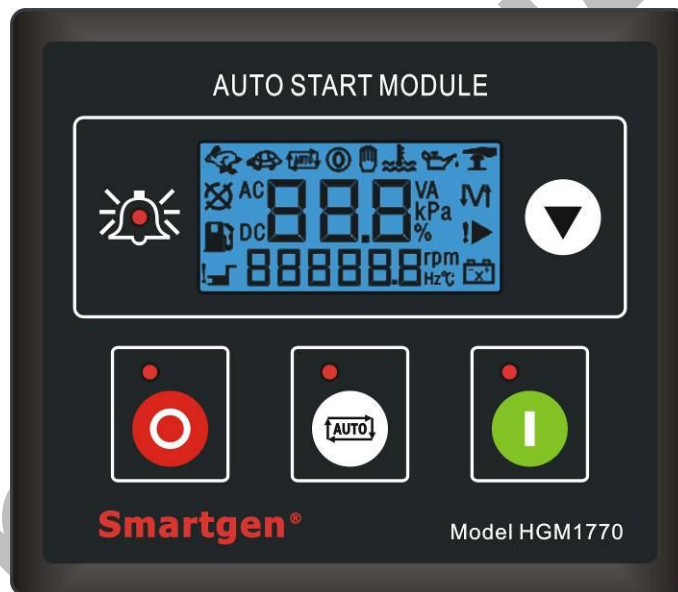


# Smartgen®

HGM1770

Automatic Generator Control Module

## OPERATING MANUAL



Smartgen Electronic

# Smartgen®

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## Software Version

Version	Date	Note
1.0	2009-11-20	Original release.
1.1	2009-11.20	Add "gens break on feedback" in function of output port.
1.2	2010-07-21	Add alternator poles.
1.3	2010-11-05	Add function of setting parameters via front panel.

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## 1. Summary

HGM1770 Series is genset automatic starts controller, which has 3 working modes for choose by panel button pressing. It can control genset start/stop by manual or remote control signal. As well as auto disconnect fuel relays and stop when controller detected faults (such as low oil pressure, water/cylinder temperature, emergency stop alarm, and over speed). LCD in panel shows faults status and authentic active alarm signals.

## 2. Performance and characteristics

- ◆ Has microprocessor as its core. The graphics and icons displayed in LCD. Gentle buttons touch for operating.
- ◆ Power supply range is wide (8~35) VDC, suitable for the start environment of 12V or 24V.
- ◆ It has input ports of Gens, speed, temperature, pressure, and liquid level. Can make electric quantity shows as digitization.

Precision measure and display of

Gens voltage (V)

Gens frequency (Hz)

Engine temperature (°C)

Engine oil pressure (kPa)

Speed (rpm)

Accumulated running time (h)

Battery voltage (V)

Engine fuel level (%)

Control protection:

Oil pressure low

- ◆ The values of gens voltage, battery voltage, speed, temperature, pressure, and level sensors can be set, below alarms and warns are generated,

Low oil pressure

High temperature of water/ cylinder

Water temperature high

Over Speed / Under Speed

Emergency stop

Start failed

Stop failed

Gens voltage is over high and low  
 Gens frequency is over high and low  
 Battery voltage is over high and low  
 Lower level of fuel oil

- ◆ It has idle speed control and energized to stop (ETS) function.
- ◆ It has 3 working modes, manual, automatic, and stop.
- ◆ Controller can be set as engine controller (don't select gens voltage input) via software and suitable for pumping unit control.
- ◆ There is Red LED shows working and alarm status in panel.
- ◆ Multiple sensors of temperature, pressure, and oil level can be used directly and its parameters can be defined. The sensors of temperature and pressure can be paralleled use with temperature and pressure alarm. First grade protection added when offering digital quantity.
- ◆ Multiple crank success conditions are optional (such as speed sensor, oil pressure and gens);
- ◆ It has 4 relays fixed output port. (Oil output, start output, stop output and idle output)
- ◆ It has 1 configured output port and it can be set as common alarm output, stop failed output, pre-heating output or idle control output.
- ◆ User can set the parameters and settings could be saved in flash memory of controller and not lost even power off. All parameters can be set via panel of controller or link port by software via PC (Smartgen SG72 adaptor is recommended). An USB port is needed only, and parameters could be set in PC via it. Storage battery is not necessary while PC could supply working power to controller for setting parameters.
- ◆ Modular design, anti-flaming ABS plastic shell, built-in mounting. Structure compact with small size. It controlled by SCM. Excellent performance and easy operation.






### 3. Specifications

Item	Content
Operating Voltage	DC8. 0V to 35. 0V, Continuous Power Supply
Power Consumption	Standby, 12V-0.3W, 24V-0.4W Working, 12V-1W, 24V-1.1W
Alternator voltage Input	1P2L 15V AC ~ 360 V AC (ph-N)
Alternator Frequency	50/60Hz
Speed sensor voltage	1V to 24V (active value)

Item	Content
Speed sensor Frequency	Max. 10kHz
Max. accumulative running time	99999.9 hours (it is 1/10 hour after decimal point, means changing/6 min.)
Start Relay Output	1Amp DC28V DC B+ power on to output
Fuel Relay Output	1Amp DC28V DC B+ power on to output
Stop Relay Output	1Amp DC28V DC B+ power on to output
Idle Relay Output	1Amp DC28V DC B+ power on to output
Configured Relay Output	1Amp DC28V DC B+ power on to output
Switching value input port	Active when connected with B-
Overall dimensions	88mm x 76mm x 44mm
Panel cut off	78x66mm
Working conditions	Temperature, (-25~+70)°C Humidity, (20~90)% without condensation
Storage Condition	Temperature, (-30~+80)°C
Protective Level	IP55: when waterproof rubber ring added between controller and its panel. IP42: when waterproof rubber ring not have between controller and its panel.
Insulation Intensity	Object: among in input/output/power Quote standard: IEC688-1992 Test way: AC1.5kV/1min 1mA leakage current
Weight	0.15kg

## 4. Operation

☉ display panel and buttons

Item	Define	Description
	Manual start/value decrease	Manual start is activated when pressing this button and enters into manual mode. Turning down items in parameters setting or decrease value where cursor located.
	Auto. / value increase	Automatic mode is activated when pressing this button. Turning up items in parameters setting or decrease value where cursor located.
	Stop	Genset is stopped and enters into standby mode when pressing this in whatever modes. Fault mode will be removed if press this when alarms occurs.
	LCD turn pages /confirm	Turn pages of LCD and can shift cursor in parameters setting or confirm setting.
	Alarm indicator	When alarm appears, this is flashing.

◎ LCD icon instruction

ICON	Define	ICON	Define
	Higher temperature alarm		Auto Mode
	Lower oil pressure alarm		Stop Mode
	Over speed alarm		Manual Mode
	Under speed alarm	AC	Gens Voltage indicate
	Emergency stop alarm	DC	Battery Voltage indicate
V	Gens over voltage	rpm	Speed unit (rpm/min.)
V	Gens under voltage	kPa	Oil pressure unit
	Start failed	V	Voltage unit
	Stop failed	%	Fuel level unit (%)
	Battery voltage abnormal	°C	Temperature unit
	Outside alarm	Hz	Frequency unit
	Normal running revolve	H	Accumulated running time
	Fuel level lower		

◎ Display description

Gens, phase voltage  $U_a$ , frequency F



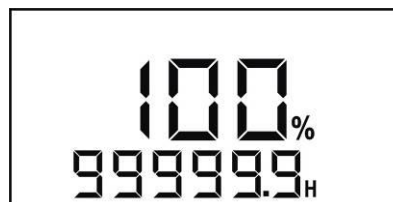
Battery voltage, engine speed



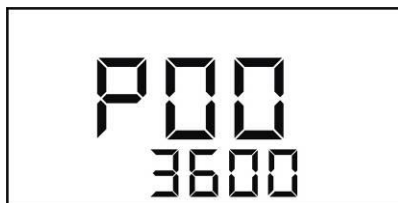
Oil pressure, water temperature



Liquid level %, accumulated running time



Parameters setting



## © Operating instructions

Controller has 3 working modes, Stop (🛑), Manual start (🟢), Automatic (🔄).

### Manual start (🟢)

This mode is activated by pressing the (🟢) (after one second to loosen), LED indicator beside the button confirms this action and is illuminating. Pre-heating is outputting first, and start pre-heating delay meanwhile. Oil output is starting before 1 second of delay is over. After 1 second of oil output, pre-heating output is disconnected and starter is power on and output, then engine is cranking. When gens frequency is over than pre-setting of successful start, started is power off and genset starts successfully and enters into safety delay. When delay is over then enters into idle delay. After it is also over, idle delay is close and genset starts in high speed running.

### Automatic (🔄)

◆ This mode is activated by pressing the (🔄) (after one second to loosen), LED indicator beside the button confirms this action and is illuminating. When remote start signal is active (remote start terminal is connected with B-), genset will start automatic after start delay. Pre-heating is outputting first, and start pre-heating delay meanwhile. Oil output is starting before 1 second of delay is over. After 1 second of oil output, pre-heating output is disconnected and starter is power on and output (genset will start according to setting start attempts. If start during attempts successfully, start is finished; if each start of attempts failed, start failed alarm will be sent and start failed LED in panel is illuminating and common alarm indicator is flashing), enters into safety delay. When delay is over then enters into idle delay. After it is also over, idle delay is close and genset starts in high speed running.

#### Note:

In the interval of start attempts, fuel output is disconnecting. After 3 sec. of starting interval delay, pre-heating and ETS is outputting. After starting interval delay is over, ETS outputting is disconnecting and oil output. The pre-heating output is disconnected before starting.

◆ When remote start signal inputting is inactive; genset enters into idle after stop delay. The idle relay has disconnected and oil relay is also disconnected after idle delay is over. ETS is outputting and genset will stop automatic. When

genset is steady stopped, ETS is disconnected.

### Stop (🔴)

- ◆ During genset in normal running (Manual or Auto mode), this mode is activated by pressing the (🔴) (after one second to loosen). LED indicator beside the button confirms this action and is illuminating and genset enters into idle delay process. The idle delay is open and after it is over, oil output is open, ETS output, genset stop. When genset is steady stopped, ETS is disconnected.
- ◆ When genset has fault alarm, pressing this key (after one second to loosen) can remove it. If over one second, all LED indicators of panel will illuminate (this is LED test).
- ◆ When genset in standby mode, press this key at least 1 second, ETS is outputting and all lamps in panel are illuminating (respond to lamp test function). After loosen Stop button, ETS outputting is closed immediately and meanwhile, the Lamp Test is over.
- ◆ When genset in standby mode, controller only responds to signal of emergency stop.

## 5. Protection

1. **LOW OIL PRESSURE**, controller will start to detect after safety delay is over and alarm shutdown before 2 seconds.
2. **HIGH ENGINE TEMPERATURE**, controller will start to detect after safety delay is over and alarm shutdown before 3 seconds.
3. **LOW FUEL LEVEL WARNING**, when the fuel level is continuously 10seconds and lower than the setting value, controller will send signal of lower fuel level. This value is only warning and not shutdown.
4. **OVERSPEED**, Start detecting while switching on, alarm shutdown before 2 seconds.
5. **UNDERSPEED**, start detecting after idle delay is over. Alarm of under speed is send to shutdown before 15 seconds.
6. **START FAILED**, if the start attempt of setting is over and starts failed, alarm to shutdown.
7. **STOP FAILED**, after the stop delay is over, if genset not steady stop, stop failed warning will be send, but this value not lock and save.
8. **HIGH BATTERY VOLTAGE**, When battery voltage keeps on being higher than to preset 20 seconds, high battery voltage warning signal will be send but not shutdown.
9. **LOW BATTERY VOLTAGE**, When battery voltage keeps on being lower than to preset 20 seconds, low battery voltage warning signal will be sending but

not shutdown.

- 10. EMERGENCY STOP**, when emergency stop input is active, ETS immediately output, cut off signals of oil, pre-heating and start. Emergency stop alarm signal will be sending.
- 11. GENS OVER VOLTAGE**, when the sample electric voltage is continuously higher than to preset five seconds, gens voltage over signal will be sending, alarm to shutdown in the meantime.
- 12. GENS UNDER VOLTAGE**, when the sample electric voltage is continuously lower than to preset five seconds, gens voltage low signal will be sending, alarm to shutdown in the meantime.
- 13. COMMON ALARM**, when there is over speed, low speed, high engine temperature, low oil pressure, emergency stop, start failed, stop failed, battery voltage is high or low, common alarm LED is flashing and common alarm output.

## 6. Parameter range and define

### 6.1 Parameters form (form 1)

Num	Parameter	Range	Default	Remark
P00	Start delay	(0-3600)S	1	Period from remote start signal is active or mains are failure to start gens.
P01	Stop delay	(0-3600)S	1	Period from remote start signal is inactive or mains is normal, to stop genset.
P02	Number of Crank	(1-9) times	3	Max. Crank times when engine start failed. Controller will send start failed signal if crank times is over.
P03	Pre-heat time	(0-300)S	0	Pre-heat plugs pre-heating time before starter power on.
P04	Cranking time	(3-60)S	8	Starter power on time.
P05	Crank rest time	(3-60)S	10	When engine crank failed, waiting time before second power on
P06	Safe time	(1-60)S	10	During this period, alarms of lower oil, high water temperature, under speed, under frequency, under voltage, charging failed and aux. input(if be configured) are inactive.
P07	Start idle time	(0-3600)S	0	Idle running time of genset start.

Num	Parameter	Range	Default	Remark
P08	Warming up time	(3-3600)S	10	After genset into high speed running, warming up time needed before break on feedback.
P09	Cooling time	(3-3600)S	10	After genset uninstalled, cooling time needed before stop.
P10	Stop idle time	(0-3600)S	0	Idle running time when stop.
P11	ETS solenoid hold	(0-120)S	20	When ready for stop, the stop magnetic power on time.
P12	Stop time	(0-120)S	0	When "ETS output time" as 0, time from idle delay to steady stop; when it is not 0, time from ETS delay to steady stop.
P13	Flywheel teeth	(10-300)	118	Number flywheel of teeth in engine, it is used as judge of engine's separation conditions and detecting of engine's speed. Details see following of mounting manual.
P14	Mode option of power on	(0-2)	0	Default, stop mode
P15	Gens abnormal delay	(0-20.0)S	10.0	Gens voltage is over and under, alarm delay.
P16	Gens voltage higher	(30-360)V	264	When gens voltage is over than this and continual over than time setting of "Gens abnormal delay", means gens voltage is over, and gens abnormal alarm stop will be sending. When this set as 360V, over voltage signal is not detected.
P17	Gens voltage lower	(30-360)V	196	When sampling voltage is lower than this and continual lower than time setting of "Gens abnormal delay", means gens voltage is low, and gens abnormal alarm stop will be sending. When this set as 30V, low voltage signal is not detected.

Num	Parameter	Range	Default	Remark
P18	low speed	(0-6000)RPM	1200	When the motor speed lower than this value and keep on 10 seconds, means low speed. Low speed alarm stop signal will be sending.
P19	Over speed	(0-6000)RPM	1710	When the motor speed over than this value and keep on 2 seconds, means over speed. Over speed alarm stop signal will be sending.
P20	Gens under frequency	(0-75.0)Hz	45.0	When the motor frequency under than this value, not 0 and keep on 10 seconds, means under frequency. Under frequency alarm stop signal will be sending.
P21	Gens over frequency	(0-75.0)Hz	57.0	When the motor frequency over than this value, and keep on 2 seconds, means over frequency. Over frequency alarm stop signal will be sending.
P22	High temperature	(80-140)°C	98	When outside connected engine temperature sensor value is higher than this point, high temperature signal will be sending. And this value only is detected after safety delay is over and only judge the temperature sensor of outside connected. When setting value is 140, higher temperature signal is not be send. (This only suit for temperature sensor, not including higher temperature alarm signal inputted via configured input port).

Num	Parameter	Range	Default	Remark
P23	Low pressure oil	(0-400)kPa	103	When outside connected engine oil pressure sensor value is lower than this point, low oil pressure delay will be started. And this value only is detected after safety delay is over. When setting value is 0, low oil pressure signal is not be send. (This only suit for pressure sensor, not including low pressure alarm signal inputted via configured input port)
P24	Low fuel level	(0-100)%	10	When outside connected fuel level sensor value is less than this point and remains for 10 seconds, send out warning alarm. This only warning but not stop.
P25	Pole number of alternator	(2-16)	4	Set pole number of alternator.
P26	Battery over voltage	(12-40V)	33.0	When battery voltage is over than the point and keeps on 20 seconds, battery over voltage signal is active. It's warning only but not stops.
P27	Battery under voltage	(4-30V)	8.0	When battery voltage is under than the point and keeps on 20 seconds, battery under voltage signal is active. It's warning only but not stops.
P28	Switching value output port	(0-6)	1	Default, Common alarm output
P29	Configured output ports	(0-6)	4	Default, outside stop alarm input. When this set as 0, type of oil level sensor can be set.
P30	Configured input ports delay	(0-20.0)S	2.0	When this port as switching value input, input active delay time.
P31	Address of model	(1-254)	1	Communication address

Num	Parameter	Range	Default	Remark
P32	Crank successful conditions option	(0-5) Details see form 5	1	Starter disconnects conditions. Conditions of starter disconnected with alternator including, gens, magnetic sensor and oil pressure. In order to make starter motor disconnected with engine immediately.
P33	Engine speed when crank OK	(0-3000)RPM	360	When engine speed is over than this point, starter Ok and will disconnect.
P34	Alternator frequency when crank OK	(10-30)Hz	14	When alternator frequency is over than this point, crank OK and starter will disconnect.
P35	Engine oil pressure when crank OK	(0-400)kPa	200	When engine oil pressure is over than this point, crank OK and starter will disconnect.
P36	Temperature sensor option	(0-10)	06	SGD(120°C resistance type)
P37	Pressure sensor option	(0-10)	06	SGD(10Bar resistance type )
P38	Fuel level sensor	(0-7)	0	Not used

## 6.2 Enable definition of programmable output ports form (form 2)

Num	Item	Description
0	Not used	Output port is inactive when select this.
1	Common alarm	All alarms stop and warning alarm are included. When warning alarm inputting is activated only, this alarm is not self-locked; when alarm stop is activated, this alarm is self-locked until this is reset.
2	Energized to stop	This used for genset which has stop electromagnet. The electromagnet is actuated close when stop idle is over. It is disconnected when the setting of "ETS delay" is over.
3	Idle control	This used for genset which has idle speed. It is actuated close when starting and disconnected when enters into high speed warm up. Also actuated close during genset in stop idle and disconnected when genset steady stop.
4	Preheat control	It is actuated close before start and disconnected before starter is power on.
5	Break on feedback output	Gens outputting with load.
6	Reserved	

### 6.3 Defined contents of programmable input ports form (All is active when connect grand (B-)) (from 3)

Num	Description	Remarks
0	Not used	
1	High Temp alarm Input	After genset is started successfully, it will alarm to stop immediately if this signal is active.
2	Low OP alarm input	
3	Reserved	Only warning not stops if this signal is active.
4	Auxiliary alarm and stop input	Genset will alarm to stop immediately if this signal is active.
5	Cooling stop when temperature is high	When this signal is active and genset in normal running, if the temperature is higher, genset will stop immediately after hi-speed cooling; when this signal is inactive, if the temperature is higher, genset will stop immediately.
6	Reserved	
7	Reserved	
8	Sensor of fuel Level	Details see Sensor option (form 4).

### 6.4 Sensor option (form 4)

Num	Item	Content	Remark
1	Temperature Sensor	0 Not used 1 activated when digit input low 2 activated when digit input high 3 defined resistance type 4 VDO 5 SGH (yellow river sensor) 6 SGD (Dongkang sensor ) 7 CURTIS 8 DATCON 9 VOLVO-EC 10 SGX 120 DEGREE	Defined resistance type input resister range is 0~999.9Ω, Default is SGD type sensor.
2	Oil pressure Sensor	0 Not used 1 activated when digit input low 2 activated when digit input high 3 defined resistance type 4 VDO 5 SGH (yellow river sensor) 6 SGD (Dongkang sensor ) 7 CURTIS 8 DATCON 10Bar 9 VOLVO-EC 10 SGX 10Bar	Defined resistance type input resister range is 0~999.9Ω, Default is SGD type sensor.









Num	Item	Content	Remark
3	Fuel Level Sensor	0 Not used 1 activated when digit input low 2 activated when digit input high 3 defined resistance type 4 SGH (yellow river sensor) 5 SGD (Dongkang sensor ) 6 Reserved 1 7 Reserved 2	Defined resistance type input resistor range is 0~999.9Ω, Default is SGD type sensor. When fuel level sensor is setting, programmable input port type should be set as 0 first, then, continued.

### 6.5 Conditions of crank succeed (form 5)

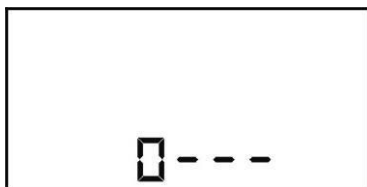
Num	Content
0	Magnetism sensor
1	Gens
2	Magnetism sensor + Gens
3	Magnetism sensor + Oil pressure
4	Gens+ Oil pressure
5	Gens + Magnetism sensor+ Oil pressure

1. There are 3 conditions to make starter disconnected with engine, magnetic sensor, gens can be used separately and engine oil pressure can be used with magnetic sensor, gens together and in order to make the starter motor is separated with engine immediately.
2. Magnetic sensor, is the magnetic equipment which be installed in starter and for detecting tooth of flywheel.
3. When start is set as magnetic sensor, must ensure that the tooth no. of flywheel is as same as setting, otherwise, "over speed stop" or "under speed stop" maybe caused.
4. If genset without Magnetic sensor, please don't select items correspond, otherwise, "stop fail" or "loss speed signal and alarming" maybe caused.
5. If genset without oil pressure sensor, please don't select items correspond.
6. If no select of gens in start successful setting, controller will not collect and display the relative power quantity (can be used in pumping unit); if no select of Magnetic sensor in start successful setting, the rotate speed displayed in controller is converted calculate on gens signal.

## 7. Parameters setting

1. When controller in standby, pressing  and  together, enters into Password menu (see below). Now, first digit is flashing, enters password of 0318 (ways showed in 2);
2. Press , the digit value which is flashing increases 1 while press  will decreases one. When digit is confirmed, shift cursor by pressing ;
3. Change digits from 2~4 follow above ways;
4. Parameters setting menu will be entered if correct password pressed (see below). Current setting series item number and parameters under this item will be displayed. Press  for setting up turn and  for down;
5. Press  enters into setting of current parameters item, and first digit is flashing. Setting way is as same as password input.

Password inputting menu,



Parameters setting menu





### Note:

- A. Please change the controller parameters when genset is in standby only (e. g. Start conditions selection, configurable input and output, various delay), otherwise, alarming to stop and other abnormal maybe caused.
- B. Each setting value must within its allowed range or, parameters couldn't be changed.
- C. Overtop voltage threshold value must greater than over-low threshold value; otherwise, there is situation that overtop as well as over-low occupy meanwhile.
- D. Overtop speed threshold value must greater than over-low threshold value; otherwise, there is situation that overtop as well as over-low occupy meanwhile.
- E. Please set genset frequency value as low as possible when start successful, in order to make the starter be separated quickly as soon as start successfully.

F. The series number of setting item, please refer to the series number of form one.

G. When fuel level sensor is setting, programmable input port type should be set as zero first, then, continued.

\* **Remark1:** during setting period, press  can immediately stop current setting in anytime.

\* **Remark2:** when genset in Manual mode, conditions of crank have, “2 magnetic sensors + Gens” or “5 Gens+ magnetic sensor+ oil pressure”, and while gens' frequency and speed is not 0, press  and  buttons simultaneously (at least 0.5 second), controller will adjust alternator's tooth number automatic according to gens' frequency and alternator's poles.

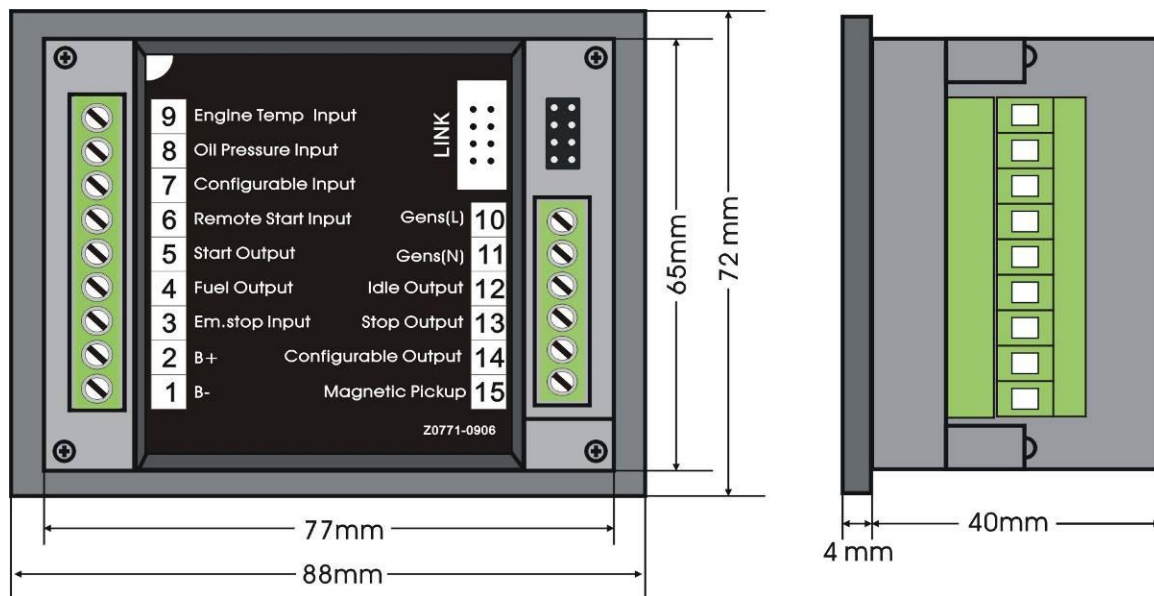
## 8. Connecting Terminal

- ◆ Pin1 (B-): (Battery Negative).
- ◆ Pin 2(B+): (Battery Positive).
- ◆ Pin 3(Em. stop input): emergency stop input (B+ voltage input is active). The stop normal close button is outside connected.
- ◆ Pin 4(Fuel Output): fuel output port (output B+), oil relay is outside connected. Contactor capacity is 1A.
- ◆ Pin 5(Start Output): Start output port (output B+), start relay is outside connected. Contactor capacity is 1A.
- ◆ Pin 6(Remote Start Input): Remote start input port, active when connected with B-.
- ◆ Pin 7(Configurable Input): Configurable input ports. Switching value and oil level sensor signals can be input via setting. Switching value input active by connected B-.
- ◆ Pin 8(Oil Pressure Input): Low oil pressure switching value or sensor signal input port, active by connected B-.
- ◆ Pin 9(Engine Temp Input): Water/cylinder high temperature switching value or sensor signal input port, active by connected B-.
- ◆ Pin 10(L), 11(N): Alternator voltage signal outside connected. Detecting start successfully and offering protection of over/low speed.
- ◆ Pin 12(Idle Output): Idle speed control output port (output B+), Contactor capacity is 1A.
- ◆ Pin 13(Stop Output): ETS output port (output B+), Contactor capacity is 1A.
- ◆ Pin 14(Configurable Output): Configurable output port (output B+); the switching value of output can be set via PC. Contactor capacity is 1A.
- ◆ Pin 15(Magnetic pickup): Magnetic head signal input and shielding line is

recommended.

- ◆ LINK port: The terminal of LINK on the rear panel is an interface for upgrading module software and all parameters can be set by PC used SG72 via USB port.

### 9. Overall Dimensions (Panel cutoff 78x66mm)



### 10. Typical application

