SmartGen
ideas for power

HEM4000

ENGINE CONTROLLER

USER MANUAL

SMARTGEN (ZHENGZHOU) TECHNOLOGY CO., LTD.

Chinese trademark

SmartGen **English trademark**

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Table 1 – Software Version

Date	Version	Note
2019-01-28	1.0	Original release
2021-01-11	1.1	Modify "generator" as "engine"; Optimize other translation problems; Use the latest header and footer format.

Table 2 – Notation Clarification

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.

CONTENTS

1 OVERVIEW

HEM4000 ENGINE CONTROLLER is used for controlling engine to realize engine auto start/stop, data measuring, alarm protection and "three remotes" (remote control, remote measuring and remote communication) functions. It provides speed regulation function, not only with relay speed-adjusting output but also with GOV interface, which can control all kinds of non-EFI engines' speed.

HEM4000 ENGINE CONTROLLER adopts large liquid crystal display (LCD) and selectable Chinese and English interface with easy and reliable operation. Users can read engine working parameters from the LCD directly.

HEM4000 ENGINE CONTROLLER uses 32 bits ARM micro-processor technology with the functions of precise parameters measuring, fixed value adjustment, time setting and threshold adjusting etc. The majority of parameters can be set on the front panel and all the parameters can be set and monitored via USB port or RS485 port by using PC. With compact structure, simple connections and high reliability, it can be widely used in a number of engine control systems, which include water pump system, beacon system, air compressor, engineering machinery system and so on.

2 PERFORMANCE AND CHARACTERISTICS

Key characteristics are as below,

— 132x64 LCD with backlight, multilingual interface (including English and Chinese languages) and easy operating interface;

— Hard acrylic screen protection with improved wear-resistance and scratch resistance;

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

— RS485 communication port to realize remote controlling, remote measuring, remote communication via ModBus protocol;

— 6-way analog sensors, 3-way fixed resistor sensors, and 3-way flexible sensors, which can be configured as resistor/current/ voltage type sensors;

— Multiple temperature, pressure and level sensor curves can be used and user-defined directly;

— Precisely collecting various engine parameters provides complete protection functions, such as engine high water temperature/ low oil pressure, over speed and under speed protection;

— With mechanical speed regulation function and GOV speed adjustment function, it can control engine speed up and down manually;

— Idle/high speed switchover function;

— All outputs are relay outputs;

— With the function of parameter setting, it allows users to change and set the parameters and

at the same time they will be stored in the internal FLASH memorizer and cannot be lost in case of power outage;

— Alternate crank disconnect conditions (engine speed, oil pressure);

— Engine speed can be obtained by speed sensor or W/L charging generator;

— Wide power supply range DC(8~35)V, which is suitable to different starting battery voltage environment;

— Event log, real-time clock, scheduled start & stop functions (start one time once a day/week/month);

— Heater, cooler and fuel pump control functions;

— Maintenance function. Actions (warning or shutdown) can be set when maintenance time due;

— All parameters adopt digital adjustment instead of conventional analog modulation with a potentiometer, which improves the reliability and stability;

— Waterproof security level IP65 of the front panel due to the rubber seal in the case design;

— Metal fixing clips enable perfect performance in high temperature environment;

— Modular design, flame retardant ABS enclosure, pluggable connecting terminals and embedded installation way; Structure is compact and the installation is very easy.

Table 3 − Technical Parameters

Items	Contents
Operating Voltage	DC8.0V to DC35.0V, Continuous Power Supply.
Power Consumption	<3W (standby ≤2W)
Speed Sensor Voltage	1.0V to 24.0V (RMS)
Speed Sensor Frequency	10,000 Hz (max.)
GOV Output Range	0V-10V
Charging Generator W/L	Voltage (1.0-24)V(RMS) Frequency (50-1000)Hz
Starting Relay Output	5A DC28V
Auxiliary Relay Output 1	5A DC28V
Auxiliary Relay Output 2-6	1A DC28V
Analog Sensor	3-way fixed resistor sensors (temperature, flexible sensor 1, flexible sensor 2); 3-way sensors can be configured as resistor/current/voltage type sensors (oil pressure, flexible sensor 3, flexible sensor 4)
Case Dimension	135mm x 110mm x 44mm
Panel Cutout	116mm x 90mm
Working Conditions	Temperature: (-25~+70)°C Humidity: (20~93)%RH
Storage Condition	Temperature: (-25~+70)°C
Protection Level	IP65 Front Panel
Net Weight	0.35kg

4 OPERATION

4.1 KEY FUNCTIONS DESCRIPTION

Table 4 – Keys Description

Icons	Keys	Description
	Stop/Reset	1. Stop running engine in Auto/Manual mode; 2. Reset alarms in stop mode; 3. Pressing over 3 seconds can know whether the panel lamp is OK (Lamp test); 4. Press this again in stop process can stop the engine immediately;
	Auto	Press this key and controller goes to **Auto** mode;
	Manual	Press this key and controller goes to **Manual** mode;
	Speed	If speed adjusting enabled, press this key to enter adjusting speed page to raise/drop engine speed;
	Start	Start engine in Manual mode;
	Up/Increase	1. Screen scroll; 2. Moving cursor up and increase value in setting menu;
	Down/Decrease	1. Screen scroll; 2. Moving cursor down and decrease value in setting menu;
	Set/Confirm	1. Entering into parameter setting page after pressing this key in main screen; 2. Confirm information in setting page;

4.2 CONTROLLER PANEL

Fig.1 – Front Panel Drawing

⚠️**NOTE:** Parts of indicators description:

Warning indicator: Waning alarms occur: slowly flash; shutdown alarms occur: fast flash; no alarms occur: extinguished;

Status indicator: It is illuminated when engine is normal; flashing when engine is in stop delay;

Auto mode indicator: It is illuminated in auto mode; flashing in start delay.

4.3 AUTO START/STOP OPERATION

4.3.1   AUTOMATIC START SEQUENCE

a)   Press ⟨icon⟩ , the indicator beside it illuminates, which means the engine is in auto start mode;

b)   When "remote start" input is active, "start delay" is initiated, and auto mode indicator flashes at the same time;

c)   After start delay, auto mode indicator changed from flashing to illuminating, and preheating relay outputs (if configured), "preheating delay XX" will be displayed on the LCD;

d)   After the preheating delay, the fuel relay outputs pre-start fuel time (1 second default) and then the starting relay outputs. If it fails to fire in the crank time, the fuel relay and starting relay stop outputs and enter "crank rest time", waiting for another crank;

e)   During the set crank times, if the engine fails to fire, the controller will output crank failure and stop and meanwhile the alarm page shows crank failure alarm;

f)   If it starts successfully in the crank attempts, it goes to "safe operation time", during which low oil pressure, high water temperature, under speed and charging failure alarms are all disabled. As soon

as the safe operation delay is over, "start idle delay" is initiated (if configured);

g) During the "start idle delay", under speed alarm is disabled. When this delay is over, "high-speed warming up delay" is initiated (if configured);

h) After the "warming up delay" has expired, the engine goes to normal operation status. If the speed is abnormal, the controller will alarm and stop (alarms will be displayed on the LCD).

4.3.2 AUTOMATIC STOP SEQUENCE

a) When the "remote start" signal is not available, and the "remote stop" signal is effective, the stop delay is initiated, and the status indicator flashes;

b) Once the "stop delay" ends, "high-speed cooling delay" is then initiated. During the cooling delay, if the "remote start" signal is active again, the controller will re-enter running status. If cooling delay ends, "stop idle delay" is initiated;

c) During the stop idle delay (if configured), idle relay outputs with power;

d) The ETS delay goes on next, ETS relay is energized and fuel relay is de-energized;

e) Stop delay begins, and complete stop is detected automatically;

f) When the engine stops completely, after-stop delay will be initiated. Otherwise, the controller fails to stop and meanwhile the alarm of stop failure is initiated. (If the engine stops successfully after "stop failure" alarm, after-stop delay will be initiated and the alarm will be removed automatically);

g) After the after-stop delay, the engine will be in standby mode.

4.4 MANUAL START/STOP OPERATION

4.4.1 MANUAL START SEQUENCE

a) Press [icon] and Manual mode is on. Indicator right by is light;

b) Press [icon] and the engine starts; Successful start can be detected automatically and the engine accelerates to high-speed running automatically;

c) The controller can protect the engine to stop quickly if high water temperature, low oil pressure and over speed appear during the running process. (please refer to automatic start sequence 4.3.1,c)～ h)).

4.4.2 MANUAL STOP SEQUENCE

Press [icon] and the running engine stops. (please refer to automatic stop sequence 4.3.2,b)～g)).

4.5 START OPERATION OF FUEL PRE-SUPPLY OUTPUT

When output is set as "Fuel Pre-supply Output", and auto/manual mode starting is active:

If the fuel pre-supply set time is under or equal to pre-heating time, LCD will display "preheating delay XX", and both preheating relay (if configured) and fuel pre-supply relay (fuel pre-supply set time) output; After the preheating delay, fuel relay outputs the pre-star fuel time (default: 1 second), then the starting relay outputs; The remaining start process is the same as automatic start procedure (please refer to automatic start sequence 4.3.1, d)~h)).

If the fuel pre-supply set time is more than the preheating time, preheating delay starts and fuel pre-supply relay outputs. When the preheating delay ends, the remaining fuel pre-supply time starts and it enters fuel pre-supply phase. LCD will display "fuel pre-supply time XX" and fuel pre-supply relay is energized; when the fuel pre-supply delay is expired, fuel relay outputs the set pre-start fuel time (default: 1 second) and afterwards starting relay outputs; The remaining start process is the same as automatic start procedure (please refer to automatic start sequence 4.3.1, d)~h)).

When the output port is set "fuel pre-supply output" and the engine is in the standby status, the set "fuel pre-supply rest time" and "fuel pre-supply time" output circularly; If the "fuel pre-supply rest time" is 0, the fuel pre-supply does not work.

4.6 IDLE MODE

Input setting 8: Idle Mode:

If engine is in good running status and the idle mode input is active, the idle mode starts and the engine enters idle running. At this time the idle relay is energized and the speed-reducing relay starts.

If engine is in the standby status and the idle mode input is active, the auto/manual mode starts regularly; "safe running delay" ends, and the engine enters "start idle delay" (if configured); When the start idle delay ends, the engine enters idle running. Idle controlling relay outputs and the speed-reducing relay outputs.

In the idle mode, engine is in the idle running process; idle mode input is invalid, it will exit from the idle mode. The engine enters normal operation, the idle controlling relay stops outputting and the speed-reducing relay stops outputting.

In the idle mode, engine is in the idle running process; press [icon] and make the engine stop. The engine goes from "idle running" to "stop idle delay",(if configured), and the remaining stop process is the same as automatic stop procedure (please refer to the automatic stop sequence 4.3.2,c)~g)).

If the configured speed adjustment type is relay or GOV, the speed can be adjusted in the normal running phase.

4.7 IDLE/HIGH SPEED MODE

Input setting 14: Idle/High Speed:

If engine is in good running status and the idle/high speed mode input is active, the engine enters idle running status. The idle controlling relay outputs and the speed-reducing relay outputs. If the configured speed adjustment type is relay or GOV, press the speed-increasing key, and the idle relay stops outputting and the speed-reducing relay is the same. The speed can be adjusted in the idle running phase.

If the engine is in the standby status and the idle/high speed input is active, the auto or manual mode can work normally. After the "safe running delay", engine goes to "start idle delay" (if configured). After start idle delay, it enters idle running, the idle controlling relay outputs and the speed-reducing relay outputs. If the configured speed adjustment type is relay or GOV, press the speed-increasing key, and the idle controlling relay and the speed-reducing relay both stop outputting. The speed can be adjusted in the idle running phase.

When the engine is running in the idle mode, the idle/high speed input is invalid. It will exit from the idle operation and go to high speed warming-up phase; at this time speed-increasing relay outputs. When the "high speed warming-up delay" ends, the speed-increasing stops outputting, the engine goes to normal running. After speed adjustment type collocation, speed can be adjusted in normal running status.

In the process of the idle running, press ⬛ and make the engine stop. The engine goes from "idle running" to "stop idle delay" (if configured), and the remaining stop process is the same as the automatic stop procedure (please refer to the automatic stop sequence 4.3.2, c)~g)).

4.8 EMERGENCY START

⚠**NOTE:** Pressing 👉 and ▮ simultaneously can force the engine to start. At this moment, controller does not judge whether the engine starts successfully is not based on the crank disconnect conditions. The starter disconnection is controlled by the operator. When the operator observes that the engine has started successfully, he/she can release the key, then the starting stops outputting and the controller enters safe running delay.

4.9 ENGINE SPEED ADJUSTMENT PROCESS

Configuration of speed regulation input type: 1: Relay Speed Adjustment

If the relay speed adjustment is set, relay output ports need to be configured as "Raise Speed Output" and "Drop Speed Output".

Configuration of speed regulation input type: 2: GOV Speed Adjustment

Set the corresponding GOV voltage output center and voltage output range according to the type of electronic speed controller, and then set the stepping coefficient of GOV speed adjustment.

Press ⊙ and the speed adjustment screen shall be as below. When the engine is in normal running, the speed can be adjusted. At this moment, press △ to raise the speed and press ▽ to reduce the speed. Press ⊙ again to exit and stop speed adjustment.

```
Engine Speed
                    ⬘Raise

1500RPM         ⬙Drop
Normal Running
```
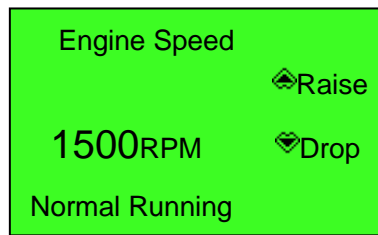
Fig.2 – Speed Adjustment Screen

⚠**NOTE:** Speed can be adjusted up to 110% of rated speed.

5 PUMP UNIT (WITH SUCTION PUMP) APPLICATION OPERATIONS

5.1 D-DRIVEN PUMP START/STOP OPERATION

Set input port function: D-driven pump started, suction pump pressure coming;

Set output port function: D-driven pump starts outputting, D-driven suction pump stops outputting.

Suction pump type: D-driven.

— D-driven Pump Start:

● After auto/manual start mode is active, preheating relay outputs (if configured) and LCD screen displays "preheating delay XX". After the preheating delay, D-driven suction pump's starting relay outputs (output is to be configured). If the successful starting input (input is to be configured) is invalid during the "D-driven suction pump's starting time", the pump starting relay stops outputting and enters "pump starting interval", waiting for next starting; during the set starting times, if the pump fails to start, the controller will output starting failure alarm and stop, and the alarm screen displays "pump starting failure alarm shutdown.";

● At any one time of starting, if D-driven pump succeeds, it will enter "waiting for pressure coming" delay. When the delay is overtime, pressure coming output (input is to be configured) is invalid and the controller conducts pump fault alarm and stops the pump; Meanwhile, the screen displays "pump fault alarm shutdown";

● For the time of waiting for pressure coming, if the pressure coming input is active (input is to be configured), the fuel relay outputs the set pre-start fuel time (default: 1 second). Afterwards the starting relay outputs. The remaining start process is the same as the automatic start procedure (for the details please refer to 4.3.1, d)~h));

— D-driven pump stop: after "safe running delay", D-driven pump stops outputting (output is to be configured), and it stops to output after the setting time (ETS time).

Set Input port function: suction pump pressure coming.

Set Output port function: E-driven pump starting outputs.

Suction pump type: E-driven suction pump.

— E-driven pump start: After suction pump type is set to be E-driven pump and safe running delay is over, the starting relay outputs (output is to be configured).

— E-driven pump stop:

● When the engine is between start idle time and high-speed cooling time, if the input is pump pressure coming (input is to be configured) or the outlet pressure is larger than the value of stop pressure of E-driven suction pump, the starting relay stops to output.

● If the engine is in ETS delay, the starting relay stops to output.

⚠**NOTE:** The outlet pressure of E-driven pump needs outlet pressure associated setup to relate to corresponding auxiliary sensors.

6 PROTECTION

6.1 WARNINGS

When the controller detects warning signals, it only outputs warnings without shutdown. If warnings are cleared, they will disappear automatically.

Table 5 – Warning Alarms

No.	Type	Description
1	Over Speed	When the controller detects that the engine speed has exceeded the pre-set value, it will initiate a warning alarm.
2	Under Speed	When the controller detects that the engine speed has fallen below the pre-set value, it will initiate a warning alarm.
3	Loss of Speed Signal	When the controller detects that the engine speed is 0 and the selected action for speed loss is "Warning", it will initiate a warning alarm.
4	Stop Failure	When "after stop" delay is over, if engine does not stop completely, it will initiate a warning alarm.
5	Charging Failure	When the controller detects that charger voltage is less than the pre-set value, it will initiate a warning alarm.
6	Battery Over Voltage	When the controller detects that engine battery voltage has exceeded the pre-set value, it will initiate a warning alarm.
7	Battery Under Voltage	When the controller detects that engine battery voltage has fallen below the pre-set value, it will initiate a warning alarm.
8	Engine Temp. Sensor Open Circuit	When the controller detects that the temperature sensor is open circuit and the selected action is "Warning", it will initiate a warning alarm.
9	Engine High Temperature	When the controller detects that engine temperature has exceeded the pre-set value, it will initiate a warning alarm.
10	Engine Low Temperature	When the controller detects that engine temperature has fallen below the pre-set value, it will initiate a warning alarm.
11	Engine OP Sensor Open Circuit	When the controller detects that the oil pressure sensor is open circuit and the selected action is "Warning", it will initiate a warning alarm.
12	Engine Low Oil Pressure	When the controller detects that the oil pressure has fallen below the pre-set value, it will initiate a warning alarm.
13	Auxiliary Sensor 1~4 Open Circuit	When the controller detects that the sensor 1 ~ 4 is open circuit and the selected action is "Warning", it will initiate a warning alarm.
14	Auxiliary Sensor 1～4 High	When the controller detects that the sensor 1～4 value has exceeded the pre-set upper limit value, it will initiate a warning alarm.
15	Auxiliary Sensor 1～4 Low	When the controller detects that the sensor 1～4 value has fallen below the pre-set lower limit value, it will initiate a warning alarm.
16	Over Flow Warning	When the controller detects that the flow value has exceeded the pre-set upper limit value, it will initiate a warning alarm.
17	Input Port 1~5 Warning	When digital input is configured as "Warning", and input port is active, controller will initiate a warning alarm.

No.	Type	Description
18	Maintenance 1~5 Warning	When the countdown time is 0 and the selected action is "Warning", it will initiate a warning alarm.
19	Authorized Time Due	When the controller reaches authorized time, and selected action is "Warning", it will initiate a warning alarm.
20	Battery Under Voltage	Under scheduled start, before starting, when controller detects battery voltage is lower than the pre-set value, it will initiate a warning alarm. This warning cannot disappear automatically, and it needs to press "Stop" key in stop mode to remove.

6.2 SHUTDOWN ALARMS

When controller detects shutdown alarm, the screen displays shutdown contents and it will shut down immediately. When the engine stops completely, users need to press alarm reset key to reset shutdown alarms.

Table 6 – Shutdown Alarms

No.	Type	Description
1	Emergency Stop	When the controller detects emergency stop alarm signals, it will initiate a shutdown alarm.
2	Over Speed	When the controller detects that the engine speed has exceeded the pre-set value, it will initiate a shutdown alarm.
3	Under Speed	When the controller detects that the engine speed has fallen below the pre-set value, it will initiate a shutdown alarm.
4	Loss of Speed Signal	When the controller detects that the engine speed is 0 and the selected action is "Shutdown", it will initiate a shutdown alarm.
5	Start Failure	If engine fails to start within preset attempts, it will initiate a shutdown alarm.
6	High Temperature Input Shutdown	When the input port of controller is set as "High Temp. Shutdown" and it is valid, controller will initiate a shutdown alarm.
7	Low Oil Pressure Input Shutdown	When the input port of controller is set as "Low Oil Pressure Shutdown" and is active, controller will initiate a shutdown alarm.
8	Engine Temp. Sensor Open Circuit Shutdown	When the controller detects that the temperature sensor is open circuit and selected action is "Shutdown", it will initiate a shutdown alarm.
9	Engine High Temp.	When the controller detects that temperature has exceeded the pre-set value, it will initiate a shutdown alarm.
10	Engine OP Sensor Open Circuit	When the controller detects that the sensor is open circuit and selected action is "Shutdown", it will initiate a shutdown alarm.
11	Engine Low Oil Pressure	When the controller detects that engine oil pressure has fallen below the pre-set value, it will initiate a shutdown alarm.
12	Auxiliary Sensor 1~4 Open Circuit	When the controller detects that sensor 1～4 is open circuit and the selected action is "Shutdown", it will initiate a shutdown alarm.
13	Auxiliary Sensor 1～4 High	When the controller detects that sensor 1～4 value has exceeded the pre-set upper limit value, it will initiate a shutdown alarm.

No.	Type	Description
14	Auxiliary Sensor 1～4 Low	When the controller detects that sensor 1～4 value has fallen below the pre-set lower limit value, it will initiate a shutdown alarm.
15	Suction Pump Crank Failure	If diesel driven pump fails to start within preset attempts, controller will initiate a shutdown alarm.
16	Suction Pump Fault	When the controller is in the phase of breakdown stop delay and the input pressure coming signal is invalid, controller will initiate a shutdown alarm.
17	Input Port 1~5 Shutdown	When digital input is configured as shutdown and is active, controller will initiate a corresponding shutdown alarm.
18	Over Flow Shutdown	When the controller detects that the flow value has exceeded the pre-set upper limit value, it will initiate a shutdown alarm.
19	Maintenance 1~5 Due	When countdown time is 0 and the selected action for maintenance due is shutdown, it will initiate a shutdown alarm.
20	Authorized Time Due	When controller reaches authorized time, and the selected action is shutdown, it will initiate a shutdown alarm.

7 WIRING CONNECTION
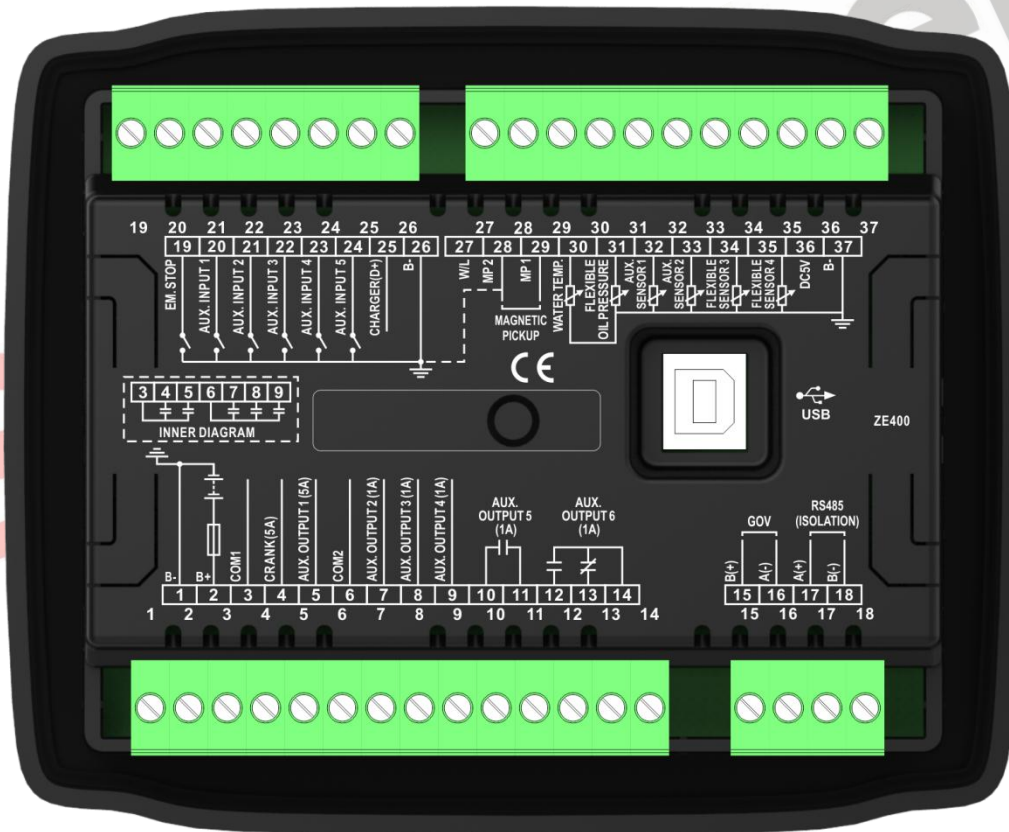
Fig.3 – Controller Rear Panel

Table 7 – Terminal Connection Description

No.	Function	Cable Size	Remarks	
1	B-	1.5mm²	Connected with negative terminal of starting battery.	
2	B+	1.5mm²	Connected with positive terminal of starting battery.	
3	COM1 Relay Common Port	1.5mm²	Connected with COM1 output, rated 5A DC28V.	
4	Crank Relay Output	1.5mm²		
5	Aux. Relay Output 1	1.5mm²		
6	COM2 Relay Common Port	1.0mm²	Connected with COM2 output, rated 1A DC28V.	For settings refer to Table 9.
7	Aux. Relay Output 2	1.0mm²		
8	Aux. Relay Output 3	1.0mm²		
9	Aux. Relay Output 4	1.0mm²		
10	Aux. Relay Output 5	1.0mm²	Relay's normally open passive contact, rated 1A DC28V.	
11		1.0mm²		
12	Aux. Relay Output 6	1.0mm²	Normally open, rated 1A DC28V	
13		1.0mm²	Normally close, rated 1A DC28V	
14		1.0mm²	Relay common port	
15	B(+)	0.5mm²	GOV speed adjustment output	
16	A(-)	0.5mm²		
17	RS485 A(+)	0.5mm²		
18	RS485 B(-)	0.5mm²		
19	Emergency Shutdown Input	0.5mm²	Once it is valid, controller stops engine immediately.	
20	Aux. Input 1	0.5mm²	Ground connected is active (B-).	For settings refer to Table 10.
21	Aux. Input 2	0.5mm²	Ground connected is active (B-).	
22	Aux. Input 3	0.5mm²	Ground connected is active (B-).	
23	Aux. Input 4	0.5mm²	Ground connected is active (B-).	
24	Aux. Input 5	0.5mm²	Ground connected is active (B-).	
25	Charger (D+) Input	1.0mm²	Connected with D + (W/L) of charger. If it does not exist, please hang it in the air.	
26	Aux. Input Common Port	0.5mm²	Has been connected to (B-) Internally.	
27	W/L	0.5mm²	Connected with W terminal of charging generator.	
28	MP2 Speed Sensor Input, controller internally has connected to B(-)	0.5mm²	Connected with engine speed sensor. Shielding wire is recommended.	
29	MP1 Speed Sensor Input	0.5mm²		
30	Temperature Sensor	1.0mm²	Connected with temperature sensor (resistor type).	For settings refer to Table 11.
31	Oil Pressure Sensor	1.0mm²	Connected with pressure sensor (resistor/current/voltage type).	
32	Aux. Sensor 1	1.0mm²	User-defined (resistor type)	

No.	Function	Cable Size	Remarks	
33	Aux. Sensor 2	1.0mm^2	User-defined (resistor type)	
34	Aux. Sensor 3	1.0mm^2	User-defined (resistor/current/voltage type)	
35	Aux. Sensor 4	1.0mm^2	User-defined (resistor/current/voltage type)	
36	DC5V	1.0mm^2	Provide power for voltage type sensor	
37	Sensor COM (B-)	1.0mm^2	Sensor common port. Controller inside has connected with B-.	
	USB	/	Communicating with PC monitoring software.	

8 SCOPES AND DEFINITIONS OF PROGRAMMABLE PARAMETERS

8.1 SCOPES AND DEFINITIONS OF PARAMETERS

Table 8 – Parameters Contents and Scopes

No.	Item		Range	Default	Description
Language Setting					
1	Language		(0-2)	0	0: Simplified Chinese; 1: English; 2: Other
Override Mode					
1	Override Mode		(0-1)	0	0: Disable; 1: Enable
Module Setting					
1	Power On Mode		(0-2)	0	0: Stop Mode; 1: Manual Mode; 2: Auto Mode
2	Module Address		(1-254)	1	Remote monitoring controller address
3	Comm. Stop Bit		(0-1)	0	0: 2-bit Stop Bit; 1: 1-bit Stop Bit (PC software set)
4	Password Setting		(0-9999)	0318	This password is used for entering high level parameter setting. ⚠ **CAUTION!** default password is "0318", and operator can change it to prevent others from changing controller's advanced configuration at will. Please memorize the new password after changing. If forget it, please contact with supplier service personnel.
5	LCD Backlight	Contrast Ratio	(0-10)	5	
		Brightness	(0-5)	5	
		Backlight Delay	(0-3600)min	5	If delay time is set as 0 min, backlight is always light.
6	Date And Time				Users can calibrate date and time by themselves.

No.	Item	Range	Default	Description
Timers Setting				
1	Start Delay	(0-3600)s	1	Time from remote start signal is active to engine start.
2	Stop Delay	(0-3600)s	1	Time from remote stop signal is active to engine stop.
3	Preheating Delay	(0-3600)s	0	Time of pre-powering of preheating plug before starter is powered up.
4	Prestart Fuel Time	(0-3600)s	1	Time of fuel relay output before starter powered up.
5	Cranking Time	(3-60)s	8	Time of starter powered up every time (If diesel driven suction pump enabled, it is also can be the cranking time).
6	Cranking Rest Time	(3-60)s	10	The waiting time before the second powering up when engine starting fails (If diesel driven suction pump enabled, it is also can be cranking rest time of diesel driven suction pump).
7	Safety On Delay	(0-3600)s	10	Alarms for low oil pressure, high temperature, under speed, under frequency/voltage, charging failure are inactive during this time.
8	Start Idle Time	(0-3600)s	0	Idle running time of engine when starting.
9	High-speed Warming Up Time	(0-3600)s	10	Warming-up time for engine after high speed running and before loading.
10	High-speed Cooling Time	(0-3600)s	10	Heat dissipating time before engine stop.
11	Stop Idle Time	(0-3600)s	0	Idle running time when engine stop.
12	ETS Output Time	(0-3600)s	20	The time of powering up the ETS before stopping (If diesel driven suction pump enabled, it is also can be stop output time of diesel driven suction pump).
13	Waiting Stop Time	(0-3600)s	0	Time between ending of idle delay and stopping completely when ETS Output Time is 0; Time between ending of ETS delay and stopping completely when ETS Output Time is not 0.
14	After Stop Time	(0-3600)s	0	Time between engine stop and standby status.
15	Fuel Pre-supply Rest Time	(0-12)h	2	Interval between the completion of the current pre-fuel supply output and the next pre-supply output in standby status when output is configured as

No.	Item		Range	Default	Description
					"Fuel Pre-supply"; If time is 0, fuel pre-supply is not outputted in standby status.
16	Fuel Pre-supply Time		(3-30)s	5	Fuel pre-supply output time when output is configured as "Fuel Pre-supply".
Engine Setting					
1	Speed Signal Source		(0-1)	0	0: Speed Sensor; 1: W/L
2	W/L Ratio		(0-99.99)	9.04	
3	Flywheel Teeth		(1.0-300.0)	118.0	Tooth number of the engine, which is used for judging crank disconnect conditions and detecting rotate speed; Refer to the installation instructions.
4	Rated Speed		(0-6000) r/min	1500	Provide standard to judge over/under/ loading speed
5	Crank Attempts		(1-10) Times	3	Maximum crank times when engine fails to fire; When it reaches set times, controller will send crank failure signal. (If diesel driven suction pump enabled, it is also can be max. crank attempts of diesel driven suction pump).
6	Crank Disconnect Conditions		(0-2)	2	See table 12. There are 2 conditions of disconnecting starter with engine. Each condition can be used alone and simultaneously to separate the starting motor and engine as soon as possible.
7	Disconnect Speed		(0-200)%	24	Set value is the percentage of rated speed. When the speed is higher than the set value, starter will be disconnected. See the installation instruction.
8	Disconnect Oil Pressure		(0-1000)kPa	200	When oil pressure is higher than the set value, starter will be disconnected. See the installation instruction.
9	Overspeed Warn	Set Value	(0-200.0)%	110.0	Set value is the percentage of rated speed. Return value and delay value can also be set.
		Return	(0-200.0)%	108.0	
		Delay	(0-3600)s	5	
10	Underspeed Warn	Set	(0-200.0)%	55.0	
		Return	(0-200.0)%	60.0	
		Delay	(0-3600)s	5	
11	Overspeed Shutdown	Set	(0-200.0)%	114.0	Set value is the percentage of rated speed. Delay value can also be set.
		Delay	(0-3600)s	2	

No.	Item		Range	Default	Description
12	Underspeed Shutdown	Set	(0-200.0)%	50.0	
		Delay	(0-3600)s	3	
13	Loss of Speed Signal Delay		(0-3600)s	5	Time from detecting speed is 0 to action gets confirmed.
14	Loss of Speed Signal Action		(0-1)	0	0: Warning; 1: Shutdown
15	Battery Rated Voltage		(0-60.0)V	24.0	Provide standard for detecting over/under voltage of battery.
16	Battery Overvolt Warn	Set	(0-200)%	120	Set value is percentage of rated voltage of battery. Return value and delay value can also be set.
		Return	(0-200)%	115	
		Delay	(0-3600)s	60	
17	Battery Undervolt Warn	Set	(0-200)%	85	
		Return	(0-200)%	90	
		Delay	(0-3600)s	60	
18	Charging Failure	Set	(0-60.0)V	8.0	In normal running, when charger D+ (W/L) voltage is under this value, charging failure alarms will be initiated.
		Return	(0-60.0)V	10.0	
		Delay	(0-3600)s	10	
19	Battery Undervolt Detection	Enable	(0-1)	0	Detection before scheduled start. If battery voltage is lower than set value, battery undervolt alarms will be initiated.
		Set	(0-60.0)V	18.0	
20	Engine Idle		(0-100)%	60	Set value is percentage of rated speed. If idle running is needed, speed will be stabilized in set value.
21	Suction Pump Cranking		(0-2)	0	0: Not Used; 1: D-driven Suction Pump; 2: E-driven Suction Pump
22	D-driven Suction Pump Fault Shutdown Delay		(0-3600)s	90	Time for waiting for pressure coming (Input port is valid).
23	Outlet Pressure for E-driven Suction Pump Shutdown		(0-1000)kPa	100	Pressure value when E-driven suction pump start output stops outputting.
Analog Sensor Setting					
Temperature Sensor					
1	Curve Type		(0-15)	9	SGD. Details see Table 11.
2	Open Circuit Action		(0-2)	0	0: Warning; 1: Shutdown; 2: No Action
3	Display Unit		(0-1)	0	0: °C 1: °F
4	High Temp. Shutdown		(0-300)°C	98	Shutdown alarm when external sensor temperature is higher than this value. It is detected after safety delay. The delay value can be set.
5	High Temp. Warning		(0-300)°C	95	Warning when external sensor temperature is higher than this value. It is detected after safety delay. The return value and delay value can be set.

No.	Item	Range	Default	Description
6	Low Temp. Warning	(0-300)°C	70	Warning when sensor temperature is lower than this value. It is detected always. The return value and delay value can be set.
7	Heater Control	((-50)-300)°C	50	When the temperature value of external sensor is lower than it, the heating controller outputs. The return value and delay value can be set.
8	Cooler Control	((-50)-300)°C	80	When the temperature value of external sensor is higher than it, the cooling controller outputs. The delay value and return value can be set.
9	Custom Curve			When custom resistor type is selected, the related curve needs to be set.
Oil Pressure Sensor				
1	Curve Type	(0-15)	9	SGD. Details see Table 11.
2	Open Circuit Action	(0-2)	0	0: Warning; 1: Shutdown; 2: No Action
3	Display Unit	(0-2)	0	0: kPa; 1: bar; 2: psi.
4	Low Oil Pressure Shutdown	(0-1000)kPa	103	Engine will send shutdown alarm when oil pressure of external sensor is lower than this value. It is detected after safety delay. The delay value can be set.
5	Low Oil Pressure Warning	(0-1000)kPa	124	Warning when oil pressure is lower than this value. It is detected after safety delay. The return value and delay value can be set.
6	Custom Curve			When custom resistor/current/voltage types are selected, the related curve needs to be set.
Auxiliary Sensor 1~4				
1	Sensor Selection	(0-8)	0	0: Not Used; 1: Temperature Sensor; 2: Pressure Sensor; 3: Level Sensor; 4: Flow Sensor; 5: Pipe Pressure Sensor; 6: Inlet Pressure Sensor; 7: Water Level Sensor; 8: Outlet Pressure Sensor.
2	Curve Type			Changing based on the sensor type
3	Open Circuit Action	(0-2)	0	0: Warning; 1: Shutdown; 2: No Action
4	Display Unit	(0-1)	0	0: °C 1: °F **Note:** Different sensors with different display units.
5	Over Limit Shutdown	(0-9000)	100	Shutdown when external sensor value is higher than this value. Alarms enable and delay value can be set.

No.	Item	Range	Default	Description
6	Under Limit Shutdown	(0-9000)	10	Shutdown when external sensor value is lower than this value. Alarms enable and delay value can be set.
7	Over Limit Warning	(0-9000)	90	Warning when external sensor value is higher than this value. Alarms enable, delay value and return value can be set.
8	Under Limit Warning	(0-9000)	20	Warning when external sensor value is lower than this value. Alarms enable, delay value and return value can be set.
9	Custom Curve			When custom resistor/current/voltage types are selected, the related curve needs to be set.
Fuel Level Sensor Correlated Setting				
1	Correlated Sensor Set	(0-4)	0	0: Not Used 1: Auxiliary Sensor 1 2: Auxiliary Sensor 2 3: Auxiliary Sensor 3 4: Auxiliary Sensor 4
2	Fuel Pump Control	(0-1000)%	10	If the fuel level value of external sensor is lower than this value, fuel pump control outputs. Both return value and delay value can be set.
3	Fuel Tank Capacity Set	(0-10000)L	1000	
Outlet Pressure Correlated Setting				
1	Correlated Sensor Set	(0-4)	0	0: Not Used 1: Auxiliary Sensor 1 2: Auxiliary Sensor 2 3: Auxiliary Sensor 3 4: Auxiliary Sensor 4
2	Head Enable Set	(0-1)	0	0: Disable; 1: Enable
3	Flow Enable Set	(0-1)	0	0: Disable; 1: Enable
4	Static Water Pressure	(-9000-9000)kPa	0	Setting static pressure of pump outlet.
5	Flow Unit	(0-1)	0	0: m³/h; 1:L/s
6	Rated Flow	(0-10000)m³/h	1000	Rated working flow of engine.
7	Over Flow Warn	(0-1000)%	110	Warning if flow value is higher than this value during running. Alarms enable, delay value and return value can be set.
8	Over Flow Shutdown	(0-1000)%	120	Shutdown if flow value is higher than this value during running. Alarms enable and delay value can be set.
9	Flow Curve Set			Set the related curve between outlet pressures and the corresponding flows.
Auxiliary Input Ports				

No.	Item	Range	Default	Description
Auxiliary Input Port 1				
1	Content Set	(0-53)	28	Remote Start. Details see Table 10.
2	Active Type	(0-1)	0	0: Close; 1: Open
Auxiliary Input Port 2				
1	Content Set	(0-53)	26	High Temp. Shutdown. Details see Table 10.
2	Active Type	(0-1)	0	0: Close; 1: Open
Auxiliary Input Port 3				
1	Content Set	(0-53)	27	Low OP Shutdown. Details see Table 10.
2	Active Type	(0-1)	0	0: Close; 1: Open
Auxiliary Input Port 4				
1	Content Set	(0-53)	0	User-defined. Details see Table 10.
2	Active Type	(0-1)	0	0: Close; 1: Open
3	Active Range	(0-3)	2	0: After safety on delay; 1: From crank; 2: Always; 3: Never.
4	Active Action	(0-4)	0	0: Warning; 1: Shutdown; 2: Indication
5	Active Delay	(0-20.0)s	2.0	It is time from detecting input port is active to action is confirmed.
6	Description			User-defined
Auxiliary Input Port 5				
1	Content Set	(0-53)	0	User Configured Details see Table 10.
2	Active Type	(0-1)	0	0: Close; 1: Open
3	Active Range	(0-3)	2	0: After safety on delay; 1: From crank; 2: Always; 3: Never
4	Active Action	(0-4)	1	0: Warning; 1: Shutdown; 2: Indication
5	Active Delay	(0-20.0)s	2.0	It is time from detecting input port is active to action confirmed.
6	Description			User-defined
Auxiliary Output Ports				
Auxiliary Output Port 1				
1	Content Set	(0-119)	29	Fuel relay outputs. Details see Table 9.
2	Active Type	(0-1)	0	0: Normally Open; 1: Normally Close
Auxiliary Output Port 2				
1	Content Set	(0-119)	28	Crank relay outputs. Details see Table 9.
2	Active Type	(0-1)	0	0: Normally Open; 1: Normally Close
Auxiliary Output Port 3				
1	Content Set	(0-119)	30	Idle Control. Details see Table 9.

No.	Item	Range	Default	Description
2	Active Type	(0-1)	0	0: Normally Open; 1: Normally Close
Auxiliary Output Port 4				
1	Content Set	(0-119)	31	Speed Raise Output. Details see Table 9.
2	Active Type	(0-1)	0	0: Normally Open; 1: Normally Close
Auxiliary Output Port 5				
1	Content Set	(0-119)	32	Speed Drop Output. Details see Table 9.
2	Active Type	(0-1)	0	0: Normally Open; 1: Normally Close
Auxiliary Output Port 6				
1	Content Set	(0-119)	1	Custom Period Output. Details see Table 9.
2	Active Type	(0-1)	0	0: Normally Open; 1: Normally Close
Speed Adjustment Setting				
1	Interface Type	(0-2)	0	0: Not Used; 1: Relay Speed Adjustment; 2: GOV Speed Adjustment.
2	Stepping Coefficient	(0-100)	1	Higher GOV speed ratio, bigger the stepping coefficient. On the contrary, it will be smaller.
3	GOV Center (SW1)	(0-10.0)V	5.0	Central voltage of electrical governor.
4	GOV Scope (SW2)	(0-10.0)V	2.0	The scope of central voltage that can be changed up and down.
5	GOV Output Reverse	(0-1) 0: Not Reverse 1: Reverse	0: Not Reverse	Whether reverse GOV output
Scheduling And Maintenance Setting				
1	Scheduled Run	(0-1)	0	0: Disable; 1: Enable
2	Scheduled Not Run	(0-1)	0	0: Disable; 1: Enable
3	Maintenance 1	(0-1)	0	0: Disable; 1: Enable
4	Maintenance 2	(0-1)	0	Set maintenance time, maintenance time due action, forewarning A and forewarning B time and action, maintenance timing way, and reset maintenance time can be set simultaneously. After unit maintenance, the maintenance time due alarm can be recovered by maintenance time reset. Details see Table 13.
5	Maintenance 3	(0-1)	0	
6	Maintenance 4	(0-1)	0	
7	Maintenance 5	(0-1)	0	

⚠ **NOTE:**

— When parameter configuration is going on via PC software, there is no need to input password if default password (0318) isn't changed; if default password has been changed, for the first time when parameters are setting via PC

software, it is requested to write password in the password input window.

— Auxiliary inputs are prohibited to set same items, or there will not appear correct functions. Programmable outputs are allowed to set same items.

— Fuel level sensor correlated setting: if fuel level is needed, any one of auxiliary sensor 1-4 could be set as level sensor, and meanwhile curve type should be set the corresponding one. Then set fuel level correlated sensor and choose the corresponding auxiliary sensor, so the auxiliary sensor is the fuel level sensor, which can realize the function of fuel pump control and fuel tank capacity display.

— Outlet pressure correlated setting: if flow and head are to be calculated via water pressure, one of auxiliary sensor 1-4 needs to be configured as outlet pressure sensor, and meanwhile, curve type needs to be the corresponding one. Then set the outlet pressure correlated sensor and select the corresponding auxiliary sensor, and at this time, flow and head can be calculated via water pressure.

— If E-driven suction pump needs to judge whether it has stopped output by water pressure, outlet pressure correlation setting is also needed.

8.2 DEFINABLE CONTENTS OF AUXILIARY OUTPUT PORTS 1-6

Table 9 – Definable Contents of Auxiliary Output 1-6

No.	Type	Description
0	Not Used	
1	Custom Period Output 1	
2	Custom Period Output 2	
3	Custom Period Output 3	
4	Custom Period Output 4	
5	Custom Period Output 5	
6	Custom Period Output 6	Details of function description please see the following.
7	Custom Combined Output 1	
8	Custom Combined Output 2	
9	Custom Combined Output 3	
10	Custom Combined Output 4	
11	Custom Combined Output 5	
12	Custom Combined Output 6	
13	Reserved	
14	Reserved	
15	Air Flap Control	Act when over speed shutdown and emergence stop, and it can close the air inflow to stop the engine sooner.
16	Audible Alarm	Act when warning and shutdown alarms occur, it can be connected to annunciator externally. When auxiliary input "alarm mute" is active or press any key on the panel, it can be stopped. When new alarm or shutdown occurs, it will output again.
17	Louver Control	Act when engine is starting and disconnect when engine stops completely.
18	Fuel Pump Control	It is controlled by fuel pump control threshold of level sensor.

No.	Type	Description
19	Heater Control	It is controlled by heater control threshold of temperature sensor.
20	Cooler Control	It is controlled by cooler control threshold of temperature sensor.
21	Fuel Pre-supply Output	In standby status, when fuel pre-supply output is active, set fuel pre-supply rest time and fuel pre-supply time are outputted circularly. If set fuel pre-supply rest time is 0, fuel pre-supply is not outputted. Before starting the set fuel pre-supply time is outputted. If the preheating time is not configured, fuel pre-supply phase is outputted. If there is preheating configuration, then the preheating phase will be outputted.
22	Reserved	
23	Pre-lubricate Output	Act in the course of preheating, cranking and cranking rest time.
24	Remote Control	This port is controlled by RS485 communication port.
25	Reserved	
26	Reserved	
27	Reserved	
28	Crank Relay Output	Act when engine is starting and disconnect when cranking is successful.
29	Fuel Relay Output	Act when engine is starting and disconnect when it stops completely.
30	Idle Control	Applicable to engines with idle. Close before cranking and open after starting high-speed warming up; Close during stop idle process and open when stop is completed. In other statuses, if idle control input is active or idle key is pressed, relay will close and starts outputting.
31	Speed Raise Output	Act in the course of high-speed warming up. It is controlled by speed adjustment during regular working period.
32	Speed Drop Output	Act during the period from stop idle speed time to waiting stop time. It is controlled by speed adjustment during regular working period.
33	ETS Control	Applicable to oil engines with ETS electromagnets. Close when stop idle time is over and open when set ETS delay time is over.
34	Reserved	
35	Reserved	
36	Reserved	
37	Reserved	
38	Cranking Success Output	Close when a successful starting signal is detected.
39	Normal Running Output	Relay closes when engine is normally running.
40	Reserved	
41	Reserved	
42	Common Alarm	Act when engine common warnings or shutdown alarms happen.
43	Common Shutdown Alarm	Act when common shutdown alarms happen.
44	Common Warning Alarm	Act when common warning alarms happen.

No.	Type	Description
45	Reserved	
46	Battery Overvoltage	Act when battery overvoltage alarms happen.
47	Battery Undervoltage	Act when battery undervoltage alarms happen.
48	Charging Failure	Act when engine charging failure alarms happen.
49	Reserved	
50	Reserved	
51	Reserved	
52	Reserved	
53	Reserved	
54	Reserved	
55	D-driven Pump Start Output	Pump start outputs when it is set as diesel-driven suction pump.
56	D-driven Pump Stop Output	Pump stop outputs when it is set as diesel-driven suction pump.
57	E-driven Pump Start Output	Pump outputs as it starts, and pump stops outputting as it stops when it is set as electronic-driven suction pump.
58	Reserved	
59	Input Port 1 Active	Act when input port 1 is active
60	Input Port 2 Active	Act when input port 2 is active
61	Input Port 3 Active	Act when input port 3 is active
62	Input Port 4 Active	Act when input port 4 is active
63	Input Port 5 Active	Act when input port 5 is active
64	Reserved	
65	Reserved	
66	Reserved	
67	Emergency Stop Alarm	Act when emergency stop alarms happen.
68	Crank Failure Alarm	Act when crank failure alarms happen.
69	Stop Failure Alarm	Act when stop failure alarms happen.
70	Under Speed Warning	Act when under speed warnings happen.
71	Under Speed Shutdown	Act when under speed shutdown alarms happen.
72	Over Speed Warning	Act when over speed warnings happen.
73	Over Speed Shutdown	Act when over speed shutdown alarms happen.
74	Reserved	
75	Reserved	
76	Bypass Control Output	Output from start idle time to stop idle time when water gun on-off input is active.
77	Reserved	
78	Reserved	
79	Engine High Temp. Warning	Act when high temp. warnings happen.
80	Engine Low Temp. Warning	Act when low temp. warnings happen.
81	Engine High Temp. Shutdown	Act when high temp. shutdown alarms happen.
82	Reserved	
83	Engine Low Oil Pressure Warning	Act when low oil pressure warnings happen.
84	Engine Low Oil Pressure	Act when low oil pressure shutdown alarms happen.

No.	Type	Description
	Shutdown	
85	Oil Pressure Sensor Open	Act when oil pressure sensor is open circuit.
86	Reserved	
87	Sensor 1 High Warning	Act when auxiliary sensor 1 high warnings happen.
88	Sensor 1 Low Warning	Act when auxiliary sensor 1 low warnings happen.
89	Sensor 1 High Shutdown	Act when auxiliary sensor 1 high shutdowns happen.
90	Sensor 1 Low Shutdown	Act when auxiliary sensor 1 low shutdowns happen.
91	Over Flow Shutdown	Act when over flow shutdown alarms occur.
92	Over Flow Warning	Act when over flow warnings occur.
93	Sensor 2 High Warning	Act when auxiliary sensor 2 high warnings happen.
94	Sensor 2 Low Warning	Act when auxiliary sensor 2 low warnings happen.
95	Sensor 2 High Shutdown	Act when auxiliary sensor 2 high shutdowns happen.
96	Sensor 2 Low Shutdown	Act when auxiliary sensor 2 low shutdowns happen.
97	Sensor 3 High Warning	Act when auxiliary sensor 3 high warnings happen.
98	Sensor 3 Low Warning	Act when auxiliary sensor 3 low warnings happen.
99	Sensor 3 High Shutdown	Act when auxiliary sensor 3 high shutdowns happen.
100	Sensor 3 Low Shutdown	Act when auxiliary sensor 3 low shutdowns happen.
101	Sensor 4 High Warning	Act when auxiliary sensor 4 high warnings happen.
102	Sensor 4 Low Warning	Act when auxiliary sensor 4 low warnings happen.
103	Sensor 4 High Shutdown	Act when auxiliary sensor 4 high shutdowns happen.
104	Sensor 4 Low Shutdown	Act when auxiliary sensor 4 low shutdowns happen.
105	Reserved	
106	Reserved	
107	Reserved	
108	Reserved	
109	Reserved	
110	Reserved	
111	Reserved	
112	Reserved	
113	System in Stop Mode	Act when system is in stop mode.
114	System in Manual Mode	Act when system is in manual mode.
115	System in Auto Mode	Act when system is in auto mode.
116	Reserved	
117	Reserved	
118	Reserved	
119	Reserved	

8.2.1 CUSTOM PERIOD OUTPUT

Users-defined period output is composed by 2 parts: period output S1 and condition output S2.

While S1 and S2 are **TRUE** synchronously, OUTPUT;

While S1 or S2 is **FALSE**, NOT OUTPUT.

Period output S1 can be configured to one or several period outputs of the engine freely. Delay time after entering the period before outputting and output time can be set.

Condition output S2 can be set as any conditions in output port setting.

⚠**NOTE:** when both period output S1's delay output time and output time are 0, period output S1 is **TRUE** in its setting period.

Output period: start

Delay output time: 2s

Output time: 3s

Condition output content: output port 1 is active.

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

When output port 1 is active, it enters start time and after it delays for 2s, the user-defined period output starts to output, then after outputting for 3s, it stops outputting;

When output port 1 is inactive, the users-defined output does not output.

8.2.2 CUSTOM COMBINED OUTPUT

Users-defined combined output is composed by 3 parts: OR condition output S1, OR condition output S2, AND condition output S3.
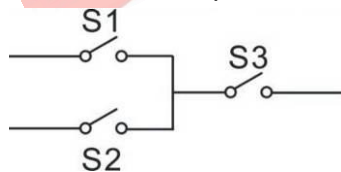
If S1 or S2 is **TRUE**, and S3 is **TRUE**, users-defined combined output works;

If both S1 and S2 are **FALSE**, or S3 is **FALSE**, users-defined combined output does not work.

⚠**NOTE:** S1, S2, and S3 can be any other contents except original users-defined combined output in the output setting.

⚠**NOTE:** The 3 parts of users-defined combined output (S1, S2, and S3) cannot include or recursively include original outputs.

OR condition output S1 contents: output port 1 is active;

OR condition output S1 close status (active/inactive): close when active (disconnect when inactive);

OR condition output S2 contents: output port 2 is active;

OR condition output S2 close status (active/inactive): close when active (disconnect when inactive);

AND condition output S3 contents: output port 3 is active;

AND condition output S3 close status (active/inactive): close when active (disconnect when inactive);

When input port 1 is active or input port 2 is active, if input port 3 is active, users-defined combined output works; if input port 3 is inactive, it does not output;

When input port 1 is inactive and input port 2 is inactive as well, whether input port 3 is active or not, users-defined combined output does not work.

8.3 DEFINABLE CONTENTS OF AUXILIARY INPUT PORTS

Table 10 – Definable Contents of Auxiliary Input Ports

No.	Type	Description
0	Users-defined	Users-defined functions are as below: Indication: Only display; No warning; No shutdown; Warning: Only warning; No shutdown; Shutdown: alarm and shutdown immediately; Invalid: input not working; Always: detecting always when inputting; Valid from cranking: starting to detect from cranking; Valid when safe running: starting to detect from safely running delay;
1	Reserved	
2	Alarm Mute	Prohibit Audible Alarm in the output setting when input is active;
3	Alarm Reset	Reset shutdown alarm when input is active;
4	Reserved	
5	Lamp Test	All the indicator on the panel are light when input is active;
6	Panel Lock	All keys on the panel do not work and cannot conduct parameter setting, but can do language setting, check event log and controller information when input is active except Page Up, Confirm and Page Down ones; Home screen displays 🔒 icon at the bottom right corner;
7	Cranking Success Input	Crank is successful when input is active; If it is configured, speed and oil pressure cranking conditions shall be invalid;
8	Idle Mode	Enter idle mode when input is active;
9	Auto Stop Inhibit	Prohibit engine to stop automatically when input is active after regular running in Auto mode;
10	Auto Start Inhibit	Prohibit engine to start automatically when input is active in Auto mode;
11	Scheduled Start Inhibit	Prohibit engine to scheduled start when input is active in Auto mode;
12	Reserved	

No.	Type	Description
13	Reserved	
14	Idle/High Speed	Enter into idle mode when input is active; Get back to high-speed running when input is invalid;
15	Reserved	
16	Reserved	
17	Reserved	
18	D-driven Suction Pump Start Success	Pump start succeeds when input is active;
19	Suction Pump Pressure Coming	Pressure forms when input is active;
20	Water Gun On-Off Status	Normal status: if input is active, bypass control outputs from start idle time to stop idle time; Idle running status: if input is active, engine goes from idle running to normal working status, and meanwhile bypass control outputs (if configured);
21	Alarm Stop Inhibit	All shutdown alarms are inhibited except for emergency stop and over speed shutdown; (Override Mode)
22	Instrument Mode	All outputs are inhibited in this mode.
23	Reserved	
24	Reset Maintenance Time	Maintenance 1's time and date is set as preset value when input is active;
25	External Charging Failure	When input is active, charging failure alarms happen;
26	High Temp. Shutdown	Connect sensor digital input;
27	Low OP Shutdown	Connect to sensor digital input;
28	Remote Start	In **Auto** mode, when input is active, engine can be started automatically.
29	Remote Stop	In **Auto** mode, when input is active and remote start input is inactive, engine can be stopped automatically.
30	High Level Input	In **Auto** mode, when input is active, engine can be started automatically (drain flood).
31	Low Level Input	In **Auto** mode, when input is active and high level input is inactive, engine can be stopped automatically (drain flood).
32	Manual Start Input	In **Auto** mode, when input is active, engine can be started automatically; when input is inactive, engine can be stopped automatically.
33	Reserved	
34	Simulate Stop key	
35	Simulate Manual key	
36	Simulate Auto key	Connect an external button (unlatched) and press simulate panel buttons;
37	Simulate Start key	
38	Simulate Speed Adjustment Key	
39-51	Reserved	
52	Speed Raise	Connect an external button (unlatched) and control speed manually;
53	Speed Drop	

8.4 SELECTION OF SENSORS

Table 11 − Sensor Selection

No.		Description	Remark
1	Temperature Sensor	0 Not used 1 Custom Resistor Curve 2 Custom (4-20)mA Curve 3 Custom Voltage Curve 4 VDO 5 CURTIS 6 VOLVO-EC 7 DATCON 8 SGX 9 SGD 10 SGH 11 PT100 12-15 Reserved	Defined resistor's resistance range is (0~1)KΩ, SGD sensor (Default)
2	Pressure Sensor	0 Not used 1 Custom Resistor Curve 2 Custom (4-20)mA Curve 3 Custom Voltage Curve 4 VDO 10bar 5 CURTIS 6 VOLVO-EC 7 DATCON 10bar 8 SGX 9 SGD 10 SGH 11-15 Reserved	Defined resistance range is (0~1)KΩ, SGD sensor (Default)
3	Fuel Level Sensor	0 Not used 1 Custom Resistor Curve 2 Custom (4-20)mA Curve 3 Custom Voltage Curve 4 SGD 5 SGH 6-15 Reserved	Defined resistance range is (0~1)KΩ, SGD sensor (Default)
4	Flow Sensor	0 Not used 1 Custom Resistor Curve 2 Custom (4-20)mA Curve 3 Custom Voltage Curve 4-15 Reserved	

8.5 CONDITION SELECTION OF CRANK DISCONNECTION

Table 12 – Crank Disconnection Conditions

No.	Setting description
0	Engine Speed
1	Oil pressure
2	Oil pressure + Engine Speed

⚠**NOTE:**

— There are 3 kinds of conditions that can disconnect the starter and the engine. Speed sensor and oil pressure sensor can be used independently. It is suggested that oil pressure sensor matches speed sensor together aiming to separate starting motor from the engine as soon as possible and judge whether it is started successfully precisely.

— Speed sensor is the magnetic equipment which is installed in the engine for detecting flywheel teeth number.

— If speed sensor is selected, please make sure that the flywheel teeth number is the same as the settings, or over speed shutdown and under speed shutdown may happen.

— If there is not speed sensor in the unit, please do not select corresponding items, or start failure and loss of speed signal alarm and shutdown may happen.

— If there is not oil pressure sensor in the unit, please do not select corresponding items.

8.6 MAINTENANCE SETTING

Table 13 – Maintenance Setting

Item	Content	Description
Enable Choice	0: Disabled, 1: Enabled	Applicable to set whether maintenance function is active or not.
Maintenance Time	(0-30000)h	Hours from maintenance enable to maintenance start.
Maintenance Time Due Action	0: No Action; 1: Warning; 2: Shutdown; 3: Indication.	Alarm action when remaining maintenance time is 0.
Pre-alarm A Time	(0-30000)h	Remaining maintenance time.
Pre-alarm A Action	Same as the Maintenance Time Due Action	Action when remaining maintenance time reaches pre-alarm A time.
Pre-alarm B Time	(0-30000)h	Remaining maintenance time.
Pre-alarm B Action	Same as the Maintenance Time Due Action	Action when remaining maintenance time reaches pre-alarm B time.
Maintenance Timing Way	0: Unit Running Time 1: Real Time Clock	The timing way of maintenance.
Reset Maintenance Time		Applicable to reset maintenance time after maintenance is finished.
Maintenance Description		Applicable to put in maintenance name, e.g. change engine oil.

9 PARAMETER SETTING

Press ⚙ key and setting menu appears after controller is powered on. The menu list is as below:

>Return

>Parameter Setting

>Override Mode

>Language

>Event Log

>Module Info

Select "Parameter Setting" and input the password (default: 0318) to the parameter setting interface.

Parameter setting details are as below:

|	
Parameter Setting >Return >Module Set >Timer Set >Engine Set	Screen 1: Entering the setting item, press △ ▽ to change the settings; press ⚙ to confirm and the parameter setting (Screen 2) appears; press 🔴 to return to previous level. Select "Return" and press "Confirm" key the previous screen appears.
Timer Set >Return >Start Delay >Stop Delay >Preheating Delay	Screen 2: Press △ ▽ to change the settings; press ⚙ to enter parameter setting (Screen 3); press 🔴 to return to the last screen (Screen 1). Select "Return" and press "Confirm" key the previous screen (Screen 1) appears.
Start Delay 00001s	Screen 3: Press ⚙ and move the cursor, then pick on the value that needs to be changed and press △▽ to modify. After modification, press ⚙ to save. Then press ▽ to return to previous screen (Screen 2).
Timer Set >Return >Start Delay >Stop Delay >Preheating Delay	Screen 4: Press ▽, select and modify the value (same with Screen 2 and Screen 3).
Over Shutdown Set Enable Choice: Enabled Set Value: +00098	Screen 5: Sensor shutdown parameter setting. Select >Over Shutdown Set, press ⚙ to enter, and then press ⚙ again to enter Screen 5.

Delay Value: 00003s	Press ⬆ ⬇ to select setting, then press ⦿ to save and meanwhile the cursor will move down as Screen 6 shows.
Over Shutdown Set Enable Choice: Enabled Set Value: +00098 Delay Value: 00003s	Screen 6: Press ⬆ ⬇ to change plus or minus, then press ⦿ to next bit. After setting finished, press ⦿ to enter delay setting. If there is no need to modify, press ◯ to return.
Pump Cranking Set 0: Not Used	Screen 7: Pump cranking setting. Select > Pump Cranking Set, press ⦿ to enter setting, press ⦿ again to enter Screen 7, press ⬆ ⬇ to select setting (as Screen 8).
Pump Cranking Set 1:D-driven Suction Pump Fault Shutdown Delay 00090s	Screen 8: Press ⬆ ⬇ to show more setting information. Press ⦿ to configure next setting (such as Screen 9). If there is no need to change, press ◯ to return.
Pump Cranking Set 1:D-driven Suction Pump Fault Shutdown Delay 00090s	Screen 9: Press ⦿ and move cursor, select the value and press ⬆ ⬇ to modify. Press ⦿ to save your modification. Then press ⬇ to return.

⚠ **NOTE:**

— Please modify inner parameters under the standby status (e.g.: cranking disconnection condition selection, auxiliary input/output configuration, all kinds of delays etc.), otherwise shutdown or other abnormal phenomenon shall appear.

— High threshold must be bigger than low threshold, otherwise over high and over low may appear at the same time.

— Please set return value correctly as to setting warning alarms, otherwise the controller cannot alarm normally. The return value shall be less than the value set as to setting over high warning; the return value shall be higher than the value set as to setting over low warning.

— Auxiliary inputs must not be set the same value, otherwise normal function cannot be produced. Auxiliary outputs can be the same.

10 SENSOR SETTING

— Standard value shall be transferred for the sensor curve when sensors are reselected. For example, if the temperature sensor set in the delivery process is SGD, it will be SGD curve; if SGX, it will be SGX curve.

— If there is difference between standard sensor curve and the using sensor, users-defined sensor can be selected, and it naturally is defined sensor curve.

— If "Not Used" is selected, the sensor curve does not work.

— "Not used" must be selected if the sensor only has an alarm switch, otherwise shutdown or warning may happen.

— The Y-axis values of the several points at the headmost and backmost can be set the same. Please see Fig. 4.
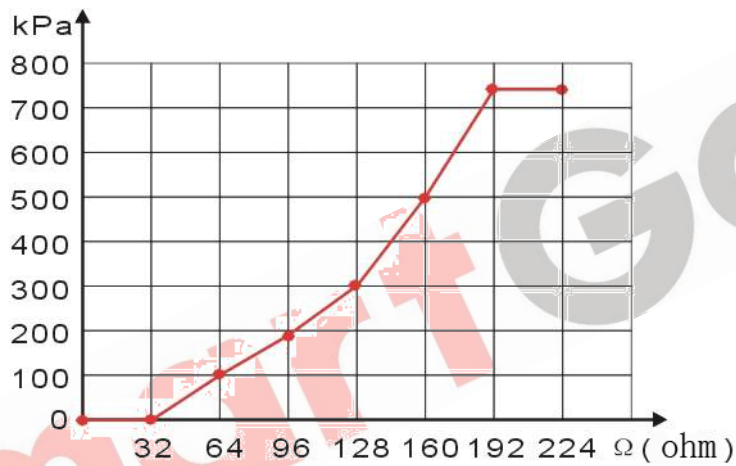
Fig.4 – Curve Setting

Table 14 – Normal Pressure Unit Conversion Form

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

11 COMMISSIONING

Before formal operation, following examinations are suggested:

a) Ensure all the connections are correct and wire diameter is suitable.

b) Ensure the DC power of the controller is equipped with fuse and that it is correctly connected with the passive and negative anodes of the starter battery.

c) Take proper measures to stop engine to crank successfully (e. g.: remove the connection wire of the fuel valve.). Make sure everything is correct and power on the starter battery, then the controller shall conduct program.

d) Press "Start" button, and the engine shall start. After the starting times set, the controller shall give out starting failure signal. Press "Stop" button and the controller shall recover.

e) Recover the actions that stop the engine to start successfully (recover the connection wire of the fuel valve.), and press the "Start" button again and the engine shall start. If everything is Ok, the engine shall work from idle speed running (if there is idle speed set) to normal running. During this period, please observe the working situation of the engine.

f) If there is any other question, please contact SmartGen's service personnel.

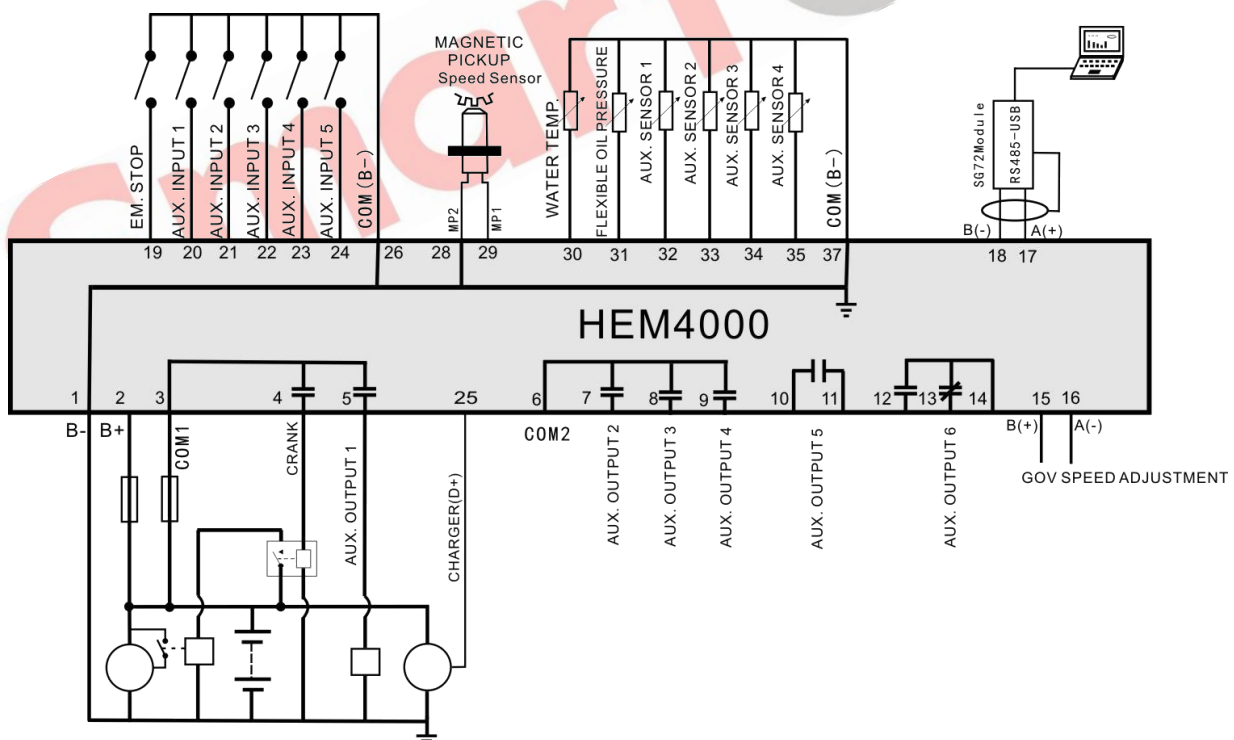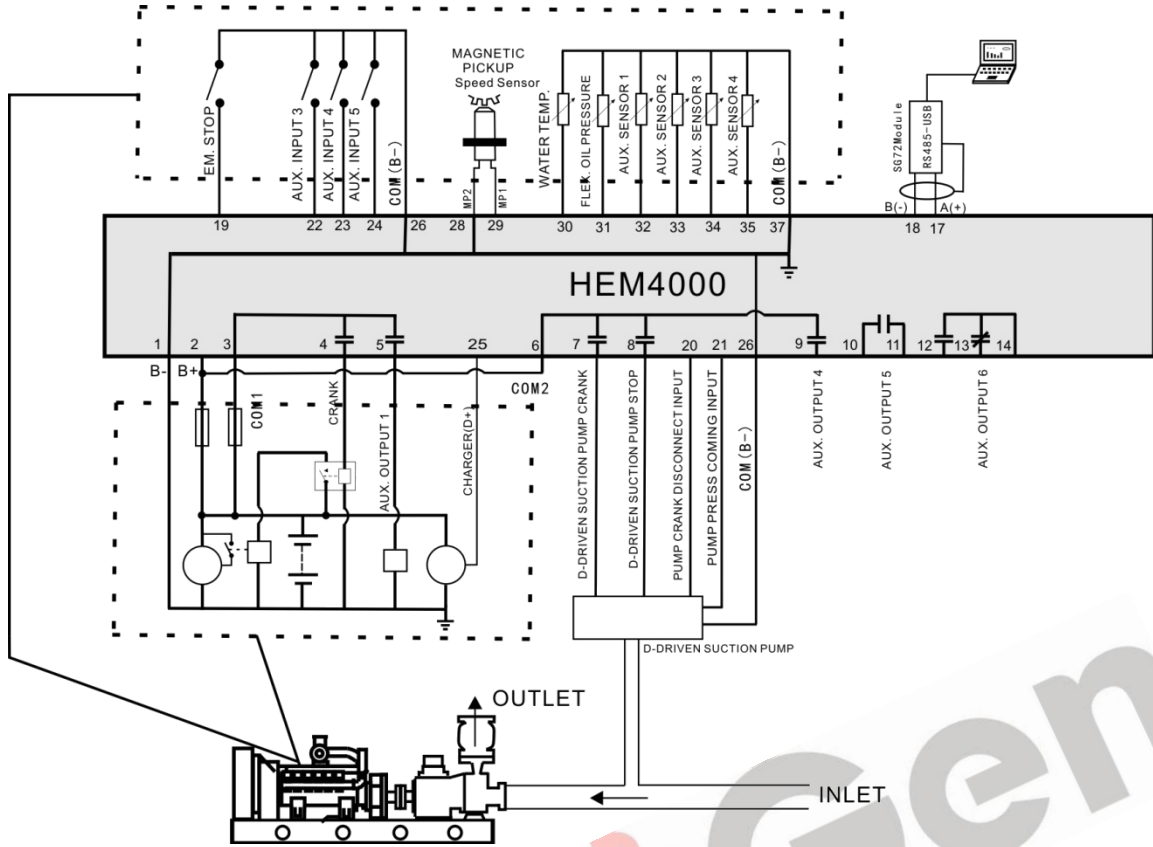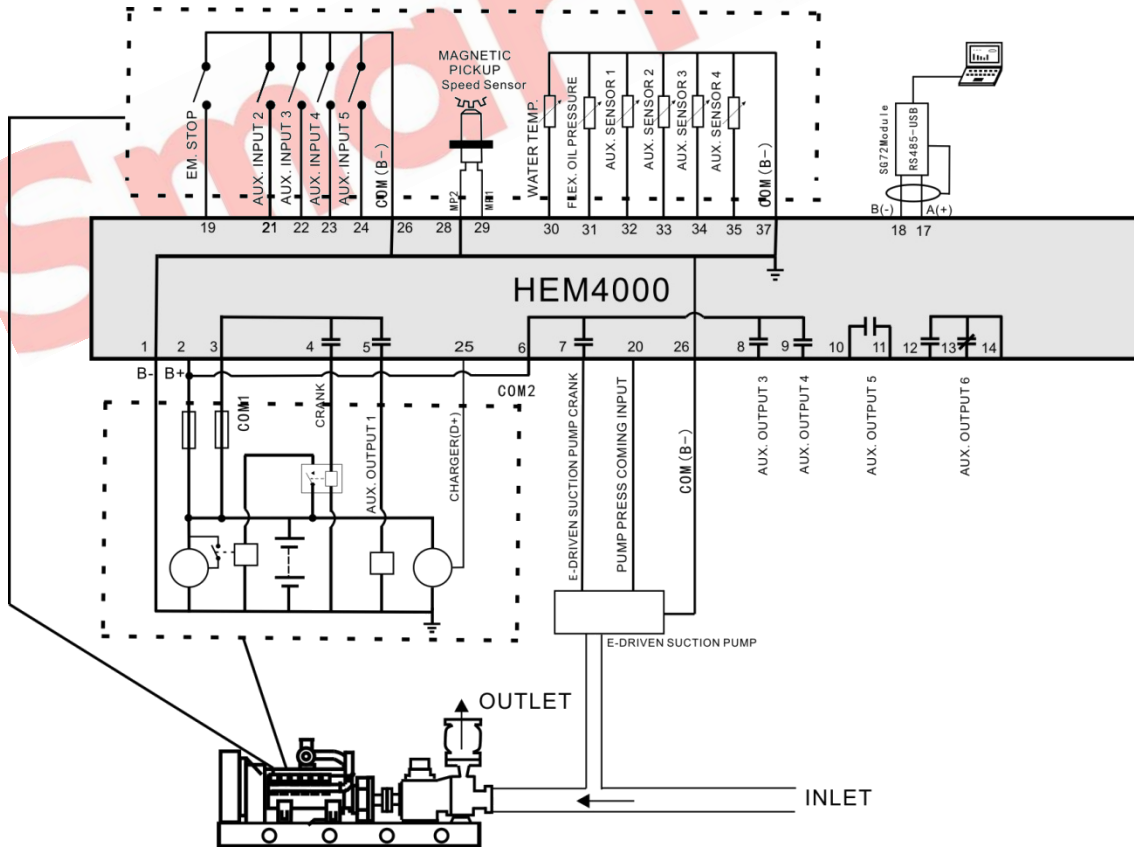## 12 TYPICAL APPLICATION

Fig.5 – HEM4000 Typical Application Diagram

Fig.6 – Connecting to D-driven Suction Pump Typical Application Diagram

Fig.7 – Connecting to E-driven Suction Pump Typical Application Diagram

![SmartGen logo - ideas for power]

13 INSTALLATION

13.1 FIXING CLIPS

HEM4000 controller is designed as panel mounting. Panels are fixed by the clips.

— Screw out the metal clips to proper position anticlockwise.

— Pull the fixed clips towards the controller back direction, and ensure four fixed metal clips are all fixed inside the allotted slots.

— Screw up the metal clips clockwise, and make sure they are fixed on the panels.

⚠️**NOTE:** The screw of the clips shall not be tightened up too much.

13.2 OVERALL DIMENSION AND CUTOUT
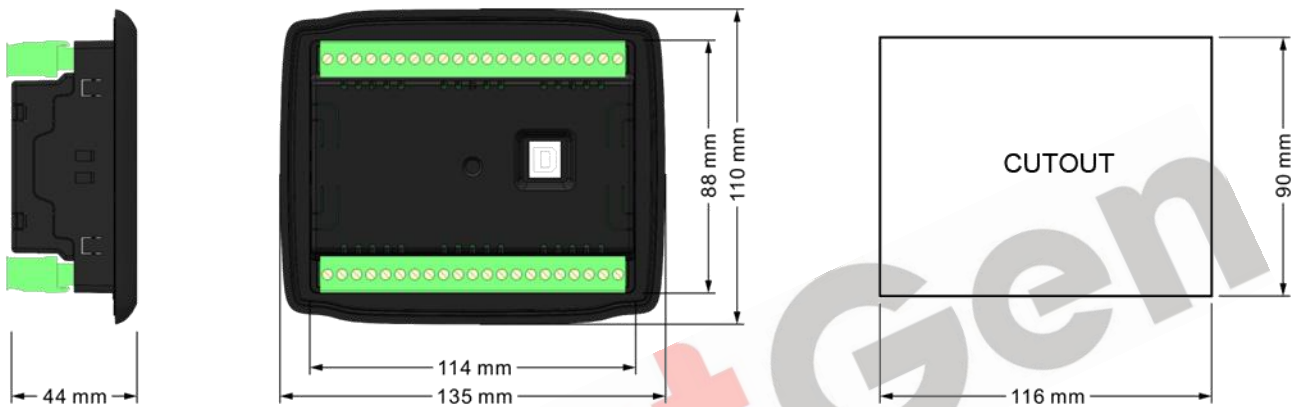
Fig.8 – Overall Dimensions and Cutout

— **BATTERY VOLTAGE INPUT**

HEM4000 controller is applicable to battery voltage DC (8~35)V environment. Negative anode of the battery must be connected with the engine shell. Sectional area of the wire that connects with the controller power B+ and B- must be equal to or over 1.5mm². If floating charger is configured, please connect output wires directly to the battery's positive and negative anodes, and then connect wires from battery's positive and negative to the controller's positive and negative input ends in order to prevent charger disturbing the controller's normal working.

— **SPEED SENSOR INPUT**

Speed sensor is the magnetic equipment installed in the engine body to detect flywheel teeth number. The wires used to connect with the controller shall be 2-core shielding wires. The shielding layer shall be connected to No. 28 terminal on the controller, and meanwhile the other terminal shall be hanging in the air. Another two signal wires shall be connected to No.28 and No.29 terminals on the controller. The output voltage of the speed sensor shall be within AC (1~24)V (RMS) in the range of full speed and AC12V is recommended (at rated speed). As to speed sensor installation, the sensor can firstly be spun to the connection flywheel, then invert 1/3 lap, and finally tighten up the screw on the sensor.

— **OUTPUT AND EXPAND RELAYS**

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

14 FAULT FINDING

Table 15 – Fault Finding

Fault Symptoms	Possible Solutions
Controller no response with power	Check starting battery; Check controller connection wirings; Check DC fuse;
Engine shutdown	Check whether the water/cylinder temperature is too high or not; Check DC fuse;
Controller emergency stop	Check whether emergence stop button is correct or not; Check whether the connection circuit is open;
Low oil pressure alarm after successful start	Check the oil pressure sensor and its connection wires.
High water temp. alarm after successful start	Check the temperature sensor and its connection wires.
Shutdown alarm in running	Check relating switches and connection wires according to the information on the LCD; Check auxiliary input ports.
Crank failure	Check fuel circuit and its connections; Check starting battery; Check speed sensor and its connections; Refer to engine manual.
Starter no response	Check starter connections; Check starting battery.
RS485 abnormal communication	Check connections; Check whether COM port settings are correct or not; Check whether A and B wires of RS485 are reversely connected or not; Check whether RS485 conversion module is damaged or not; Check whether the communication port of PC is damaged or not.

15 PACKING LIST

Table 45 – Packing List

No.	Name	Quantity	Remark
1	Controller	1	
2	Fixed Clip	2	
3	Certification	1	
4	User Manual	1	

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