SmartGen
MAKING CONTROL SMARTER

APC1700
ENGINE PUMP CONTROLLER
USER MANUAL

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SmartGen **Registered trademark**

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Table 1 Software Version

Date	Version	Note
2025-7-30	1.0	Original release.

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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 a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.

CONTENTS

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1 OVERVIEW

APC1700 Engine Pump Controller is used for diesel engine-driven water pump units to realize water pump start/stop, data measurement, maintenance, alarm protection and "Three Remotes" (remote control, remote measurement, and remote communication). It is compatible with various diesel engine-driven water pump units.

APC1700 Engine Pump Controller adopts 32-bit micro-processor technology, which can realize functions of precise measurement for many parameters, set value adjustment, timer and threshold setting, etc. The parameters can be adjusted from the controller panel, and they can be adjusted and monitored on PC via RS485 port. The controller can be widely applied to diesel engine-driven water pump units control system with its small size, compact structure, simple wiring, and high reliability.

2 PERFORMANCE AND FEATURES

Main features are as follows:
— LCD screen with 132x64 resolution and backlight; Optional Chinese and English languages; Simple operation interface;
— Screen protection is hard screen of acrylic material with better wear-resisting and scratch resistant quality;
— Silicon front panel and buttons with strong adaptive capacity of high/low temperature environment;
— With RS485 communication port, it can realize "Three Remotes" function via MODBUS protocol;
— 5 ways of analog sensors, including 3 resistance type sensors, 1 current type sensor and 1 multifunctional sensor (resistance/current/voltage type), which can precisely detect data of engine temperature, engine oil pressure, fuel level, outlet pressure, pipe pressure, flow rate, head, etc.;
— Provide multiple common temperature, pressure, and level sensor curves, and self-defined sensor curve is also available;
— Protection functions, including high engine water temperature, low engine oil pressure, engine over speed, high outlet pressure, high pipe pressure, over flow, etc.;
— Remote start/stop function, and support the pump unit start/stop control via external switch;
— Pipe pressure start/stop function enables it to automatically start/stop the unit according to the preset pipe pressure under auto mode;
— High outlet pressure return to idle speed function can control the unit run at idle speed when the outlet pressure exceeds the set value;
— Crank disconnect conditions (speed, oil pressure) are optional;
— Wide power supply range DC (8-35V), which can suit different starting battery voltage environment;
— Event log function, which can continuously save 99 records;
— Heater, cooler and fuel pump control functions;
— Maintenance function, maintenance time due action can be set;
— Plastic sealing gasket is designed for enclosure and front panel can reach IP65 protection level;
— Modular design, anti-flaming enclosure, embedded mounting on the outside of control panel, compact structure and easy installation.

3 SPECIFICATIONS

Table 3 Technical Parameters

Items	Contents
Operating Voltage	DC8.0V~35.0V, continuous power supply
Power Consumption	<3W (Standby mode: ≤2W)
Speed Sensor Voltage	1.0V~24.0V (RMS)
Speed Sensor Frequency	Max. 10,000Hz
Crank Relay Output	1A DC28V Active Output
Aux. Output 1~4	1A DC28V Active Output
Digital Input	Two ways (Auxiliary)
Analog Sensor	Three resistance-type sensors (Aux. sensor 1, Aux. sensor 2, Aux. sensor 3) One multifunctional sensor (Aux. sensor 4) One current-type sensor (Aux. sensor 5)
RS485 Port	Isolated, half-duplex, baud rate at 9600, maximum communication distance at 1000m.
Vibration Test	Frequency range: 5Hz~8Hz; Amplitude: ±7.5 mm; Frequency range: 8Hz~500Hz; Constant acceleration: 2g; IEC 60068-2-6
Shock Test	Acceleration: 50g; Pulse duration: 11ms; Pulse waveform: Half-sine IEC 60068-2-27
Bump Test	Acceleration: 20g; Pulse duration: 16ms; Pulse waveform: Half-sine IEC 60255-21-2
Case Dimensions	96mm × 86mm × 47mm
Panel Cutout	78mm × 66mm
Working Temperature	(-25~+70)°C
Working Humidity	(20~93)%RH
Storage Temperature	(-30~+80)°C
Protection Level	Front panel: IP65
Weight	0.17kg

4 OPERATION

4.1 CONTROLLER PANEL

Fig.1 Front Panel

⚠**NOTE:** Instructions of the indicators:

Alarm Indicator: slow flash (once per second) for warning alarms; quick flash (5 times per second) for shutdown alarms;

light off for no alarms;

Start Indicator: it is always on when the it is running normally.

Auto Indicator: it is always on after the it is in auto mode.

Stop Indicator: it is always on when it is in the stop status.

4.2 KEYS FUNCTION DESCRIPTION

Table 4 Keys Description

Icon	Keys	Function Description
I	Start/Confirm	Home page: Press it to start the engine when it is in the stop status. Parameter setting interface: Press it to confirm the settings.
⊚	Auto/Manual/Up	Home page: Manual/Auto Mode switching. When the Auto Mode indicator is always on, it indicates that the unit is in Auto Mode. Press this key to switch to Manual Mode, and the Auto Mode indicator will turn off. Press the key again to return to Auto Mode, and the Auto Mode indicator will be always on. Parameter setting interface: Press it to move up the cursor or increase the value in the setting.

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🔴	Stop/ Alarm Reset/ Lamp Test	Home page: 1. In the start status, press it to stop the running engine; 2. In the stop status, press it to reset alarms; 3. In the stop status, press and hold it for more than 3 seconds to test if the indicators on the front panel work normally (lamp test); Parameter setting interface: Press it to return to the previous menu.
🔽	Down/Set	Home page: 1. Press it to scroll down the screen page. 2. Press and hold it for 3 seconds to enter the setting menu; Parameter setting interface: Press it to move down the cursor or reduce the value in the setting.

4.3 AUTO START/STOP OPERATION

If the remote stop input is configured for the input ports: The unit will start automatically when the remote start input is active and the remote stop input is inactive. The unit will stop when the remote stop input is active. If no remote stop input is configured for the input ports: The unit will start automatically when the remote start input is active. The unit will stop when the remote start input is inactive.

4.3.1 AUTO START SEQUENCE

a) When the Auto indicator is always on, it indicates that the water pump unit is in Auto Mode;

b) When the remote start input is active, it enters "Start Delay", and LCD displays "Remote Start";

c) After the start delay is over, the pre-heat relay outputs (if configured), and LCD displays "Pre-heat Delay XX";

d) After pre-heat delay is over, fuel relay outputs the pre-set fuel time before start (default: 1s), then starting relay outputs; If water pump unit crank disconnection fails during "Crank Delay", then fuel relay and starting relay stop outputting, and enter "Crank Rest", waiting for next start;

e) After the pre-set start attempts, if water pump unit doesn't succeed to start, then controller issues failed to start shutdown, and meanwhile LCD alarm page displays "Failed to Start" alarm;

f) During any one of the start attempts, if crank disconnect is fulfilled, then it enters "Safety On Delay", during which oil pressure low, water temperature high, underspeed, and charging failure alarms are all inactive; after safety on delay it enters "Start Idle Delay" (if configured);

g) During the start idle delay, if underspeed alarm is inactive, then the start idle delay ends, and it enters "Warming Up Time" (if configured);

h) When warming up time ends, the engine enters normal running status.

4.3.2 AUTO STOP SEQUENCE

a) When the remote stop input is active, it enters "Stop Delay";

b) After the stop delay is over, then "Cooling Time" starts; During the cooling time, the remote start input is active again, the controller will enter the running status again;

c) After the cooling delay is over, when it enters "Stop Idle Delay" (if configured), the idle relay is energized to output;

d) After the stop Idle delay is over, IT enters "ETS Delay", and the ETS relay is energized to output; fuel

relay output is disconnected;

e) After the ETS delay is over, it enters "Wait Stop Time", and automatically judges whether it stops completely;

f) When the unit stops completely, it enters "After Stop Time"; Otherwise, controller enters stop failure and issues "Failed to Stop" warning (after the alarm, if the unit stops completely, then it enters "After Stop Time", and meanwhile "Failed to Stop" alarm is removed automatically);

g) After the "After Stop Time" is over, it enters At Rest status.

4.4 MANUAL START/STOP OPERATION

4.4.1 MANUAL START SEQUENCE

a) In non-auto mode, press the [I] key to start the water pump unit, and it enters start control process (refer to 4.3.1 Auto Start Sequence, c–h);

b) During operation, if high water temperature, low oil pressure, overspeed, or other fault conditions occur, it will perform a rapid protective shutdown;

4.4.2 MANUAL STOP SEQUENCE

Press the [O] key to stop the running water pump unit (refer to 4.3.2 Auto Stop Sequence, b–g)

4.5 START OPERATION FOR LUBRICATION OUTPUT SETTING

When the output port is configured to "Lubrication Output":

If the set lubrication time is less than or equal to the pre-heat time, the lubrication relay outputs when it enters the pre-heat time, and the lubrication output stops after the set lubrication time.

If the set lubrication time is more than the pre-heat time, the lubrication relay outputs when it enters the pre-heat time; after pre-heat delay is over, it enters the following lubrication phase, and LCD displays "Lubrication Time XX"; after lubrication delay is over, the output stops and the total output time equals the set lubrication time.

If the engine stays at standby status and it outputs cyclically at the pre-set "Lubrication Rest Time" and "Lubrication Time"; If the pre-set "Lubrication Rest Time" is 0h, then lubrication doesn't output at the standby status.

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5 PROTECTION

5.1 WARNINGS

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

Table 5 Warnings

No.	Type	Description
1	Over Speed Warn	When controller detects speed is above the pre-set over speed warning threshold, it issues warning signal.
2	Under Speed Warn	When controller detects speed is below the pre-set under speed warning threshold, it issues warning signal.
3	Loss of Speed Signal	When controller detects speed is 0, and speed signal loss action is selected "Warning", it issues warning signal.
4	Failed to Stop	When engine stop delay is over and engine doesn't stop completely, controller issues warning signal.
5	Battery Overvoltage	When controller detects engine battery voltage is larger than pre-set threshold, it issues warning signal.
6	Battery Undervoltage	When controller detects engine battery voltage is less than pre-set threshold, it issues warning signal.
7	High Engine Temp.	When controller detects engine temperature value is higher than pre-set high temp warning value, it issues warning signal.
8	Low Engine Temp.	When controller detects engine temperature value is lower than pre-set low temp warning value, it issues warning signal.
9	Low Engine OP	When controller detects engine oil pressure value is below pre-set oil pressure warning value, it issues warning signal.
10	Aux. Sensor 1~5 Open	When controller detects sensor is open, and action type is selected as "Warning", it issues warning signal.
11	Aux. Sensor 1~5 High	When controller detects sensor value is above pre-set upper limit of warning values, it issues warning signal.
12	Aux. Sensor 1~5 Low	When controller detects sensor value is below pre-set lower limit of warning values, it issues warning signal.
13	Aux. Sensor 4 Error	When controller detects the value of sensor 4 is out of the measurement range, it issues warning signal.
14	High Outlet Pressure to Idle	When the sensor is correlated with outlet pressure sensor, if the outlet pressure value is above pre-set pressure, the controller issues warning signal, and the engine returns to the idle stage.
15	Over Flow	When the Pump Flow is enabled, if the outlet flow rate is higher than the set flow rate, it issues warning signal.
16	Input 1~5	When digital input port is configured to "Warning", and when it is active, it issues corresponding input warning signal.
17	Engine Oil Filter Time Over	When the pre-set maintenance time is due, and due action type is selected as "Warning", it issues warning signal.
18	Engine Fuel Filter Time Over	
19	Engine Lubricant Time Over	

No.	Type	Description
20	Engine Air Filter Time Over	
21	Maintenance 5 Time Over	
22	Maintenance 6 Time Over	
23	Maintenance 7 Time Over	
24	Maintenance 8 Time Over	
25	Maintenance 9 Time Over	
26	Maintenance 10 Time Over	

5.2 SHUTDOWNS

When controller detects shutdown alarm signal, it immediately stops. When engine stops completely, it needs to press manually Alarm Reset button to remove alarms.

Table 6 Shutdown Alarms

No.	Type	Description
1	Emergency Stop	When controller detects emergency stop alarm signal, it issues emergency stop signal.
2	Overspeed	When controller detects engine speed is over preset over speed stop threshold, it issues shutdown signal.
3	Underspeed	When controller detects engine speed is below preset under speed stop threshold, it issues shutdown signal.
4	Loss of Speed Signal	When controller detects speed is 0, and speed signal loss action is selected "Shutdown", it issues shutdown signal.
5	Failed to Start	When engine fails to start during pre-set start attempts, controller issues failed to start signal.
6	Low Coolant Level Input	When controller input port is set to Low Coolant Level Input and if it is active, it issues shutdown signal.
7	High Engine Temp. Input	When controller input port is set to High Temp Shutdown Input and if it is active, it issues shutdown signal.
8	Low Engine OP Input	When controller input port is set to Low Oil Pressure Shutdown Input and if it is active, it issues shutdown signal.
9	High Temp.	When controller detects engine temperature value is above pre-set shutdown value, it issues shutdown alarm signal.
10	Low Engine OP	When controller detects engine oil pressure value is below pre-set shutdown value, it issues shutdown signal.
11	Aux. Sensor 1~5 Open	When controller detects sensor is open, and action type is selected "Shutdown", it issues shutdown signal.
12	Aux. Sensor 1~5 High	When controller detects sensor value is above pre-set upper shutdown limit value, it issues shutdown signal.
13	Aux. Sensor 1~5 Low	When controller detects sensor value is below pre-set lower shutdown limit value, it issues shutdown signal.
14	Over Flow	When the Pump Flow is enabled, if the outlet flow rate is higher than the set shutdown flow rate, it issues shutdown signal.
15	Input 1~5	When digital input is configured to shutdown alarm, and if it is active, it issues corresponding input shutdown signal.

No.	Type	Description
16	Engine Oil Filter Time Over	When the pre-set maintenance time is due, and due action type is selected as "Shutdown", it issues shutdown signal.
17	Engine Fuel Filter Time Over	
18	Engine Lubricant Time Over	
19	Engine Air Filter Time Over	
20	Maintenance 5 Time Over	
21	Maintenance 6 Time Over	
22	Maintenance 7 Time Over	
23	Maintenance 8 Time Over	
24	Maintenance 9 Time Over	
25	Maintenance 10 Time Over	

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6 WIRING CONNECTION

Fig.2 Controller Back Panel

Table 7 Connection Terminals Description

No.	Function	Size	Remark	
1	Aux. Input 1	0.5mm^2	Active when it is grounded (B-).	See settings in Table 10.
2	Aux. Input 2	0.5mm^2	Active when it is grounded (B-).	
3	Aux. Sensor 1	1.0mm^2	If it is configured as sensor port, it connects with resistance type sensor; If it is configured as digital input, active when it is grounded (B-).	See settings in Table 11.
4	Aux. Sensor 2	1.0mm^2		
5	Aux. Sensor 3	1.0mm^2		
6	Aux. Sensor 4	1.0mm^2	Configure by user (Resistance/current/voltage type).	
7	MP2	0.5mm^2	If the controller model is APC1700: Speed sensor: Two speed signal cables are connected to Terminal MP1 and MP2 of the controller respectively. W/L: Connect Terminal MP1 to Terminal W/L, and connect Terminal MP2 to Terminal B-.	
8	MP1	0.5mm^2		
9	RS485 B(-)	0.5mm^2	120Ω impedance shielded cable is recommended; One end of the shielded cable should be grounded.	
10	RS485 A(+)	0.5mm^2		
11	Aux. Sensor 5	1.0mm^2	It connects with current type sensor.	See settings in Table 11.
12	Aux. Output 1	1.0mm^2	It is configured as active relay output, and powered by Terminal 18 (B+). Its contact rated capacity is 1A.	See setting in Table 9.
13	Aux. Output 2	1.0mm^2		
14	Aux. Output 3	1.0mm^2		
15	Aux. Output 4	1.0mm^2	It is configured as active relay output, and powered by Terminal 17 (B+). Its contact	

No.	Function	Size	Remark	
			rated capacity is 1A.	
16	Crank Output	1.0mm^2	It is configured as active relay output, and powered by Terminal 17 (B+). Its contact rated capacity is 1A.	
17	E-Stop Input	1.5mm^2	Active when there is B+ voltage input. Connect with external emergency stop button (NC).	
18	DC Power Input B+	1.5mm^2	Connect with the positive of starting battery.	
19	DC Power Input B-	1.5mm^2	Connect with the negative of starting battery.	

7 CONFIGURATION PARAMETER RANGE AND DEFINITION

7.1 PARAMETER RANGE AND DEFINITION

Table 8 Manufacturer Parameters Setting Contents and Range List

No.	Item	Range	Default	Description
Language				
1	Language	(0-1)	0	0: Simplified Chinese; 1: English.
LCD Backlight				
1	Contrast	(0-10)	5	Set LCD screen contrast.
2	Brightness	(0-5)	5	Set LCD backlight brightness.
3	Delay	(0-3600)min	5	Backlight is always on when delay is set as 0min.
Module Setting				
1	Module Address	(1-254)	1	Controller address for remote monitoring;
2	Password	(0-65534)	01234	It is used for advanced parameter setting; ⚠CAUTION! Default password is "01234"; It can be changed by operator to prevent others changing controller's advanced configuration. If password is changed, please remember it clearly. If it is forgotten, please contact SmartGen service personnel.
3	Maintenance Password	(0-65534)	01234	Independent password for maintenance setting.
4	Comm. Baud Rate	(0-2)	0	0: 9600bps; 1: 19200bps; 2: 38400bps.
5	Comm. Stop Bit	(1-2)	1	1: 1-bit Stop Bit; 2: 2-bit Stop Bit.
6	Comm. Parity Bit	(0-2)	0	0: None parity; 1: Odd parity; 2: Even parity.
7	Top-left Parameter Displayed in Home Page	(0-12)	0	0: Speed; 1: Engine temperature; 2: Engine oil pressure;
8	Top-right Parameter Displayed in Home Page	(0-12)	1	3: Fuel level; 4: Outlet pressure; 5: Head;
9	Bottom-left Parameter Displayed in Home Page	(0-12)	4	6: Battery voltage; 7: Aux. sensor 1; 8: Aux. sensor 2;

No.	Item	Range	Default	Description
10	Bottom-right Parameter Displayed in Home Page	(0-12)	5	9: Aux. sensor 3; 10: Aux. sensor 4; 11: Aux. sensor 5; 12: Flow rate.
11	Boot-up Screen Time	(0-3600)s	2	
Timer Setting				
1	Start Delay	(0-3600)s	1	Time between the remote start signal becoming active and the unit starting.
2	Stop Delay	(0-3600)s	1	Time between the remote stop signal becoming active and the unit stopping.
3	Pre-heat Delay	(0-3600)s	0	Time for pre-heating plug to be energized before starter is energized.
4	Fuel On Delay	(0-3600)s	1	Time for fuel relay output every time before starter is energized.
5	Crank Delay	(3-60)s	8	Time for starter to be energized every time.
6	Crank Rest Time	(3-60)s	10	Waiting time before second energization when engine fails to start.
7	Safety On Delay	(0-3600)s	10	During this time oil pressure low, temp. high, under speed alarms are all inactive.
8	Start Idle Time	(0-3600)s	10	Time for engine idle running in start process.
9	Warming Up Time	(0-3600)s	0	Warming up time for engine before normal running after high speed running.
10	Cooling Time	(0-3600)s	0	Cooling time before stop
11	Stop Idle Time	(0-3600)s	10	Time for engine idle running in stop process.
12	Energized to Stop (ETS)	(0-3600)s	20	Time for ETS to be energized before stop.
13	Wait Stop Time	(0-3600)s	0	Time after idle running delay before complete stop when ETS is set 0; When it is not 0, it is time after ETS delay before complete stop.
14	After Stop Time	(0-3600)s	0	Time from complete stop to standby status.
15	Lubrication Rest Time	(0-12)h	2	Interval time from the first lubrication to the second lubrication when output is configured as lubrication in standby status; when it is set as 0, lubrication will not output in standby status.
16	Lubrication Time	(3-30)s	5	Time for lubrication output when output is configured as lubrication.

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No.	Item		Range	Default	Description
17	Manual Pre-heat Time		(0-3600)s	0	Time for pre-heating output when it is on standby, and the manual pre-heat input is active.
Engine Setting					
1	Engine Speed Signal Source		(0-1)	0	0: Speed Sensor 1: W/L
2	W/L Ratio		(0-99.99)	9.04	This value represents the number of pulses output per revolution of the engine by the W/L. The engine speed can be calculated based on this value.
3	Flywheel Teeth		(1.0-300.0)	118.0	Flywheel teeth of engine, used for starter disconnect conditions and engine speed detection; please refer to the below installation.
4	Engine Rated Speed		(0-6000)RPM	2200	Provide the judgement standard for overspeed, and underspeed.
5	Start Attempts		(1-10)times	1	Maximum start times in case of failed start; when this number is reached, controller shall issue Failed to Start signal.
6	Crank Disconnect		(0-2)	2	Please refer to Table 12; There are two kinds of disconnect conditions for engine and starter. They can be used independently or together and the purpose is to separate starter motor and engine as soon as possible.
7	Disconnect Speed		(0-200)%	24	Set value is the percentage of rated speed; when speed is above the set value, starter shall disconnect; Please refer to the rear installation.
8	Disconnect OP		(0-1000)kPa	200	When Oil Pressure is above pre-set value, starter shall disconnect. Please refer to the following installation.
9	Overspeed Warning	Set	(0-200.0)%	110.0	Set value is the percentage of rated speed; Return value and delay value can also be set. Overspeed warning is enabled by default, underspeed warning is disabled by default.
		Return	(0-200.0)%	108.0	
		Delay	(0-3600)s	5	
10	Underspeed Warning	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. Overspeed shutdown is enabled by default, underspeed shutdown is disabled by default.
		Delay	(0-3600)s	2	
12	Underspeed Shutdown	Set	(0-200.0)%	50.0	
		Delay	(0-3600)s	3	
13	Loss of Speed Signal		(0-3600)s	5	Time from detecting speed is 0 to

No.	Item		Range	Default	Description
	Delay				confirming the action;
14	Loss of Speed Signal Action		(0-1)	0	0: Warning 1: Shutdown
15	Battery Rated Voltage		(0-60.0)V	24.0	Provide judgement standard for battery over/under voltage detection.
16	Battery Overvolt Warn	Set	(0-200)%	120	Set value is the percentage of battery rated voltage; Return value and delay value can also be set. Battery over/under voltage warning is enabled by default.
		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	Pre-heat Link Temperature Enable		(0-1)	0	0: Disabled; 1: Enabled.
19	Pre-heat Link Temperature Setting		(0-300)°C	25	When it is enabled, if engine temperature is higher than set value in pre-heat period, after pre-heat is over, pre-heat output stops.
20	Start Idle Delay Correlated Temperature	Enable	(0-1)	0	0: Disabled; 1: Enabled.
		Set	(0-100)°C	40	When it is enabled, if engine temperature reaches the set value in start idle period, it will skip the Start Idle Delay, and enters high speed running.
		Sensor	(0-6)	0	0: Aux. sensor 1; 1: Aux. sensor 2; 2: Aux. sensor 3; 3: Aux. sensor 4; 4: Aux. sensor 5;
Analog Sensor Setting					
Aux. Sensor 1					
1	Sensor Type		(0-5)	1	0: Not Used 1: Temperature Sensor 2: Pressure Sensor 3: Level Sensor 4: Flow Rate Sensor; 5: Digital Input 3.
2	Curve Type		(0-15)	9	It depends on the sensor types, and default is SGD curve.
3	Open Action		(0-2)	0	0: Warning; 1: Shutdown; 2: No action.
4	Display Unit		(0-1)	0	0: °C; 1: °F. **NOTE**: Unit varies with different sensor.
5	Alarm Detection Range		(0-2)	0	0: After safety on delay 1: From crank 2: Always active
6	Over Shutdown	Enable	(0-1)	1	When external sensor value is larger

No.	Item		Range	Default	Description
		Set	(0-9000) °C	98	than set value, controller issues shutdown alarm; Alarm enable and delay value can be set.
		Delay	(0-3600) s	3	
7	Under Shutdown	Enable	(0-1)	0	When external sensor value is less than set value, controller issues shutdown alarm; alarm enable and delay value can be set.
		Set	(0-9000) °C	50	
		Delay	(0-3600) s	3	
8	Over Warn	Enable	(0-1)	1	When external sensor value is larger than set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Set	(0-9000) °C	95	
		Return	(0-9000) °C	93	
		Delay	(0-3600) s	5	
9	Under Warn	Enable	(0-1)	0	When external sensor value is less than set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Set	(0-9000) °C	70	
		Return	(0-9000) °C	75	
		Delay	(0-3600) s	5	
10	Custom Curve				When custom resistance type sensor is selected, related curve setting is required.
11	Custom String Name				It can be modified via host PC.
Aux. Sensor 2					
1	Sensor Type		(0-5)	2	0: Not Used 1: Temperature Sensor 2: Pressure Sensor 3: Level Sensor 4: Flow Rate Sensor; 5: Digital Input 4.
2	Curve Type		(0-15)	9	It depends on the sensor types, and default is SGD curve.
3	Open Action		(0-2)	0	0: Warning; 1: Shutdown; 2: No action.
4	Display Unit		(0-2)	0	0: kPa; 1: bar; 2: psi. **NOTE**: Unit varies with different sensor.
5	Alarm Detection Range		(0-2)	0	0: After safety on delay 1: From crank 2: Always active
6	Over Shutdown	Enable	(0-1)	0	When external sensor value is larger than set value, controller issues shutdown alarm; Alarm enable and delay value can be set.
		Set	(0-9000) kPa	1000	
		Delay	(0-3600) s	3	
7	Under Shutdown	Enable	(0-1)	1	When external sensor value is less than set value, controller issues shutdown alarm; alarm enable and delay value can be set.
		Set	(0-9000) kPa	103	
		Delay	(0-3600) s	3	

No.	Item		Range	Default	Description
8	Over Warn	Enable	(0-1)	0	When external sensor value is larger than set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Set	(0-9000) kPa	950	
		Return	(0-9000) kPa	900	
		Delay	(0-3600) s	5	
9	Under Warn	Enable	(0-1)	1	When external sensor value is less than set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Set	(0-9000) kPa	124	
		Return	(0-9000) kPa	138	
		Delay	(0-3600) s	5	
10	Custom Curve				When custom resistance type sensor is selected, related curve setting is required.
11	Custom String Name				It can be modified via host PC.
Aux. Sensor 3					
1	Sensor Type		(0-5)	3	0: Not Used 1: Temperature Sensor 2: Pressure Sensor 3: Level Sensor 4: Flow Rate Sensor; 5: Digital Input 5.
2	Curve Type		(0-15)	6	It depends on the sensor types, and default is 4Ω-126Ω curve.
3	Open Action		(0-2)	0	0: Warning; 1: Shutdown; 2: No action.
4	Display Unit		(0-0)	0	0: %. **NOTE**: Unit varies with different sensor.
5	Alarm Detection Range		(0-2)	2	0: After safety on delay 1: From crank 2: Always active
6	Over Shutdown	Enable	(0-1)	0	When external sensor value is larger than set value, controller issues shutdown alarm; Alarm enable and delay value can be set.
		Set	(0-9000) %	100	
		Delay	(0-3600) s	3	
7	Under Shutdown	Enable	(0-1)	0	When external sensor value is less than set value, controller issues shutdown alarm; alarm enable and delay value can be set.
		Set	(0-9000) %	8	
		Delay	(0-3600) s	3	
8	Over Warn	Enable	(0-1)	0	When external sensor value is larger than set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Set	(0-9000) %	90	
		Return	(0-9000) %	80	
		Delay	(0-3600) s	5	
9	Under Warn	Enable	(0-1)	1	When external sensor value is less than

No.	Item		Range	Default	Description
		Set	(0-9000) %	10	set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Return	(0-9000) %	15	
		Delay	(0-3600) s	5	
10	Custom Curve				When custom resistance type sensor is selected, related curve setting is required.
11	Custom String Name				It can be modified via host PC.
Aux. Sensor 4					
1	Sensor Type		(0-4)	2	0: Not Used; 1: Temperature Sensor; 2: Pressure Sensor; 3: Level Sensor; 4: Flow Rate Sensor.
2	Curve Type		(0-15)	2	It depends on the sensor types, and default is 4~20mA curve.
3	Open Action		(0-2)	0	0: Warning; 1: Shutdown; 2: No action.
4	Display Unit		(0-1)	0	0: kPa; 1: bar; 2: psi. **NOTE**: Unit varies with different sensor.
5	Alarm Detection Range		(023)	2	0: After safety on delay 1: From crank 2: Always active
6	Over Shutdown	Enable	(0-1)	1	When external sensor value is larger than set value, controller issues shutdown alarm; Alarm enable and delay value can be set.
		Set	(0-9000) kPa	1500	
		Delay	(0-3600) s	3	
7	Under Shutdown	Enable	(0-1)	0	When external sensor value is less than set value, controller issues shutdown alarm; alarm enable and delay value can be set.
		Set	(0-9000) kPa	100	
		Delay	(0-3600) s	3	
8	Over Warn	Enable	(0-1)	1	When external sensor value is larger than set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Set	(0-9000) kPa	1400	
		Return	(0-9000) kPa	1300	
		Delay	(0-3600) s	5	
9	Under Warn	Enable	(0-1)	0	When external sensor value is less than set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Set	(0-9000) kPa	200	
		Return	(0-9000) kPa	300	
		Delay	(0-3600) s	5	
10	Custom Curve				When custom resistance type sensor is selected, related curve setting is required. It can be set as resistance, current, or

No.	Item		Range	Default	Description
					voltage type sensor curve.
11	Custom String Name				It can be modified via host PC.
Aux. Sensor 5					
1	Sensor Type		(0-4)	0	0: Not Used; 1: Temperature Sensor; 2: Pressure Sensor; 3: Level Sensor; 4: Flow Rate Sensor.
2	Curve Type		/	2	It only supports custom 4-20mA curve.
3	Open Action		(0-2)	0	0: Warning; 1: Shutdown; 2: No action.
4	Display Unit		(0-1)	0	0: °C; 1: °F. **NOTE**: Unit varies with different sensor.
5	Alarm Detection Range		(0-2)	2	0: After safety on delay 1: From crank 2: Always active
6	Over Shutdown	Enable	(0-1)	1	When external sensor value is larger than set value, controller issues shutdown alarm; Alarm enable and delay value can be set.
		Set	(0-9000) °C	1500	
		Delay	(0-3600) s	3	
7	Under Shutdown	Enable	(0-1)	0	When external sensor value is less than set value, controller issues shutdown alarm; alarm enable and delay value can be set.
		Set	(0-9000) °C	100	
		Delay	(0-3600) s	3	
8	Over Warn	Enable	(0-1)	1	When external sensor value is larger than set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Set	(0-9000) °C	1400	
		Return	(0-9000) °C	1300	
		Delay	(0-3600) s	5	
9	Under Warn	Enable	(0-1)	0	When external sensor value is less than set value, controller issues warning alarm; alarm enable, return and delay values can be set.
		Set	(0-9000) °C	200	
		Return	(0-9000) °C	300	
		Delay	(0-3600) s	5	
10	Custom Curve				When custom 4-20mA type sensor is selected, related curve setting is required.
11	Custom String Name				It can be modified via host PC.
Engine Temperature Setting					
1	Signal Source Set		(0-5)	1	0: Not Used; 1: Aux. sensor 1; 2: Aux. sensor 2; 3: Aux. sensor 3; 4: Aux. sensor 4;

No.	Item		Range	Default	Description
					5: Aux. sensor 5;
2	Heater Control	On	((-50)-300)°C	50	When collected temperature is less than set value, heater control outputs. It is disabled by default.
		Off	((-50)-300)°C	55	
		Max. Working Duration	(0-3600)min	60	
3	Cooler Control	On	((-50)-300)°C	95	When collected temperature is larger than set value, cooler control outputs. It is disabled by default.
		Off	((-50)-300)°C	92	
		Max. Working Duration	(0-3600)min	60	
Engine Oil Pressure Correlation Setting					
1	Signal Source Set		(0-5)	2	0: Not Used;; 1: Aux. sensor 1; 2: Aux. sensor 2; 3: Aux. sensor 3; 4: Aux. sensor 4; 5: Aux. sensor 5;
Fuel Level Sensor Setting					
1	Signal Source Set		(0-5)	3	0: Not used; 1: Aux. sensor 1; 2: Aux. sensor 2; 3: Aux. sensor 3; 4: Aux. sensor 4; 5: Aux. sensor 5;
2	Fuel Pump Control	On	(0-300)%	10	When external fuel level sensor value is less than set value, fuel pump control outputs. It is disabled by default.
		Off	(0-300)%	80	
		Max. Working Duration	(0-3600)s	60	
3	Fuel Tank Capacity Set		(0-10000)L	1000	It is disabled by default.
Outlet Pressure Sensor Setting					
1	Signal Source Set		(0-5)	4	0: Not used; 1: Aux. sensor 1; 2: Aux. sensor 2; 3: Aux. sensor 3; 4: Aux. sensor 4; 5: Aux. sensor 5;
2	Rated Outlet Pressure		(0-9000) kPa	1000	Set the rated working pressure of the pump outlet.
3	Static Water Pressure		(-9000-9000) kPa	0	Set the static water pressure of the pump outlet. Head = (Outlet Pressure - Static Water Pressure) * 10 / 98

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No.	Item		Range	Default	Description
4	High Pressure Return to Idle Speed	Set	(0-9000) kPa	2500	When external sensor value is larger than the set pressure threshold, controller issues warning alarm, and the engine returns to idle status; Alarm enable and delay value can be set. It is disabled by default.
		Return	(0-9000) kPa	2000	
		Delay	(0-3600)s	5	
Pipe Pressure Sensor Setting					
1	Signal Source Set		(0-5)	4	0: Not used; 1: Aux. sensor 1; 2: Aux. sensor 2; 3: Aux. sensor 3; 4: Aux. sensor 4; 5: Aux. sensor 5.
2	Start Return	Enable	(0-1)	0	After it is enabled, under auto mode, if the pipe pressure is larger than the set value, the engine will stop.
		Set	(0-9000)kPa	2000	
		Delay	(0-3600)s	3	
3	Low Pressure Start	Enable	(0-1)	0	After it is enabled, under auto mode, if the pipe pressure is lower than the set value, the engine will start.
		Set	(0-9000)kPa	200	
		Delay	(0-3600)s	3	
Flow Rate Setting					
1	Enable		(0-1)	0	0: Disabled; 1: Enabled.
2	Signal Source Set		(0-6)	0	0: Not used; 1: Aux. sensor 1; 2: Aux. sensor 2; 3: Aux. sensor 3; 4: Aux. sensor 4; 5: Aux. sensor 5; 6: Outlet Pressure.
3	Rated Flow		(0-10000)m³/h	1000	The rated working flow rate of the pump unit.
4	Over Flow Shutdown	Enable	(0-1)	0	When the unit is running, if the flow rate exceeds the set value, the controller issues shutdown alarm.
		Set	(0-300.0)%	120.0	
		Delay	(0-3600)s	5	
5	Over Flow Warning	Enable	(0-1)	0	When the unit is running, if the flow rate exceeds the set value, the controller issues warning alarm.
		Set	(0-300.0) %	110.0	
		Return	(0-300.0) %	105.0	
		Delay	(0-3600)s	5	
6	Custom Curve				When the signal source is set as outlet pressure, the corresponding curve between outlet pressure and flow rate can be configured.
Digital Input Ports					
Digital Input 1					
1	Contents Setting		(0-53)	3	Alarm Reset;

No.	Item	Range	Default	Description
				Please refer to Table 10 for details.
2	Active Type	(0-1)	0	0: Close 1: Open
Digital Input 2				
1	Contents Setting	(0-53)	26	High Temp. Shutdown Input; Please refer to Table 10 for details.
2	Active Type	(0-1)	0	0: Close 1: Open
Digital Input 3				
1	Contents Setting	(0-53)	27	Low Oil Pressure Shutdown Input; Please refer to Table 10 for details.
2	Active Type	(0-1)	0	0: Close 1: Open
Digital Input 4				
1	Contents Setting	(0-53)	0	Users defined; Please refer to Table 10 for details.
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 active 3: Inactive
4	Active Action	(0-2)	0	0: Warning 1: Shutdown
5	Active Delay	(0-20.0)s	2.0	Time from detecting input is active to confirm;
6	Input Description			Users defined.
Digital Input 5				
1	Contents Setting	(0-53)	0	Users defined; Please refer to Table 10 for details.
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 active 3: Inactive
4	Active Action	(0-2)	1	0: Warning 1: Shutdown
5	Active Delay	(0-20.0)s	2.0	Time from detecting input is active to confirm;
6	Input Description			Users defined.
Auxiliary Output Ports				
Aux. Output 1				
1	Contents Setting	(0-119)	26	Reserved; Please refer to Table 9 for details.
2	Output Type	(0-1)	0	0: Normally Open 1: Normally Close
Aux. Output 2				
1	Contents Setting	(0-119)	42	Common alarm; Please refer to Table 9 for details.
2	Output Type	(0-1)	0	0: Normally Open 1: Normally Close
Aux. Output 3				

No.	Item	Range	Default	Description
1	Contents Setting	(0-119)	30	Idle control; Please refer to Table 9 for details.
2	Output Type	(0-1)	0	0: Normally Open 1: Normally Close
Aux. Output 4				
1	Contents Setting	(0-119)	29	Fuel relay output; Please refer to Table 9 for details.
2	Output Type	(0-1)	0	0: Normally Open 1: Normally Close
Maintenance Setting				
1	Engine Oil Filter Time Over	(0-1)	0	0: Disabled 1: Enabled Maintenance time, maintenance time due action, pre-maintenance time, pre-maintenance time due action, maintenance time reset can also be set; After maintenance, maintenance time due alarm can be removed by resetting maintenance time; Please refer to Table 13 for details.
2	Engine Fuel Filter Time Over	(0-1)	0	
3	Engine Lubricant Time Over	(0-1)	0	
4	Engine Air Filter Time Over	(0-1)	0	
5	Maintenance 5 Time Over	(0-1)	0	
6	Maintenance 6 Time Over	(0-1)	0	
7	Maintenance 7 Time Over	(0-1)	0	
8	Maintenance 8 Time Over	(0-1)	0	
9	Maintenance 9 Time Over	(0-1)	0	
10	Maintenance 10 Time Over	(0-1)	0	

⚠CAUTION:

— Please modify the controller's internal parameters in standby status (such as crank disconnect condition, auxiliary input/output ports, delay setting, etc.), otherwise shutdown or abnormal situation may occur;

⚠NOTES:

— When setting parameter on PC software, it doesn't need to input default password "1234" if not changed. If it is the first time to do configuration on PC after the password has been changed, then it needs to enter module password in password input screen.

— The value of high threshold must be larger than the low threshold, otherwise there will be both excessively high and excessively low conditions.

— When setting warnings, please set the correct return value, otherwise it will not issue warnings normally. When setting high warnings, the return value should be less than the set value; When setting low warnings, the return value should be larger than the set value;

— Digital input ports cannot be set as the same functions. Otherwise, function shall not work normally; Auxiliary output ports can be set as the same functions;

— If the custom string name of auxiliary sensor is not set, its name will follow the linked signal source. For example, if Auxiliary Sensor 1 is linked to the engine temperature signal, its display and alarm name will be "Engine Temperature".

7.2 DEFINABLE CONTENTS OF AUXILIARY OUTPUT PORTS 1~4

Table 9 Definable Contents of Auxiliary Output Ports 1~4

No.	Type	Function Description
0	Not Used	
1	Custom Period 1	Please refer to the following contents for function details.
2	Custom Period 2	
3	Custom Period 3	
4	Custom Period 4	
5	Custom Period 5	
6	Custom Period 6	
7	Custom Combined 1	
8	Custom Combined 2	
9	Custom Combined 3	
10	Custom Combined 4	
11	Custom Combined 5	
12	Custom Combined 6	
13	Reserved	
14	Reserved	
15	Air Flap Control	Act at the time of over speed shutdown alarm and emergency stop; Air flap can be closed to close the engine intake and realize fast stop.
16	Audible Alarm	Act at the time of warning and shutdown alarms; Buzzer can be connected externally; It can be inhibited to output when input port "Alarm Mute" is active; When there is new warning or shutdown alarm, it outputs again.
17	Louver Control	Act at the time of engine start; Disconnect after engine stop.
18	Fuel Pump Control	Act by fuel pump control upper and lower limits of fuel level sensor.
19	Heater Control	Act by heater control upper and lower limits of temp. sensor.
20	Cooler Control	Act by cooler control upper and lower limits of temp. sensor.
21	Lubrication	Under standby status, lubrication output port is active and it outputs circularly according to pre-set "Lubrication Rest Time" and "Lubrication Time"; If "Lubrication Rest Time" is 0h, then it doesn't output; Before start, pre-set lubrication time is outputted; If pre-heat time is not configured, lubrication outputs; If pre-heat time is configured, then pre-heat phase outputs.
22	Reserved	
23	Engine Oil Lubrication	Act at the phase of pre-heating, fuel, start, and start rest time.
24	Remote Control	Controlled by communication port RS485.
25	Reserved	
26	Reserved	
27	Reserved	
28	Starting Relay	Act at engine start; and disconnect after successful start.

No.	Type	Function Description
29	Fuel Relay	Act at engine start; and disconnect at ETS stop.
30	Idle Control	Used for engine with idle speed; Pull in before start, and disconnect at entering warming up time; Pull in at the process of stop idle speed, and disconnect when engine stops completely.
31	Speed Raise Output	Act in warming up period, and controlled by speed regulator in normal running period.
32	Speed Drop Output	Act from stop idle to waiting for stop period and controlled by speed regulator in normal running period.
33	Energize to Stop	Used for engine with ETS solenoid; It pulls in when stop idle speed is over, and disconnect when pre-set "ETS Delay" is over.
34	Run Key Switch Control	It outputs once it is power on; it stops outputting the signal during ETS delay and failed to stop time;.
35	Reserved	
36	Reserved	
37	Reserved	
38	Crank Success	Pull in when it detects crank success signal.
39	Normal Running	Pull in and output when it is in normal running period.
40	Reserved	
41	Reserved	
42	Common Alarm	Act at the time of common alarm and common shutdown.
43	Common Shutdown	Act at time of common shutdown.
44	Common Warning	Act at the time of common warning.
45	Reserved	
46	Battery Overvoltage	Act when battery overvoltage warning occurs.
47	Battery Undervoltage	Act when battery undervoltage warning occurs.
48	Reserved	
49	Pre-heat	Output in pre-heat period.
50	Reserved	
51	Reserved	
52	Reserved	
53	Reserved	
54	Reserved	
55	Reserved	
56	Reserved	
57	Reserved	
58	Reserved	
59	Input 1 Active	Act when input port 1 is active.
60	Input 2 Active	Act when input port 2 is active.
61	Input 3 Active	Act when input port 3 is active.
62	Input 4 Active	Act when input port 4 is active.
63	Input 5 Active	Act when input port 5 is active.
64	Reserved	
65	Reserved	
66	Reserved	

No.	Type	Function Description
67	Emergency Stop	Act when emergency stop alarm occurs.
68	Failed to Start	Act when failed to start alarm occurs.
69	Failed to Stop	Act when failed to stop alarm occurs.
70	Underspeed Warn	Act when engine underspeed warning occurs.
71	Underspeed Shutdown	Act when engine underspeed shutdown occurs.
72	Overspeed Warn	Act when engine overspeed warning occurs.
73	Overspeed Shutdown	Act when engine overspeed shutdown occurs.
74	Reserved	
75	Reserved	
76	Reserved	
77	Reserved	
78	Reserved	
79	High Engine Temp. Warning	Act when high engine temp. warning alarm occurs.
80	Low Engine Temp. Warning	Act when low engine temp. warning alarm occurs.
81	High Engine Temp. Shutdown	Act when high engine temp. shutdown alarm occurs.
82	Reserved	
83	Low Engine OP Warning	Act when low engine oil pressure warning occurs.
84	Low Engine OP Shutdown	Act when low engine oil pressure shutdown occurs.
85	Reserved	
86	Reserved	
87	Reserved	
88	Reserved	
89	Reserved	
90	Reserved	
91	Reserved	
92	Reserved	
93	Aux. Sensor 1 High Warn	Act when sensor 1 high warning occurs.
94	Aux. Sensor 1 Low Warn	Act when sensor 1 low warning occurs.
95	Aux. Sensor 1 High Shut	Act when sensor 1 high shutdown occurs.
96	Aux. Sensor 1 Low Shut	Act when sensor 1 low shutdown occurs.
97	Aux. Sensor 2 High Warn	Act when sensor 2 high warning occurs.
98	Aux. Sensor 2 Low Warn	Act when sensor 2 low warning occurs.
99	Aux. Sensor 2 High Shut	Act when sensor 2 high shutdown occurs.
100	Aux. Sensor 2 Low Shut	Act when sensor 2 low shutdown occurs.
101	Aux. Sensor 3 High Warn	Act when sensor 3 high warning occurs.
102	Aux. Sensor 3 Low Warn	Act when sensor 3 low warning occurs.
103	Aux. Sensor 3 High Shut	Act when sensor 3 high shutdown occurs.
104	Aux. Sensor 3 Low Shut	Act when sensor 3 low shutdown occurs.
105	Aux. Sensor 4 High Warn	Act when sensor 4 high warning occurs.
106	Aux. Sensor 4 Low Warn	Act when sensor 4 low warning occurs.
107	Aux. Sensor 4 High Shut	Act when sensor 4 high shutdown occurs.
108	Aux. Sensor 4 Low Shut	Act when sensor 4 low shutdown occurs.
109	Aux. Sensor 5 High Warn	Act when sensor 5 high warning occurs.
110	Aux. Sensor 5 Low Warn	Act when sensor 5 low warning occurs.

No.	Type	Function Description
111	Aux. Sensor 5 High Shut	Act when sensor 5 high shutdown occurs.
112	Aux. Sensor 5 Low Shut	Act when sensor 5 low shutdown occurs.
113	Over Flow Shutdown	Act when over flow shutdown alarm occurs.
114	Over Flow Warning	Act when over flow warning alarm occurs.
115	Reserved	
116	Reserved	
117	Reserved	
118	Reserved	
119	Reserved	

⚠NOTE: After pressing the emergency stop button, the power of crank output and auxiliary output 4 will be disconnected. When doing configuration, please note that the function of ETS solenoid hold after stop should not be configured to the auxiliary output 4.

7.2.1 CUSTOM PERIOD OUTPUT

Custom period output is composed by 2 parts: period output S1 and condition output S2.

S1 and S2 both are true, then it outputs; S1 or S2 is false, it doesn't output;

Period output S1 can be configured randomly to one, or several period outputs; Delay time and output time after entering period can be set;

Condition output S2 can be any contents of output settings.

⚠NOTE: When period output S1 delay time and output time are both 0, configurations of period output S1 are both true.

EXAMPLE:

Output period: Start

Delay output time: 2s

Output time: 3s

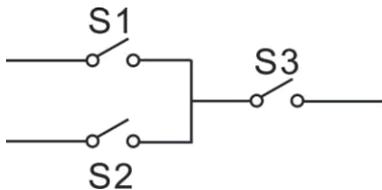Condition output contents: Input 1 is active;

Condition output active/inactive close; close when active (disconnect when inactive)

When input port 1 is active, and it enters start time and delays for 2s, custom period output starts to output, after outputting for 3s, it stops outputting;

When input port 1 is inactive, custom output doesn't output.

7.2.2 CUSTOM COMBINATION OUTPUT

Custom combination output is composed by 3 parts: OR condition output S1, OR condition output S2, AND condition output S3.

S1 or S2 is true, and S3 is true, then combination output works.

S1 and S2 both are false, or S3 is false, then combination output doesn't work.

⚠NOTE: S1, S2 and S3 can be any contents except itself custom combination output of the output settings.

⚠NOTE: S1, S2 and S3 cannot include or recursively include itself.

EXAMPLE:

Contents of OR condition output S1: input port 1 is active;

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

Contents of OR condition output S2, input port 2 is active;

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

Contents of AND condition output S3: input port 3 is active;

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

When input port 1 is active or input port 2 is active, if input port 3 is active, custom combination output is working; if input port 3 is inactive, custom combination output is not working;

When input port 1 is inactive and port 2 is inactive, no matter port 3 is active or not, custom combination output is not working.

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7.3 DEFINABLE CONTENTS OF DIGITAL INPUT PORTS

Table 10 Definable Contents of Digital Input Ports

No.	Type	Function Description
0	Users Configured	Users can define the following functions: Warning: warning only, no shutdown. Shutdown: alarm and shutdown immediately Inactive: input is inactive. Always: input is active all the time. From crank: start to detect at the time of start. After safety on delay: start to detect after safety on delay.
1	Reserved	
2	Alarm Mute	Prohibit output configurations "Audible Alarm" outputs when input is active.
3	Alarm Reset	Reset shutdown alarm when input is active.
4	Reserved	
5	Lamp Test	All LED indicators are illuminated when input is active.
6	Panel Lock	All buttons in panel are inactive except DOWN key. Parameters cannot be configured. But users can set language, check event log and controller information. There is 🔒 in the bottom right corner on LCD when input is active.
7	Crank Success Input	When this function is active, it means the engine is started successfully. If this function is configured, the speed and oil pressure of crank success conditions will be invalid.
8	Reserved	
9	Auto Stop Inhibit	When the input is active, auto stop is inhibited.
10	Auto Start Inhibit	When the input is active, auto start is inhibited.
11	Reserved	
12	Reserved	
13	Reserved	
14	Reserved	
15	Reserved	
16	Reserved	
17	Reserved	
18	Reserved	
19	Reserved	
20	Reserved	
21	Alarm Stop Inhibit	All shutdown alarms are inhibited except emergency stop and over speed shutdown. (Override mode)
22	Instrument Mode	All outputs are inhibited in this mode.
23	Reserved	
24	Reset Maintenance	Controller will set the time of maintenance 1 as default value when input is active.
25	Reserved	
26	High Temp. Shutdown	Connects to sensor digital input.

No.	Type	Function Description
27	Low OP Shutdown	Connects to sensor digital input.
28	Reserved	
29	Low Coolant Level Shutdown	Connects to sensor digital input.
30	High Water Level Start	Under auto mode, the engine starts when the input is active.
31	Low Water Level Stop	Under auto mode, the engine stops when the input is active.
32	Manual Start Input	Under stop 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	An external button (non-latching) can be connected and pressed as simulate panel.
35	Simulate Auto key	An external button (non-latching) can be connected and pressed as simulate panel.
36	Simulate Manual key	An external button (non-latching) can be connected and pressed as simulate panel.
37	Simulate Start key	An external button (non-latching) can be connected and pressed as simulate panel.
38	Remote Start	Under auto mode, the engine starts when the input is active.
39	Remote Stop	Under auto mode, the engine stops when the input is active.
40	Speed Up	When the input is active, speed up outputs.
41	Speed Down	When the input is active, speed down outputs.
42-52	Reserved	
53	Manual Pre-heat	Connects to manual pre-heat digital input.

7.4 SELECTION OF SENSORS

Table 11 Sensors Selection

No.	Items	Description	Remark
1	Temperature Sensor	0: Not used 1: Custom Res Curve 2: Custom (4-20)mA Curve 3: Custom Volt Curve 4: VDO 5: CURTIS 6: VOLVO-EC 7: DATCON 8: SGX 9: SGD 10: SGH 11: PT100 12: Cu50 13-15: Reserved	Custom resistance input range is (0~6)kΩ; Custom current input range is (4.0~20.0)mA; Custom voltage input range is (0~5.0)V; Users can select the corresponding curve by themselves. If pre-set sensor channel doesn't support current, and voltage type, then curve type item 2 and 3 will display "Reserved".
2	Oil Pressure Sensor	0: Not used 1: Custom Res Curve 2: Custom (4-20)mA Curve 3: Custom Volt Curve 4: VDO 10bar 5: CURTIS 6: VOLVO-EC 7: DATCON 10bar 8: SGX 9: SGD 10: SGH 11-15: Reserved	Custom resistance input range is (0~6)kΩ; Custom current input range is (4.0~20.0)mA; Custom voltage input range is (0~5.0)V; Users can select the corresponding curve by themselves. If pre-set sensor channel doesn't support current, and voltage type, then curve type item 2 and 3 will display "Reserved".
3	Fuel Level Sensor	0: Not used 1: Custom Res Curve 2: Custom (4-20)mA Curve 3: Custom Volt Curve 4: SGD 5: SGH 6: 4-126Ω 7: 0-130Ω 8: 0-190Ω 9: 10-180Ω 10: 10-120Ω 11-15: Reserved	Custom resistance input range is (0~6)kΩ; Custom current input range is (4.0~20.0)mA; Custom voltage input range is (0~5.0)V; Users can select the corresponding curve by themselves. If pre-set sensor channel doesn't support current, and voltage type, then curve type item 2 and 3 will display "Reserved".

No.	Items	Description	Remark
4	Flow Rate Sensor	0: Not used 1: Custom Res Curve 2: Custom (4-20)mA Curve 3: Custom Volt Curve 4-15: Reserved	Custom resistance input range is (0~6)kΩ; Custom current input range is (4.0~20.0)mA; Custom voltage input range is (0~5.0)V; Users can select the corresponding curve by themselves. If pre-set sensor channel doesn't support current, and voltage type, then curve type item 2 and 3 will display "Reserved".

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7.5 CONDITIONS OF CRANK DISCONNECT SELECTION

Table 12 Crank Disconnect Conditions

No.	Settings
0	Engine Speed
1	Oil Pressure
2	Oil Pressure + Engine Speed

⚠️**NOTES:**

— There are 3 conditions to make starter disconnected with engine. Engine speed and oil pressure can be used separately. We recommend that oil pressure should be used with speed sensor together, in order to make the starter motor disconnect with engine immediately and can check crank disconnect exactly;

— Speed sensor is the magnetic equipment installed in starter for detecting flywheel teeth;

— When set it speed sensor, users must ensure that the number of flywheel teeth is the same as settings, otherwise, "over speed shutdown" or "under speed shutdown" may be caused;

— If the unit doesn't have speed sensor please don't select corresponding items, otherwise, shutdown alarms of "start failure" or "loss speed signal" may be caused;

— If the unit doesn't have oil pressure sensor, please don't select corresponding items.

7.6 MAINTENANCE SETTING

Table 13 Maintenance Setting

Item	Content	Description
Enable Choose	0: Disabled, 1: Enabled	Set maintenance function active or not;
Maintenance Time	(0-30000)h	It is the number of hours from the time the maintenance is enabled to when maintenance is required.
Maintenance Due Action	0: No Action; 1: Warning; 2: Shutdown.	Alarm action when maintenance left time is 0.
Maint. Timing Method	Running Time	The timing of maintenance.
Pre-maint. Time	(0-30000)h	
Pre-maint. Due Action	0: No Action; 1: Warning; 2: Shutdown.	Alarm action when pre-maintenance left time is 0.
Reset Maintenance		After maintenance completion, through this item reset maintenance time.
Maintenance Description		The string name of maintenance description can be set for maintenance 5-10; Users can input maintenance name, like Change Engine Oil.

8 PARAMETERS SETTING

Press ▼ key and hold it for 3 seconds to enter the setting menu after the controller is powered on. The menu list is as below:

>Return
>Parameters Set
>Maintenance Set
>Lock Set
>Language
>LCD Backlight Set
>Event Logs
>Controller Info

Select "Parameters Set" and input correct password (default: 01234) to enter the parameters setting interface.

Corresponding function of keys in parameter setting interface:

I Confirm key; ◎ Up key; **O** Return key; ▼ Down key.

Parameters Set >Return >Module Set **>Timers Set** >Engine Set	Screen 1: Enter setting menu, press Up/Down key to change setting items, press Confirm key to enter setting interface (Screen 2), press Return key to go back to previous menu. Or select "Return" by pressing Up/Down key and Confirm key to go back to previous menu.
Timers Set >Return **>Start Delay** > Pre-heat Time >Prestart Fuel Time	Screen 2: Press Up/Down key to change settings, press Confirm key to enter setting interface (Screen 3), press Return key to return (Screen 1). Or select "Return" by pressing Up/Down key and press Confirm key to go back to the previous menu (screen 1).
Start Delay 0000**0**s	Screen 3: Press Confirm key and move the cursor, select the value and press Up/Down key to modify it. Press Confirm key to save your modification. Then press Down key to return (Screen 2).
Timers Set >Return >Start Delay **>Pre-heat Time** > Prestart Fuel Time	Screen 4: Press Down key, select and modify the value (it is the same method as Screen 2 and Screen 3).
Over Shutdown **Enable Choose: Enabled** Set Val: 00098°C Delay 00003s	Screen 5: Set temp. sensor shutdown parameters. Select >Over Shutdown, press Confirm key to enter setting menu, then press Confirm key again to enter Screen 5, press Up/Down key to select settings, then press Confirm key to save and meanwhile the cursor will move down (as Screen 6 shows).

Over Shutdown Enable Choose: Enabled Set Val:　　█0098°C Delay　　　00003s	Screen 6: Press Up/Down key to change the value, then press Confirm key to next bit. After setting is finished, press Confirm key to enter delay setting. If it does not need to modify, press Return key to go back to the previous menu.

9　SENSOR SETTING

— If a sensor is needed to change again, the sensor curve will be transferred into the standard value. For example, if the default temperature sensor is SGD, the sensor curve is SGD curve; if it is set SGX, the temperature sensor curve is SGX curve.

— If there is difference between standard sensor curve and the used sensor, users can choose "defined sensor", and input defined sensor curve.

— At the time of inputting the sensor curve, X value must be inputted from small to large, otherwise, some mistake may occur.

— If sensor is selected to "Not Used", then sensor curve doesn't work.

— If corresponding sensor only has alarm switch, then it is a must that set the sensor "Not Used", otherwise shutdown alarm or warning may occur.

— It is applicable to set the headmost and backmost values in the vertical coordinate as the same as the Figure 7.
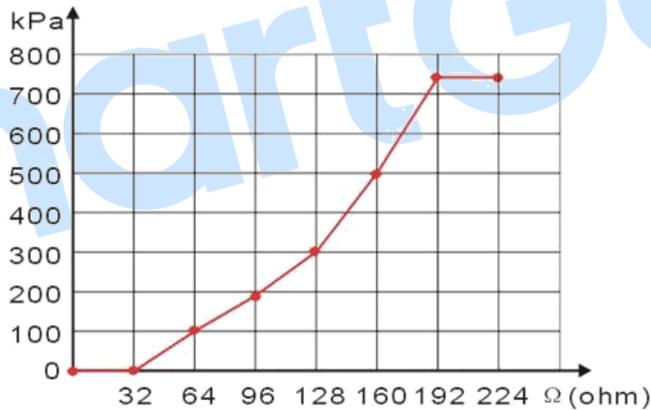

Fig.3 Sensor Curve Setting

Table 14 Common Pressure Unit Conversion Table

Item	N/m^2 (pa)	kgf/cm^2	bar	(p/in^2.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

10 COMMUNICATION CONFIGURATION AND CONNECTION

10.1 DESCRIPTION

APC1700 engine pump controller has a RS485 communication port. The port allows connection to an open local area network. It uses the Modbus communication protocol, and realize the Three Remote function (remote control, remote measurement, and remote communication) of the diesel pump unit through software on a PC or data acquisition system.

For more specific information of the communication protocol, please refer to the APC1700 water pump controller Communication Protocol.

10.2 RS485 COMMUNICATION DESCRIPTION

Communication Protocol: Modbus-RTU
Communication Parameters
Module Address: 1 (Range: 1-254)
Baud Rate: 9600bps(9600/19200bps/38400bps)
Data Bit: 8-bit
Parity Bit: None (None parity, odd parity, even parity)
Stop Bit: 1-bit (1-bit or 2-bit)

10.3 TERMINATION RESISTOR

At the ends of the linear network (the two communication ports that are the farthest apart), termination resistors of 120 ohms should be connected in parallel. According to transmission line theory, the termination resistors can absorb the reflected waves on the network and effectively enhance the signal strength. The value of the combined termination resistors should be approximately equal to the characteristic impedance of the transmission line at the communication frequency.

A reliable RS-485 network typically uses termination resistors. They may not be needed when the network cable is very short, temporary, or for laboratory testing.

11 COMMISSIONING

It is suggested to do the following examination before formal system operation:
a)   Check all the connections are correct and wire diameter is suitable.
b)   Ensure that controller DC power has fuse, controller's positive and negative are correctly connected to starting battery.
c)   Take proper action to prevent engine from crank disconnect (e. g. Remove the connection wire of fuel valve). If everything is OK, make the starting battery power on and controller will execute routine.
d)   Press "start" button, engine will start. After pre-set start times, controller will send failed to start signal; then press "stop" button to reset controller.
e)   Recover the action of stop engine start (e. g. Connect wire of fuel valve), and press start button again, then engine will start. If everything goes well, engine will go to normal running after idle running (if idle running is set). During this time, please observe engine's running situation.
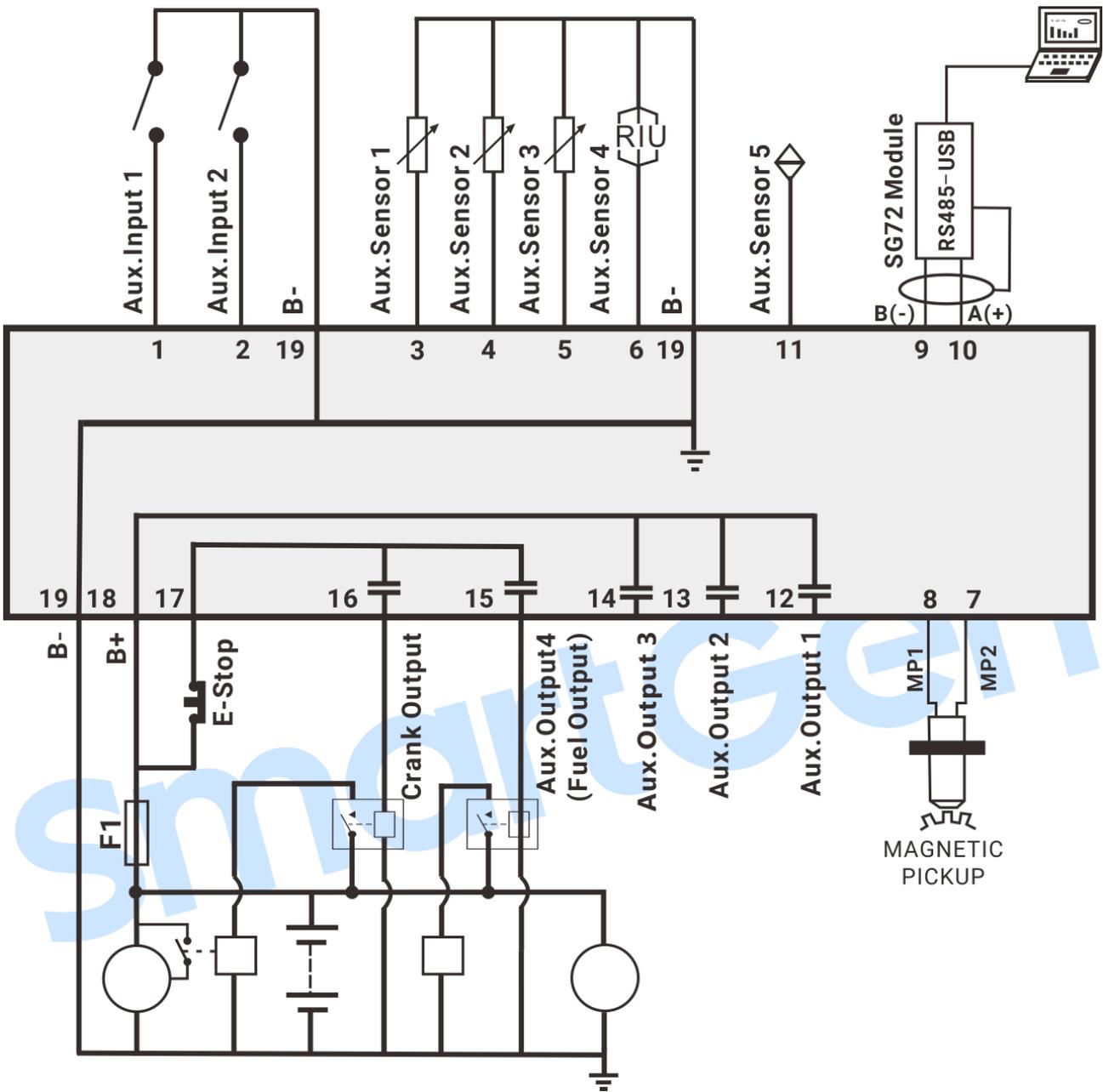f)   If there is any other question, please contact SmartGen's service.

12 TYPICAL APPLICATION

Fig.4 APC1700 Typical Application Diagram

⚠**NOTE:** After pressing the emergency stop button, the power of crank output and auxiliary output 4 will be disconnected. When doing configuration, please note that the function of ETS solenoid hold after stop should not be configured to the auxiliary output 4.
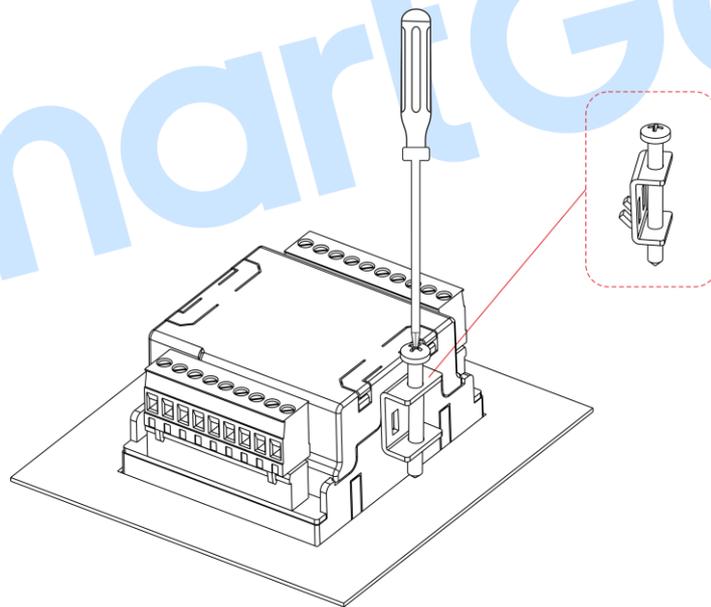
13 INSTALLATION

Controller is panel mounted design; and it is fixed with clips and screws for installation.

Unit: mm
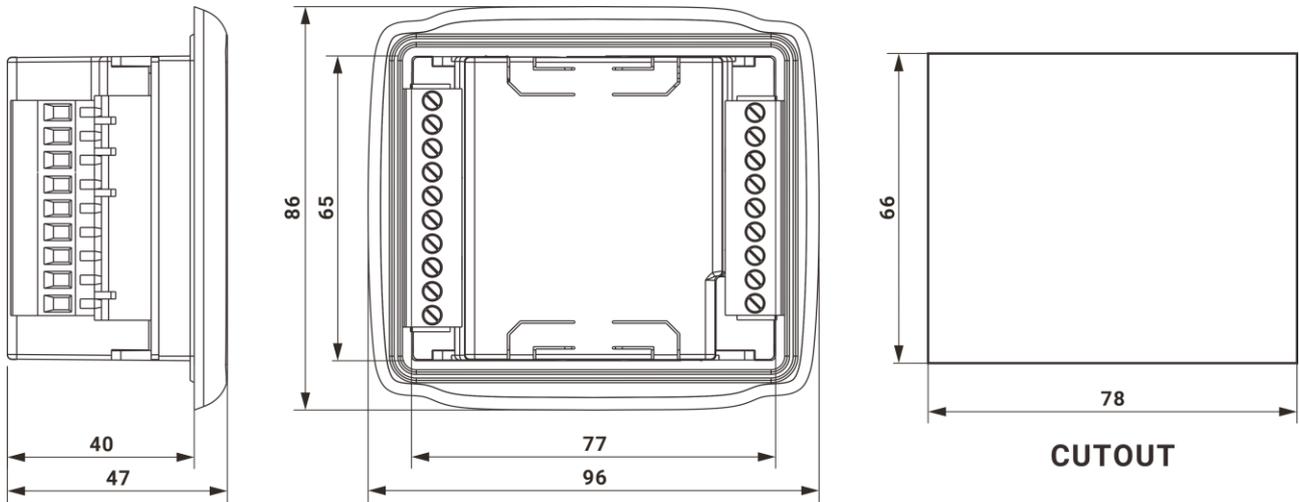
Fig.5 Overall & Cutout Dimensions

Fig.6 Clips Installation Diagram

— **BATTERY VOLTAGE INPUT:** APC1700 controller can suit battery voltage environment of (8~35)VDC. Negative of battery must be connected with the engine shell. Diameter of wire which connects power supply B+ and B- with battery positive and negative must be over 1.5mm^2. If floating charger is configured, please firstly connect output wires of the charger to battery's positive and negative directly, then connect wires from battery's positive and negative to controller's positive and negative input ports to prevent charger disturbing the controller's normal working;

— **SPEED SENSOR INPUT:** Speed sensor is the magnetic equipment installed in the starter for detecting flywheel teeth. The connection wires with controller should apply 2-core shielded line.

The shielded layer should be connected to ground terminal in the controller and another end connects with nothing. The other two signal wires are connected to Terminal MP1 and MP2, and the Terminal MP2 has been connected with B- internally. The output voltage of speed sensor should be within (1~24)VAC (RMS) during the full speed range, and 12VAC is recommended (at rated speed). When speed sensor is installed, let the sensor spun to contacting flywheel first, then, port out 1/3 lap, and lock the nuts of sensor at last;

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

14 TROUBLESHOOTING

Table 15 Troubleshooting

Symptoms	Possible Solutions
Controller no response with power	Check starting battery; Check controller wirings; Check DC fuse.
Engine stop	Check water/cylinder temperature is too high; Check DC fuse.
Controller emergency stop	Check emergency stop button function is right or not; Check wire connection is open circuit or not.
Oil pressure low alarm after crank disconnection	Check oil pressure and its wire connections.
Water temp. high alarm after crank disconnection	Check water temperature sensor and its wire connections.
Shutdown alarm in running	Check related switch and wirings according to LCD information; Check auxiliary input ports.
Crank failure	Check fuel circuit and related wirings; Check starting battery; Check speed sensor and its wire connections; Refer to engine manual.
None response for starter	Check starter wire connections; Check starting battery.
RS485 communication abnormal	Check RS485 wire connections; Check RS485 COM port settings are correct or not; Check RS485 A and B are connected reversely or not; Check RS485 conversion module is damaged or not; Check PC communication port is damaged or not.
ECU communication failure	Check wire CAN high and CAN low polarity; Check 120Ω termination resistor is connected correctly or not; Check engine type is selected right or not; Check wire connection between controller and engine is right or not; output port settings are right or not.
ECU warning or shutdown	Refer to alarm screen to obtain information; If there is detailed alarm information, then check engine according to it; If there is not, refer to engine manual to obtain information according to SPN alarm code.

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15 PACKING LIST

Table 16 Packing List

No.	Item	Quantity	Remarks
1	Controller	1	
2	Fixed Clips	2	
3	Qualification Certificate	1	
4	User Manual	1	

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