C; Humidity: (20~93)%RH
Storage Condition	Temperature:(-25~+70)°C
Protection Level	IP55 Gasket
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	0.56kg

4 OPERATION

4.1 KEY FUNCTIONS

Table 4- Button Description

Icon	Definition	Description
	Stop/ Reset	Stop running generator in Auto/Manual mode; Reset alarm if alarm occurs; During stopping process, press this button again to stop generator immediately.
	Start	Start genset in Manual/Test mode.
	Manual Mode	Pressing this key will set the module into Manual mode.
	Auto Mode	Pressing this key will set the module into AUTO mode.
	Lamp Test	Pressing this key will test the lamp if it is working.
	Close	In manual mode, it can be controlled to close.
	Open	In manual mode, it can be controlled to open.
	Set/Confirm	In parameter setting interface, 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.
	Menu	Pressing this key will enter into menu interface; pressing this button again will return to main interface.

4.2 INDICATOR LIGHT

Figure 1- Indicator Light

4.3 AUTO START/STOP OPERATION

4.3.1 Illustration

Auto mode is selected by pressing the 

button; a LED besides the button will illuminate to confirm the operation.

4.3.2 Automatic Start Sequence

a) When “Remote Start” is active, “Start Delay” timer is initiated;
b) “Start Delay” countdown will be displayed on LCD;
c) When start delay is over, preheat relay energizes (if configured), “preheat delay XX s” information will be displayed on LCD;
d) After the above delay, the Fuel Relay is energized, and then one second later, the throttle of the driving stepper motor will rotate as the pre-set angle and then the Start Relay is engaged. The engine is cranked for a pre-set time. If the engine fails to fire during this cranking attempt then the fuel relay and start relay are disengaged for the pre-set rest period; “crank rest time” begins and wait for the next crank attempt.
e) Should this start sequence continue beyond the set number of attempts, the start sequence will be terminated, the fourth line of LCD display will be highlighted with black and Fail to Start fault will be displayed.
f) In case of successful crank attempt, the “Safety On” timer is activated and the throttle of the driving stepper motor will govern the speed, allowing Low Oil Pressure, High Temperature, Under speed, Charge Alternator Failure and auxiliary inputs (be configured) to stabilise without triggering the fault. As soon as this delay is over, “start idle” delay is initiated (if configured).
g) During “start idle” delay, under speed, under frequency, under voltage alarms are inhibited. When this delay is over, “warming up” delay is initiated (if configured).
h) After the “warming up” delay, if generator status is normal, its indicator will be illuminated. If generator voltage and frequency have reached on-load requirements, then the generator close relay will be energized; genset will take load; generator power indicator will illuminate and generator will enter into Normal Running status. If voltage or frequency is abnormal, the controller will initiate shutdown alarm (alarm information will be displayed on LCD).

4.3.3 Automatic Stop Sequence

a) When the “Remote Start” signal is removed, the Stop Delay is initiated.
b) Once this “stop delay” has expired, the “Cooling Delay” is then initiated. Moreover, the generator indicator is extinguished.
c) During “Stop Idle” Delay (if configured), idle relay is energized.
d) “ETS Solenoid Hold” delay begins, ETS relay is energized while fuel relay is de-energized.
e) "Fail to Stop Delay" begins, complete stop is detected automatically.
f) When generator is stop completely, generator is placed into its standby mode. Otherwise, fail to stop alarm is initiated and the corresponding alarm information is displayed on LCD.

4.3.4 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; then press  button to start the genset; can detect crank disconnect condition and generator accelerates to high-speed running automatically. With high temperature, low oil pressure, over speed and abnormal voltage during generator running, controller can protect genset to stop quickly. (please refer to No.3~8 of Automatic Start Sequence for detail procedures.) Pressing 

button the genset will be on load after the genset is normal running.

b) MANUAL STOP: Press  can stop the running generators. (please refer to No.2~6 of Automatic Stop Sequence for detail procedures).

5 PROTECTION

5.1 WARNINGS

Warnings are not shutdown alarms and do not affect the operation of the genset. Warning alarms does not lead to shutdown and the alarm information will be displayed on the LCD.

Table 5- Warning alarms types are as follows

No.	Type	Description
1	Loss of Speed Signal	When the controller detects the speed is 0 and the Loss of Speed Signal delay is set as 0, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
2	Generating Overcurrent Warn	When the controller detects the speed is 0 and the Generating Overcurrent delay is set as 0, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
3	Fail to Stop	After the ETS delay/Fail to Stop delay has expired, if the genset stop failure, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
4	Low Fuel Level	When the controller detects that there is Low Fuel Level input, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
5	Charge Alt Fail	When the controller detects that the charger voltage has fallen below the pre-set value, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
6	Battery Under Voltage	When the controller detects that the battery voltage has fallen below the pre-set value, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
7	Battery Over Voltage	When the controller detects that the battery voltage has exceeded the pre-set value, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
8	Low Water Level	When the low water level is set as warning and active, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
9	Temperature Sensor Open	When the sensor didn't connect to correct port, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
10	Oil Pressure Sensor Open	When the sensor didn't connect to correct port, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
11	Maintain Time Over	When the genset working time has exceeded the maintain time, moreover the maintain action has been set to alarm, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
12	Aux. Sensor Over	When the controller detects that the aux. sensor has exceeded the pre-set value, it will initiate a warning alarm and the alarm information will be displayed on the LCD.
13	Aux. Sensor Under	When the controller detects that the aux. sensor has fallen below the pre-set value, it will initiate a warning alarm and the alarm information will be displayed on the LCD.

5.2 SHUTDOWN ALARM

When controller detects shutdown alarm, it will send signal to open breaker and shuts down generator. Besides, the alarm information will be displayed on the LCD.

Table 6- Shutdown alarms as following

No.	Type	Description
1	Emergency Stop	When the controller detects that there is Emergency Stop input, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
2	High Temperature	When the controller detects that there is High Temperature input and the shutdown is allowed, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
3	Low Oil Pressure	When the controller detects that there is Low Oil Pressure input and the shutdown is allowed, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
4	Over Speed	When the controller detects that the generator speed has exceeded the pre-set value, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
5	Under Speed	When the controller detects that the generator speed has fallen below the pre-set value, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
6	Loss of Speed Signal	When the controller detects the speed is 0 and the Loss of Speed Signal delay is NOT set as 0, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
7	Gen Over Volt.	When the controller detects that the generator voltage has exceeded the pre-set value, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
8	Gen Under Volt.	When the controller detects that the generator voltage has fallen below the pre-set value, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
9	Gen Over Current	When the controller detects that the generator current has exceeded the pre-set value and the Overcurrent Stop Threshold delay is NOT set as 0, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
10	Fail To Start	If the engine does not fire after the pre-set number of attempts, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
11	Gen Over Freq.	When the controller detects that the generator frequency has exceeded the pre-set value, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
12	Gen Under Freq.	When the controller detects that the generator frequency has fallen below the pre-set value, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
13	No gens freq	When the controller detects the generator frequency is 0, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.

No.	Type	Description
14	Low Fuel Level	When the controller detects that the fuel level is lower than the set value or there is Low Fuel Level input, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
15	Low Water Level	When the controller detects that there is Low Water Level input, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
16	Tem Sensor Open	When the sensor didn't connect to correct port, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
17	Oil Sensor Open	When the sensor didn't connect to correct port, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
18	Maintain Time Over	When the genset working time has exceeded the maintain time, moreover the maintain action has been set to shutdown, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD. When the maintain action is negative, the alarm resets.
19	Tps Fail	When the Tps feedback signal failed, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
20	Aux. Sensor Over	When the controller detects that the aux. sensor has exceeded the pre-set value, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.
21	Aux. Sensor Under	When the controller detects that the aux. sensor has fallen below the pre-set value, it will initiate a shutdown alarm and the alarm information will be displayed on the LCD.

6 WIRINGS CONNECTION

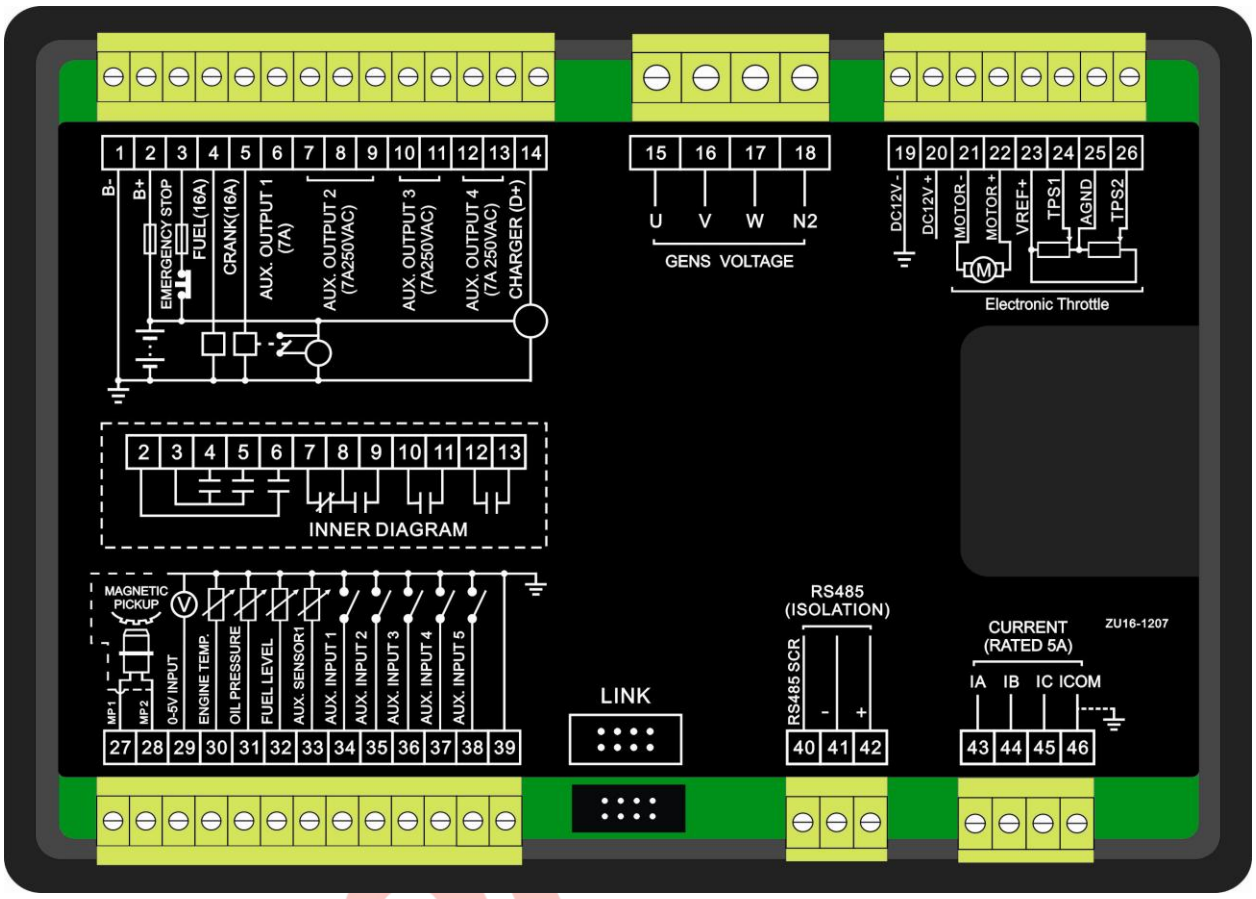

Figure 2- Back Panel

Table 7- Description of terminal connection

No.	Function	Cable Size	Remarks	
1	B-	2.5mm^2	Connected with negative of starter battery	
2	B+	2.5 mm^2	Connected with positive of starter battery. Max. 20A fuse is recommended.	
3	EM. Stop	2.5 mm^2	Connected with B+ via emergency stop button	
4	Fuel	1.5 mm^2	Fuel relay output; B+ is supplied by 3 terminal; rated 16A	
5	Crank	1.5 mm^2	Start relay output; B+ is supplied by 3 terminal; rated 16A; Connected to starter coil.	
6	Aux. Output 1	1.5 mm^2	B+ is supplied by 2 terminal; rated 7A	
7	Aux. Output 2	1.5 mm^2	Always close output; rated 7A;	
8		1.5 mm^2	Common terminal	
9		1.5 mm^2	Always open output; rated 7A;	
10	Aux. Output 3	2.5 mm^2	Free contact always open; rated 7A; free contact output	Details see Table 9
11		2.5 mm^2		
12	Aux. Output 4	2.5 mm^2		

No.	Function	Cable Size	Remarks	
13		2.5 mm^2		
14	CHARGER(D+)	1.0 mm^2	Connected with charger starter's D+ (WL) terminals. Being hang up If there is no this terminal.	
15	Gens AC Voltage (U)	1.0 mm^2	Connected to U-phase of generator (2A fuse is recommended).	
16	Gens AC Voltage (V)	1.0 mm^2	Connected to V-phase of generator (2A fuse is recommended).	
17	Gens AC Voltage (W)	1.0 mm^2	Connected to W-phase of generator (2A fuse is recommended).	
18	Gens AC Voltage (N2)	1.0 mm^2	Connected to N-phase of generator.	
19	DC12V Negative	1.5 mm^2	Connected with Tps DC engine for power supply.	Connected to Tps
20	DC12V Positive	1.5 mm^2		
21	DC Gens Negative	1.5 mm^2	Connected with Tps DC engine.	
22	DC Gens Positive	1.5 mm^2		
23	Position Positive	1.0 mm^2	Supply positive pole for position sensor.	
24	Position Signal1	1.0 mm^2	Connected to the signal of forward direction (the larger the aperture of Tps is, the higher the signal voltage is.)	
25	Position Negative	1.0 mm^2	Supply negative pole for position sensor.	
26	Position Signal2	1.0 mm^2	Connected to the signal of reverse direction (the larger the aperture of Tps is, the lower the signal voltage is.)	
27	MP1	0.5 mm^2	Connected with Speed sensor, shielding line is recommended.	
28	MP2 ((B-) has already connected)			
29	GOV	1.0 mm^2	Connected to external GOV speed regulation signal.	
30	Temp Input	1.0 mm^2	Connected to resistance sensor of water temperature or cylinder temperature.	Details see Table 11
31	Pressure Input	1.0 mm^2	Connected to resistance sensor.	
32	Level input	1.0 mm^2	Connected to oil pressure resistance sensor.	

No.	Function	Cable Size	Remarks	
33	Aux. Sensor	1.0 mm^2	Connected to level resistance sensor.	
34	Digit Input1	1.0 mm^2	Ground connected is active (B-)	Details see form 10
35	Digit Input2	1.0 mm^2	Ground connected is active (B-)	
36	Digit Input3	1.0 mm^2	Ground connected is active (B-)	
37	Digit Input4	1.0 mm^2	Ground connected is active (B-)	
38	Digit Input5	1.0 mm^2	Ground connected is active (B-)	
39	Sensor COM	1.0 mm^2	Digital input port and sensor common terminal.	
40	RS485 COM	/	Impedance-120Ω shielding wire is recommended, its single-end earthed.	
41	RS485-	0.5 mm^2		
42	RS485+	0.5 mm^2		
43	CT (A)	1.5 mm^2	External connected to CT secondary coil. (Rated 5A)	
44	CT (B)	1.5 mm^2	External connected to CT secondary coil. (Rated 5A)	
45	CT (C)	1.5 mm^2	External connected to CT secondary coil. (Rated 5A)	
46	CT COM	1.5 mm^2	Details see installation instructions.	

NOTE: LINK interface is parameters configured interface that can be programmed by PC using an SG72 adapter.

7 SCOPES AND DEFINITIONS OF CONFIGURABLE PARAMETERS

Table 8- Contents and scopes of parameters

No	Items	Range	Default	Description
1	Start Delay	(0-3600)s	1	Time from remote start signal is active to start genset.
2	Stop Delay	(0-3600)s	1	Time from remote start signal is deactivated to genset stop.
3	Start Attempts	(1-10)times	3	Maximum crank times of crank attempts. When reach this number, controller will send start failure signal.
4	Pre-heat 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
6	Crank Rest Time	(3-60)s	10	The waiting time before second power up when engine start fail.
7	Safety On Delay	(1-60)s	10	Alarms for low oil pressure, high temperature, under speed, under frequency/voltage, charge alt failure are inactive.
8	Start Idle Time	(0-3600)s	0	Idle running time of genset when starting.
9	Warming Up Time	(0-3600)s	10	Warming time between genset switch on and 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 Hold Time	(0-120)s	20	Stop electromagnet's power on time when genset is stopping.
13	Fail to Stop	(0-120)s	0	Time between ending of genset idle delay and stopped when "ETS time" is set as 0; Time between ending of ETS hold delay and stopped when "ETS time" is not 0.
14	Switch Close Time	(0-10)s	5.0	Pulse width of generator switch on. When it is 0, means output constantly.
15	Flywheel Teeth	(1-300)	118	Tooth number of the engine, for judging of starter crank disconnect conditions and inspecting of engine speed. See the installation instructions.
16	GenVolt AbnormTime	(0-20.0)s	10.0	The alarm delay of generator over voltage and under voltage.

No	Items	Range	Default	Description
17	Gens Over Volt	(30-620)V	264	When generator voltage has exceed the set value and the “Gen abnormal delay” has expired, Gen Over Voltage shutdown alarm is active. When set the value as 620V, the controller does not detect over voltage signal.
18	Gens Under Volt	(30-620)V	88	When generator voltage has fallen below the set value and the “Gen abnormal delay” has expired, Gen Under Voltage shutdown alarm is active. When set the value as 30V, the controller does not detect under voltage signal.
19	Under Speed	(0-6000) r/min	1000	When engine speed has fallen below the set value for 10s, Under Speed shutdown alarm is active. It will initiate a shutdown alarm signal.
20	Over Speed	(0-6000) r/min	4200	When engine speed has exceed the set value for 2s, Over Speed shutdown alarm is active. It will initiate a shutdown alarm signal.
21	Gens Under Freq	(0-75.0)Hz	45.0	When generator frequency has fallen below the set value but Not equal to 0 for 10s, Under Frequency shutdown alarm is active. It will initiate a shutdown alarm signal.
22	Gens Over Freq	(0-75.0)Hz	68.0	When generator frequency has exceeded the set value for 2s, Over Frequency shutdown alarm is active. It will initiate a shutdown alarm signal.
23	High Temperature	(80-140) ºC	98	When temperature of external sensor is higher than this value, it will send high temperature signal. This value is only judged after safety delay and only judge to temperature sensor connecting with external port. When this value is 140, it will not send high temperature signal. (Only send signal to temperature sensor, not including alarm signal of digital input port.)

No	Items	Range	Default	Description
24	Low Oil Pressure	(0-400)kPa	103	When pressure of external sensor is lower than this value, the delay will initiate. This value is only judged after safety delay. When this value is 0, it will not send low oil pressure signal. (Only send signal to pressure sensor, not including alarm signal of digital input port.)
25	Low Fuel Level	(0-100)%	10	When the level value is fallen below this value and last for 10s, it will not send low fuel level signal. (Only alarm not shutdown)
26	Loss of Speed Signal	(0-20.0)s	5.0	If the set value is 0, only warning and not to shutdown the generator.
27	Charge Alt Failure (Warning)	(0-30)V	6.0	During generator is normal running, when alternator D+(WL) voltage has fallen below the set value and remains for 5s, It will initiate a shutdown alarm signal.
28	Battery Over Voltage (Warning)	(12-40)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.
29	Battery Under Voltage (Warning)	(4-30)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.
30	CT	(5-6000)/5	500	External connecting.
31	Rating Current	(5-6000)A	500	Using for calculation of over current
32	Over Current	(50-130)%	120	When gens current has exceeded this range, the over current delay will initiate.
33	Over Current Delay	(0-3600)s	1296	When current has exceeded the pre-set value and last for pre-set time, it will be judged to over current. When delay is set to 0s, it will only warn not shutdown.
34	Fuel Pump On	(0-100)%	25	When fuel level is lower than the pre-set value and last for 10s, it will initiate a fuel pump on signal.

No	Items	Range	Default	Description
35	Fuel Pump Off	(0-100)%	80	When fuel level is higher than the pre-set value and last for 10s, it will initiate a fuel pump off signal.
36	Digit Output1	(0-17)	2	Factory default: Energized To Stop
37	Digit Output2	(0-17)	3	Factory default: Idle Control
38	Digit Output3	(0-17)	5	Factory default: Close Generator
39	Digit Output4	(0-17)	7	Factory default: Open Generator
40	Digit Input1 Set	(0-16)	1	Factory default: High Temperature Input
41	Digit Input1 Act	(0-1)	0	Factory default: Close to active
42	Digit Input1 Delay	(0-20.0)s	2.0	
43	Digit Input2 Set	(0-16)	2	Factory default: Low Oil Pressure Input
44	Digit Input2 Act	(0-1)	0	Factory default: Close to active
45	Digit Input2 Delay	(0-20.0)s	2.0	
46	Digit Input3 Set	(0-16)	10	Factory default: Remote Start
47	Digit Input3 Act	(0-1)	0	Factory default: Close to active
48	Digit Input3 Delay	(0-20.0)s	2.0	
49	Digit Input4 Set	(0-16)	11	Factory default: Fuel Level Warn
50	Digit Input4 Act	(0-1)	0	Factory default: Close to active
51	Digit Input4 Delay	(0-20.0)s	2.0	
52	Digit Input5 Set	(0-16)	12	Factory default: Cooling Liquid Level Warn
53	Digit Input5 Act	(0-1)	0	Factory default: Close to active
54	Digit Input5 Delay	(0-20.0)s	2.0	
55	Power On Mode	(0-2)	0	0: Stop Mode 1: Manual Mode 2: Auto Mode
56	Slave Address	(1-254)	1	Communication address of controller.
57	Passwords	(0-9999)	1234	
58	Disc. Condition	(0-5)	2	There are 2 conditions of disconnecting starter with engine: Generating, Magnetic Sensor and Oil Pressure. Each condition can be used alone and simultaneously to separating the start motor and genset as soon as possible.
59	Disconnect Speed	(0-3000) r/min	360	When the engine speed has exceeded the set value, starter will be disconnected.
60	Disconnect Freq	(10.0-30.0)Hz	14.0	When the generator frequency has exceeded the set value, starter will be disconnected.
61	Disconnect OP	(0-400)kPa	200	

No	Items	Range	Default	Description
62	Inhibit WTH	(0-1)	0	Factory default: High Temp. Shutdown. When high temperature occurs, shutdown alarm is active. Table8 Note1
63	Inhibit OPL	(0-1)	0	Factory default: when low oil pressure occurs, shutdown alarm is active. Table8 Note2
64	AC System	(0-3)	0	0: 3P4W; 1: 2P3W 2: 1P2W; 3: 3P3W
65	Engine Temp Curve	(0-9)	8	SGX
66	Oil Pressure Curve	(0-9)	8	SGX
67	Fuel Level Curve	(0-5)	3	SGD
68	Generator Poles	(2-64)	4	The gain is regulated during the genset is idle running.
69	Temp.S Open Action	(0-2)	1	0 Indicate; 1 Warn; 2 Shutdown
70	OP.S Open Action	(0-2)	1	0 Indicate; 1 Warn; 2 Shutdown
71	Maintenance Time	(0-5000)h	30	Used to set the intermission of maintenance time.
72	Maintenance Action	(0-2)	0	0 Negative; 1 Warn; 2 Shutdown When maintenance action is set to Negative, the alarm will reset.
73	Aux.Sensor1 Type	(0-3)	0	0 Not used; 1 Temp sensor 2 Pressure sensor; 3 Level sensor
74	Aux.Sensor1 Curve	(0-9)	0	
75	Aux.S.1 H Warn	(0-1000)	0	When the value of external aux. sensor has exceeded this value, it will initiate warn alarm.
76	Aux.S.1 H Shutdown	(0-1000)	0	When the value of external aux. sensor has exceeded this value, it will initiate shutdown alarm.
77	Aux.S.1 L Warn	(0-1000)	0	When the value of external aux. sensor has fallen below this value, it will initiate warn alarm.
78	Aux.S.1 L Shutdown	(0-1000)	0	When the value of external aux. sensor has fallen below this value, it will initiate shutdown alarm.
79	Crank Angle	(0-100)%	45	The throttle opening before the genset is starting.
80	Crank Disc. Angle	(0-100)%	35	The initial opening of the throttle after the genset is started.

No	Items	Range	Default	Description
81	Idle Speed	(0-6000) r/min	900	Offer standard to adjust idle speed.
82	Idle Slope	0-6000	10	The rising speed rate during the process of genset change idle running status into rated speed running status.
83	Idle Gain	1-1000	500	The gain is regulated during the genset is idle running.
84	Rated Speed	(0-6000) r/min	1500	Offer standard to adjust rated speed.
85	P Gain	1-3000	1100	The regulated gain when the genset is running in rated speed.
86	I Gain	1-3000	35	
87	D Gain	1-3000	1	
88	Total Gain	1-1000	300	
89	Window	(1-1000) r/min	200	
90	Window Gain	1000-3000	1100	
91	Position Gain	0-1000	0	
92	Compensate Gain	0-100	0	
93	P Gain(Position)	1-3000	1000	The regulated gain of throttle position.
94	I Gain(Position)	1-3000	300	
95	D Gain(Position)	1-3000	100	
96	Defined Curve Set	(0-3)		0: Defined temperature sensor 1: Defined pressure sensor 2: Defined level sensor 3: Defined aux. sensor Chose the sensor which needs setting, then input resistance value and corresponding value of each point. It needs to input 8 points.

Note 1, if “high temperature inhibit” is configured, or set auxiliary input as “inhibit high temperature stop” and this input is active, when temperature is higher than the preset value, or high temperature alarm input is active, controller will send warning signal only and not stop the unit.

Note 2, if “low oil pressure inhibit” is configured, or set auxiliary input as “inhibit low oil pressure stop” and this input is active, when oil pressure is lower than the preset value, or low oil pressure alarm input is active, controller will send warning signal only and not stop the unit.

Note 3, if “3P3W” is selected, maximum shutdown threshold of “Gens Over Voltage” can be set as 620V; when select others, maximum shutdown threshold can be set as 360V.

Table 9- Enable definition of programmable output ports

No	Items	Description
0	Not Used	Output port is deactivated when “Not Used” is selected.
1	Common Alarm	Include 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	Energized to Stop	Suitable for genset with electromagnet and will active after “stop idle delay”. It is deactivated when the “ETS Solenoid delay” expires.
3	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 stop is completed.
4	Preheat Control	Close before starting and open before power up;
5	Close Generator	When close time is 0, it’s continuous output.
6	Reserved	
7	Open ATS	When close time is 0, it’s disabled.
8	Raise Speed	Close when the generator enters into Warming Up delay (close time: warming up delay) while open when Aux. Raise Speed input is active.
9	Drop Speed	Close when the generator enters into Stop Idle delay/ Energized to Stop delay (close time: Stop Idle delay) while open when Aux. Drop Speed input is active.
10	Generator Run	Action when genset is normal running while deactivated when engine speed is lower than the “crank disconnect speed”.
11	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;
12	High Speed Control	Close when the generator enters into Warming Up delay while open after cooling delay.
13	In Auto Mode	The controller is in automatic mode.
14	Reserved	
15	Reserved	
16	Reserved	
17	Reserved	

Table 10- Defined contents of configurable input ports (All active when connect to grand (B-))

No	Items	Description
0	Not Used	
1	High Temperature Input	If these signals are active after safety on delay, shutdown alarm will be immediately initiated.
2	Low Oil Pressure Input	
3	Warn Input	Only warning and not shutdown if this input is active.
4	Shutdown input	Shutdown alarm will be immediately initiated if this input is active.
5	WTH 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 generator and then stop it; if the signal is deactivated and a high temperature situation occurs, the controller will shut down the gen-set without cooling down.
6	Generator Closed input	
7	Reserved	
8	Inhibit High Temperature Stop	When it is active, high temperature shutdown will be prohibited. **Table8Note 1**
9	Inhibit Low Oil Pressure Stop	When it is active, low oil pressure shutdown will be prohibited. **Table8Note 2**
10	Remote Start	
11	Fuel Level Warn	
12	Coolant Level Warn	
13	Fuel Level Shutdown	
14	Coolant Level Shutdown	
15	Inhibit Start Auto	In Auto mode, if this input is active, whether remote start signal activates 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.
16	Reserved	

Table 11- SENSOR SELECTION

No	Items	Description	Note
1	Temp Sensor	0 None 1Defined Resistance 2 VDO 3 SGH 4 SGD 5 CURTIS 6 DATCON 7 VOLVO-EC 8 SGX 9 Reserved	The range of Defined Resistance is: 0-6000Ω, factory default is SGX.
2	Pressure Sensor	0 None 1Defined Resistance 2 VDO 10bar 3 SGH 4 SGD 5 CURTIS 6 DATCON 10bar 7 VOLVO-EC 8 SGX 9 Reserved	The range of Defined Resistance is: 0-6000Ω, factory default is SGX.
3	Fuel Level Sensor	0 None 1Defined Resistance 2 SGH 3 SGD 4 Reserved 5 Reserved	The range of Defined Resistance is: 0-6000Ω, factory default is SGX.

Table 12- Conditions of crank dinsconnect selection

No.	Setting Description
0	Speed sensor
1	Gen frequency
2	Speed sensor + Gen frequency
3	Speed sensor + Oil Pressure
4	Gen frequency + Oil Pressure
5	Speed sensor + Gen frequency + Oil Pressure

NOTE:

a) There are 3 conditions to make starter disconnected with engine, that is, speed sensor, generator frequency and oil pressure. Speed sensor and generator frequency can be used separately, oil pressure needs speed sensor and generator frequency simultaneously for cooperation in order to make the starter motor is separated with engine immediately and can check crank disconnect exactly.

b) Speed sensor is the magnetic equipment which be installed in starter for detecting flywheel teeth.

c) When set as speed sensor, 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 is 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 sensor in crank disconnect setting, the rotating speed displayed in controller is calculated by generator signal.

8 PARAMETERS SETTING

8.1 MENU ITEMS

Start the controller, then press to enter into the parameters setting menu, see fig 1 below:

a) Set Parameters
b) Information
c) Language

8.2 PARAMETERS SETTING

When entering password interface, input password (1234) can set parts of the parameter items in Form 8, and input password (0318) can set all of the parameter items in Form 8. If there is need to set more parameters (e.g. Voltage, Current Calibration), please contact the factory.

CAUTION:

——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 happen.

——Over voltage set value must be higher than under voltage set value, otherwise over voltage and under voltage condition may occur simultaneously.

——Over speed set value must be higher than under speed set value, otherwise over speed and under speed condition may occur simultaneously.

——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.

——Auxiliary input 1~5 could not be set as same items; otherwise, there are abnormal functions. However, the auxiliary output 1~4 can be set as same items.

——If need to shut down after cooling, please set any digital input as “WTH STOP by cool”, then connect this input port to ground soundly.

8.3 INFORMATION

LCD will display software version, issue date of the controller.

Note: In this interface, press will display the auxiliary inputs and outputs status.

8.4 LANGUAGE

Chinese and English interface can be selected.

8.5 LCD CONTRAST REGULATION

Simultaneously press and or can adjust contrast in order to make LCD more distinct. The range of regulation is 0-7.

Note: In setting process, press in any time will break the parameter setting off and return back to main interface.

9 SENSOR SELECT

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 chose “Defined sensor”, and input defined sensor curve.

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

If select sensor type as “None”, temperature, pressure and fuel level which LCD displays will be “---”.

If there is no pressure sensor only pressure low alarm switch, user must set the sensor as “None”, otherwise, maybe pressure low alarm shutdown occurs.

The headmost or backmost values in the vertical coordinates can be set as same as below,

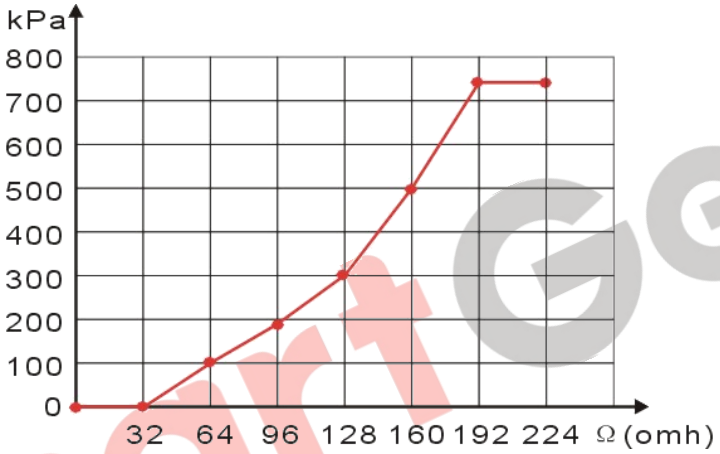

Figure 3- Sensor Curve

Table 13- Common unit conversion table

Unit	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 the under procedures checking 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 disconnect (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 setting times as setting, controller will send signal of Start Fail; then press “stop” to reset controller.

——Recover the action of stop engine start (e. g. Connect wire of fuel valve), press start button again, genset will start. If everything goes well, genset will normal run 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 running and check all wires connection according to this manual.

——Select the AUTO mode from controller’s panel, connect remote start signal. genset will be started automatically and into normal running, then controller send signal to close generator.

——Cut-off remote start signal, the genset will be stopped automatically and the Open Generator signal will be send out. If not like this, please check ATS’ wires connection of control part according to this manual.

——If there is any other question, please contact Smartgen’s service.

11 TYPICAL APPLICATION

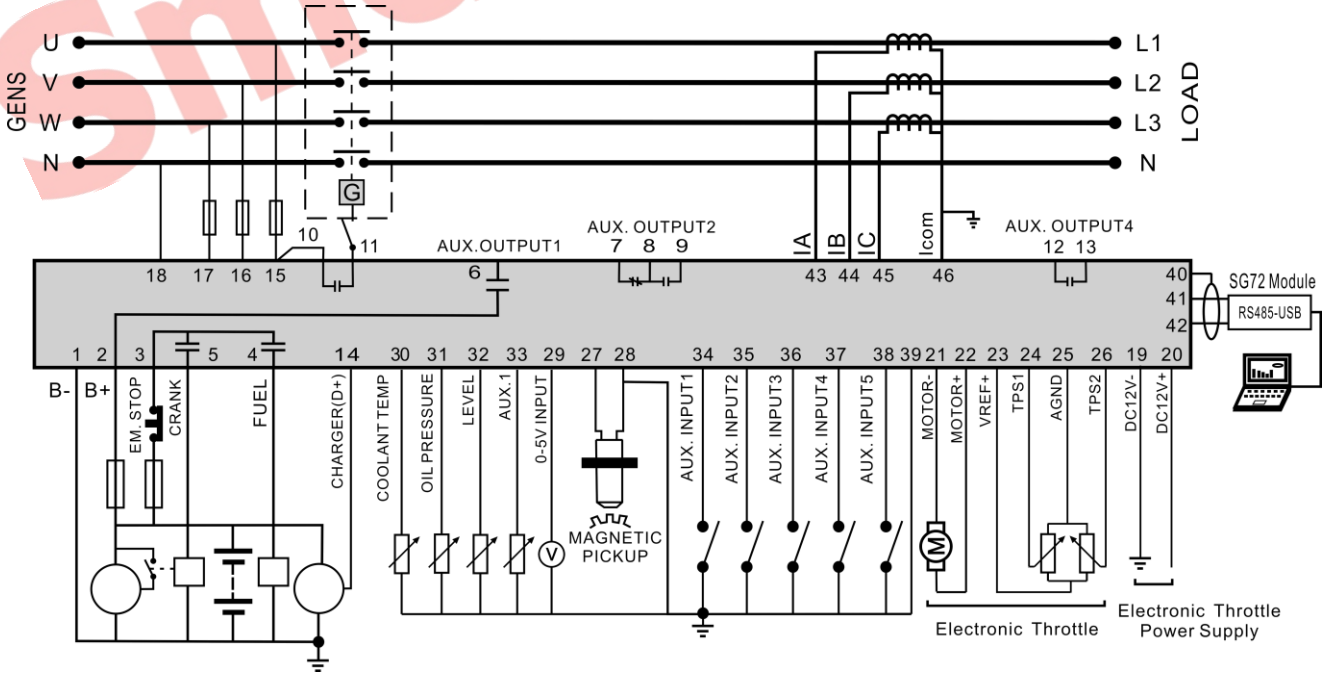

Figure 4- Typical Application Diagram

CAUTION! Expand relay with high capacity in start and fuel output is recommend.

CAUTION! Expand relay must be used in generator closed outputs.

12 THE CONNECTION BETWEEN CONTROLLER AND GENSET

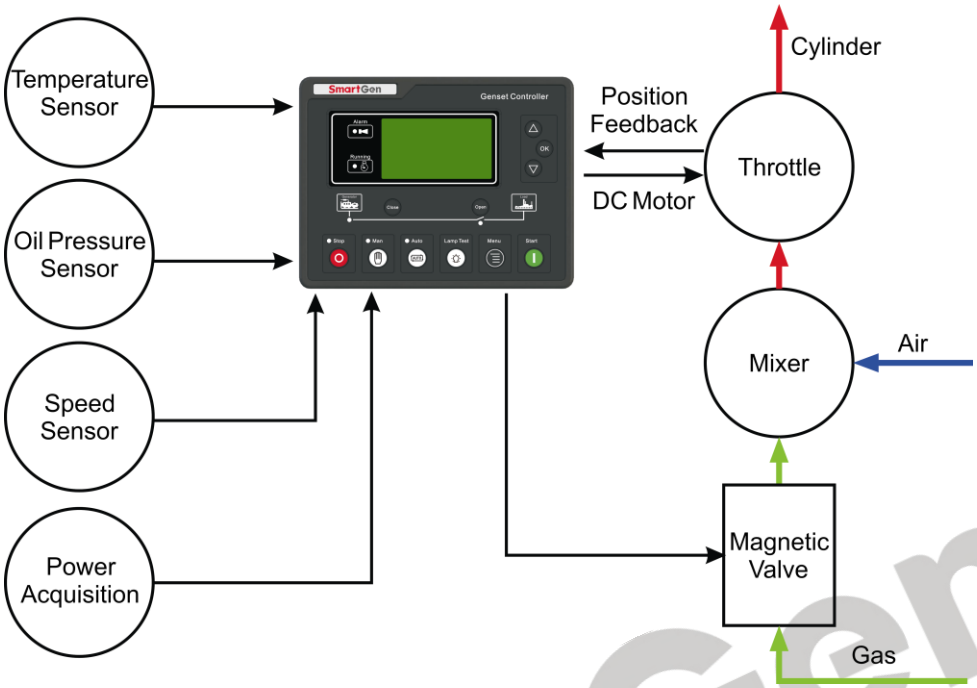

Figure 5- Connection Diagram

13 FIXING CLIPS INSTALLATION

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.

Figure 6- Fixing Clips

14 OVERALL DIMENSION AND PANEL CUTOUT

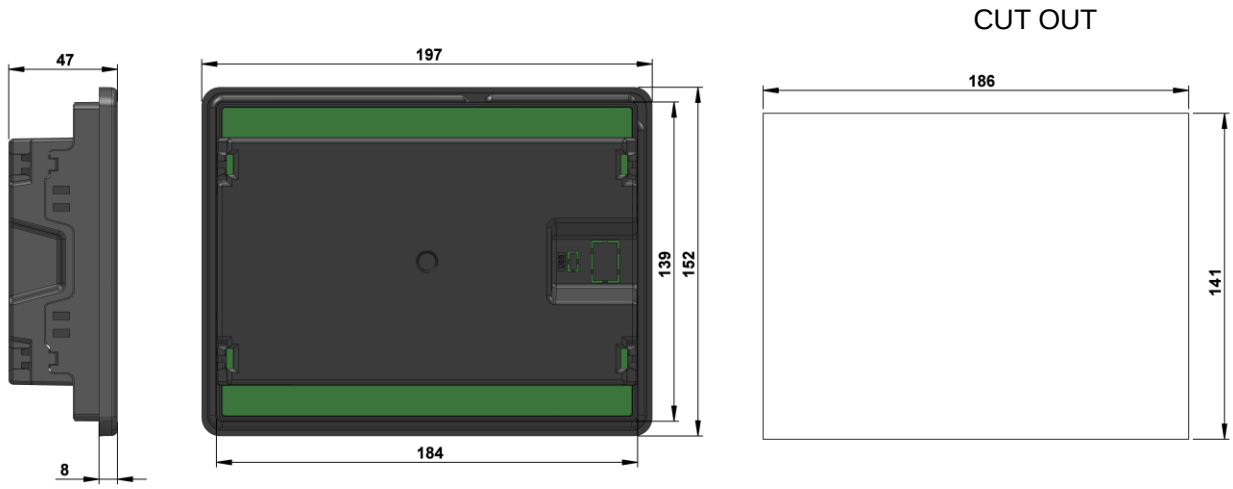

Figure 7- Dimension And Cutout

15 MATTERS NEED ATTENTION OF INSTALLATION

15.1 BATTERY VOLTAGE INPUT

HSC960 controller can suit for widely range of battery voltage DC(8~35)V. Negative of battery must be connected with the engine shell. The diameter of wire which from power supply to battery must be over 2.5mm^2. 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.

15.2 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. 17 terminal in controller while another side is hanging in air. The else two signal wires are connected to No.17 and No.18 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.

15.3 OUTPUT AND EXPANSION RELAY

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, add resistance-capacitance return circuit (when coils of relay has AC current), in order to prevent disturbance to controller or others equipment.

15.4 AC CURRENT INPUT

The current input of HSC960 Controller must be connected with external common reactance whose secondary current must be 5A, meanwhile, the phase and voltage of common reactance must be correct otherwise the sampling current and active power may be incorrect.

Note: ICOM must be connected to battery controller negative pole.

Note: When there is load current, the common reactance secondary side mustn't be open.

15.5 WITHDRAW 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.

16 FAULT FINDING

Table 14- fault finding

Symptoms	Possible Solutions
Controller no response with power.	Check starting batteries; Check controller connection wirings; Check DC fuse.
Genset shutdown	Check the water/cylinder temperature is too high or not; Check the genset AC voltage; Check DC fuse.
Low oil pressure alarm after crank disconnect	Check the oil pressure sensor and its connections.
High water temp. alarm after crank disconnect	Check the temperature sensor and its connections.
Shutdown Alarm in running	Check related switch and its connections according to the information on LCD; Check auxiliary input ports.
Fail to start	Check fuel oil circuit and its connections; Check starting batteries; Check speed sensor and its connections; Refer to engine manual.
Starter no response	Check starter connections; Check starting batteries.
DC Motor Reverse	Cross the connections of throttle and DC motor.
GOV is out of control.	Check the speed sensor voltage is no less than 2V when cranking. Check the connections of throttles.
Switch no action (Genset OK)	Check the switch. Check the connections of controller and switch.
RS485 Communication Fail	Check the connections. Check the setting of COM. Check the wire A and wire B of RS485 is reverse or not. Check the communication port of PC is broke or not. Adding a 120Ω resistance between port A and B of RS485 of controller is commanded.