

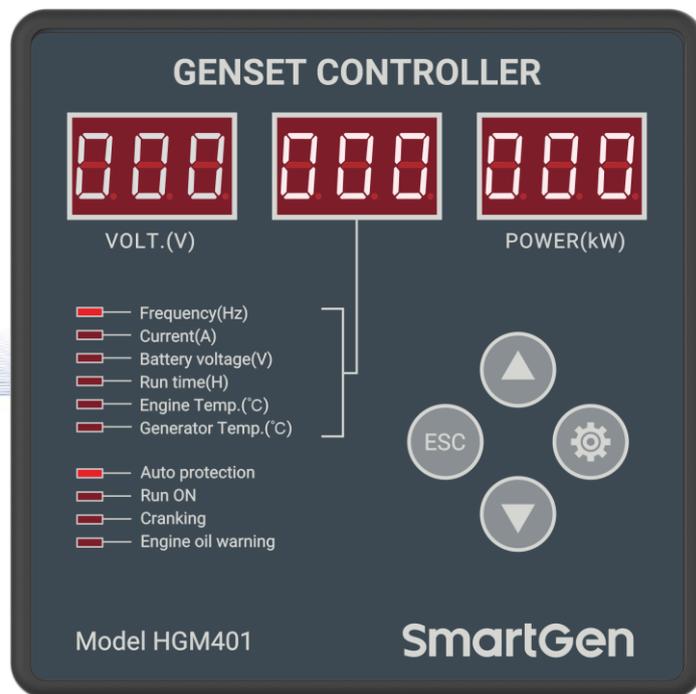
SmartGen

MAKING CONTROL SMARTER

HGM401

GENSET CONTROLLER

USER MANUAL



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Table 1- Version History

Date	Version	Content
2025-03-31	1.0	Original release.

Table 2 - Clarification of signs

Signs	Explanation
 Note	Concerns an operating procedure that needs highlighting.
 Caution!	Indicates a procedure or practice, which, if not strictly observed, can result in damage of the equipment.
 Warning!	Indicates a procedure or practice, which, if not strictly observed, can result in personal death, serious injury or significant property damage.

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1 OVERVIEW

HGM401 Genset Controller is smart digital controller for control and protection of single genset. It can carry out start/stop, data measurement, alarm indication, shutdown protection and other functions. The controller is fitted with 7-segment LED display, which is reliable and easy to use.

HGM401 Genset Controller contains the microprocessor allows precise measurement of multiple parameters, which can be configured using controller front panel. With simple wiring, compact structure and high reliability, HGM401 can be widely used for data display and fault protection of a large number of diesel and petrol generator sets.

2 PERFORMANCE AND CHARACTERISTICS

The main features are as follows:

- 1) 7-segment LED display can show the single phase voltage, line voltage, and total active power (calculated by single phase power, the load is considered as balanced load);
- 2) Multifunction 7-segment LED display that can be switched between single phase frequency, single phase current, battery voltage, total running time (max. 999 hours), engine and generator temperature;
- 3) Under voltage, over voltage, under frequency, over frequency, over load, high temperature protection. When the protection occurs, it triggers the flashing light alarm. And the shutdown protection is followed by alarm delay;
- 4) Low oil pressure digital input, which can immediately shut down the engine in case of low oil pressure;
- 5) Parameters displayed can be selected using touch keys;
- 6) Flexible selection of temperature sensor types in settings;
- 7) Parameter setting function allows user to modify the parameter, and the setting will not be lost when powered off. Most parameters can be set via front panel, and all parameters can be set by host PC via USB port;
- 8) Modular design, pluggable wiring connection terminal, anti-flaming ABS plastic enclosure, compact structure, convenient embedded installation.

3 SPECIFICATIONS

Table 3 – Technical Parameters

Parameter	Details
Operating voltage	DC9.0V to 16V, uninterrupted power supply – Compatible for DC12V system Resolution: 0.1V Accuracy: 1%
Overall consumption	<2W (Standby mode \leq 1.5W)
Generator Voltage Input: Single Phase 2-Wire (L and N only) 2-Phase 3-Wire (L and N only) 3-Phase 4-Wire (L and N only)	AC 30V - 360V (ph-N) AC 30V - 360V (ph-N) AC 30V - 360V (ph-N)
AC Frequency	50/60Hz
CT Secondary Current	Rated 62.5mA
Analog Sensor	Resistance Input Range: (0 - 6000) Ω Resolution: 0.1 Ω Accuracy: 1 Ω (below 1000 Ω)
Fuel Output	7A DC12V power supply output (relay output)
Start Output	7A DC12V power supply output (relay output)
Digital Output	7A DC12V power supply output (relay output)
Digital Input	Low ON threshold voltage 1.2V, max. input voltage 60V
Vibration	5Hz~8Hz: displacement= \pm 7.5mm 8Hz~500Hz: a= \pm 2g IEC 60068-2-6
Shock	50g, 11ms, half-sine, three consecutive shocks are applied in each of the three mutually perpendicular directions, i.e., a total of 18 times. IEC 60068-2-27
Bump	25g, 16ms, half-sine IEC 60255-21-2
Case dimensions	96mm x 96mm x 34mm
Panel Cutout	91mm x 91mm
Operating Temperature	(-25~+70) $^{\circ}$ C
Operating Humidity	(20~90)%RH
Storage Temperature	(-30~+80) $^{\circ}$ C
Protection level	IP42
Insulation strength	Apply AC2.2kV voltage between high voltage terminal and low voltage terminal, leakage current is less than 3mA within 1min.
Product Standard	GB/T 37089 Reciprocating internal combustion engine driven alternating current generating sets—Controller
Weight	0.146kg

4 OPERATION

4.1 BUTTON DESCRIPTION

Table 4 – Key Functions

Icon	Key Function	Description
	SET	1. Press and hold the key for 1s to enter parameter configuration. 2. When setting parameters, confirm and enter the current setting.
	UP	1. In normal operation status, press it to switch the LED indicator upward. 2. When setting parameters, press it to increase the parameter value.
	DOWN	1. In normal operation status, press it to switch the LED indicator downward. 2. When setting parameters, press it to decrease the parameter value.
	CANCEL	1. In alarm shutdown status, press it to cancel the alarm. 2. When setting parameters, press it to exit the parameter setting. 3. Press and hold it for 3s to enter lamp test mode. All indicators and LED tubes will illuminate (except Run ON, Cranking, and Engine oil warning indicators), then release it to return to normal.

4.2 FRONT PANEL

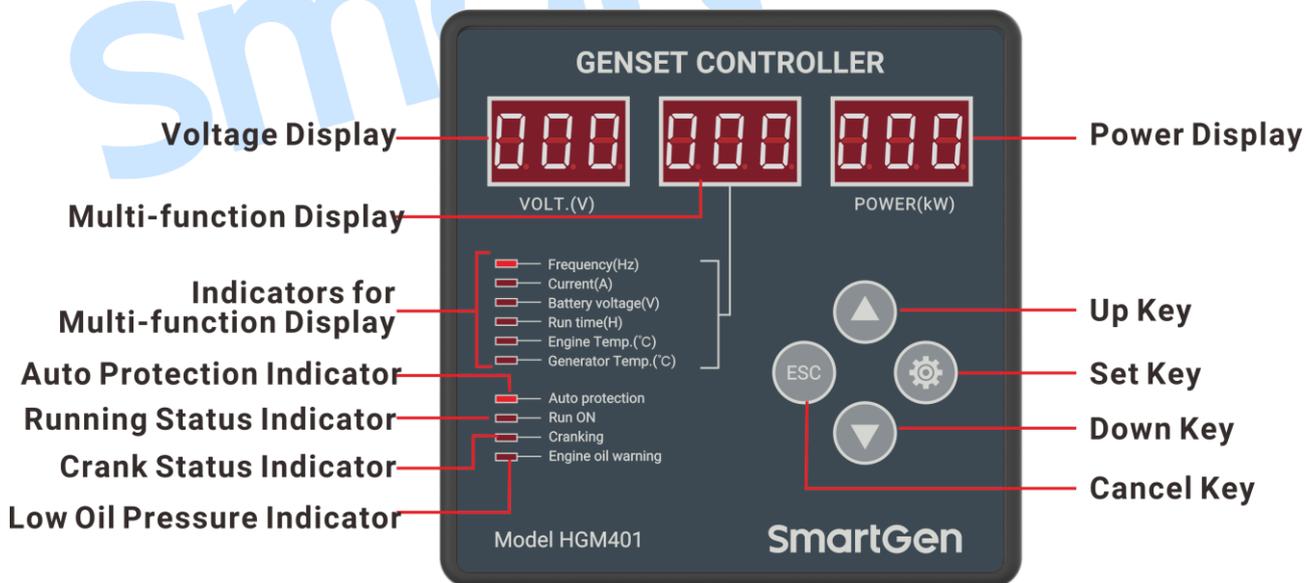


Fig.1 – HGM401 Front Panel

NOTE 1: Voltage display: When the AC wiring system is 3P4W, it displays single-phase line voltage; when the AC wiring system is 2P3W, it displays the sum of two-phase voltages; for other wiring systems, it displays single-phase phase voltage.

NOTE 2: Total active power is calculated from single-phase power, assuming the load is balanced.

4.3 START/STOP OPERATION

4.3.1 STARTING PROCEDURE

In stop mode turn the starter key from OFF to ON position to power on the controller, then change the starter key position to START to begin cranking; after the engine fires, release the starter key (crank disconnect condition: gen. frequency>14.0Hz), then voltage, power and frequency display

windows will show the real-time measured values. Press  or  button to switchover between indicators 1#-6# and multifunctional display indicators will show corresponding settings.

Press  button to return to the frequency display.

LED indicators status:

1#	Frequency (Hz)	
2#	Current (A)	
3#	Battery voltage (V)	
4#	Run time (H)	
5#	Engine temp. (°C)	
6#	Generator temp. (°C)	
7#	Auto protection	If on, auto protection is enabled; if off, it is disabled.
8#	Run ON indicator	Fuel relay output indicator
9#	Cranking indicator	Cranking output indicator
10#	Engine oil warning	Low oil pressure indicator

▲NOTE: Before starting the engine, please make sure that all the parameter settings are correct.

▲NOTE: "Engine oil warning" indicator will be ON/OFF according to the status of oil pressure switch. If the oil pressure is low, it will be ON (it will be always ON before the generator starts). If the oil pressure is normal, it will be OFF; if it is OFF before the generator starts, it means that oil pressure switch or its return circuit is faulty. In this case, please do not proceed before clearing up the problem.

4.3.2 STOPPING PROCEDURE

1) Auto stop

If auto protection condition occurs, the system will be stopped automatically;

During normal running of the genset, if low oil pressure signal is detected, after 2 seconds delay, the genset will be stopped.

2) Manual stop

Under any circumstances, if starter key is turned from ON to OFF position, it will shut down the genset.

5 PROTECTION

In auto protection mode, except for low oil pressure protection, all the other protections (voltage, frequency, overload, temperature) are also active.

1) Voltage protection

When the limits of rated voltage are exceeded by $\pm 10\%$, Voltage LED tube starts flashing; after 7 seconds delay in case of under voltage or 3 seconds delay in case of over voltage, the alarm shutdown is initiated. After that voltage LED tube continues to flash and shows the voltage value before the protection triggers.

2) Frequency protection

50Hz: (45~55)Hz

60Hz: (55~65)Hz

When the frequency exceeds the set value, frequency LED tube starts flashing; after 7 seconds delay in case of under frequency and 3 seconds delay in case of over frequency, alarm shutdown is initiated. After that frequency LED tube continues to flash and shows the frequency value before the protection triggers.

3) Overload protection

If the set value is exceeded by 5% or less, alarm will not be initiated;

If the set value is exceeded by more than 5%, power LED tube will start flashing;

If the set value is exceeded by 5%-7.5% and continuous for more than 3 hours, then alarm shutdown will be initiated;

If the set value is exceeded by 7.5%-10% and continues for more than 1 hour, alarm shutdown will be initiated;

If the set value is exceeded by more than 10%, and continues for more than pre-set over power delay value, alarm shutdown will be initiated (default: 30s);

After alarm shutdown is initiated power LED continues to flash and shows pre-alarm value.

4) Low oil pressure protection

Whether auto protection mode is enabled or not, after the genset enters normal running, it will shut down automatically if low oil pressure occurs and last for more than 2s.

5) High engine temperature protection

If engine temperature exceeds pre-set high temperature threshold, the LED indicator of engine temperature starts flashing; after 7 seconds delay, the protection is triggered. The indicator continues to flash and shows pre-protection value (suitable for air-cooled engine).

6) High generator temperature protection

When generator temperature exceeds 95°C, the LED indicator of generator indicator starts flashing; after 7 second delay, the protection is triggered. The indicator continues to flash and shows pre-protection value.

7) Battery voltage protection

Battery voltage protection is enabled irrespective of whether auto protection mode is enabled or not and whether genset is running. If battery voltage value is lower than 8V or higher than 16.5V, LED tube or indicator starts flashing for alarm, but shutdown protection is not initiated.

▲NOTE: During Safety On delay, protection is disabled; after Safety On Delay, when voltage, frequency, overload, high temperature protection is initiated, fuel output deactivates.

6 TERMINAL

The back panel of the HGM401 controller is as follows:

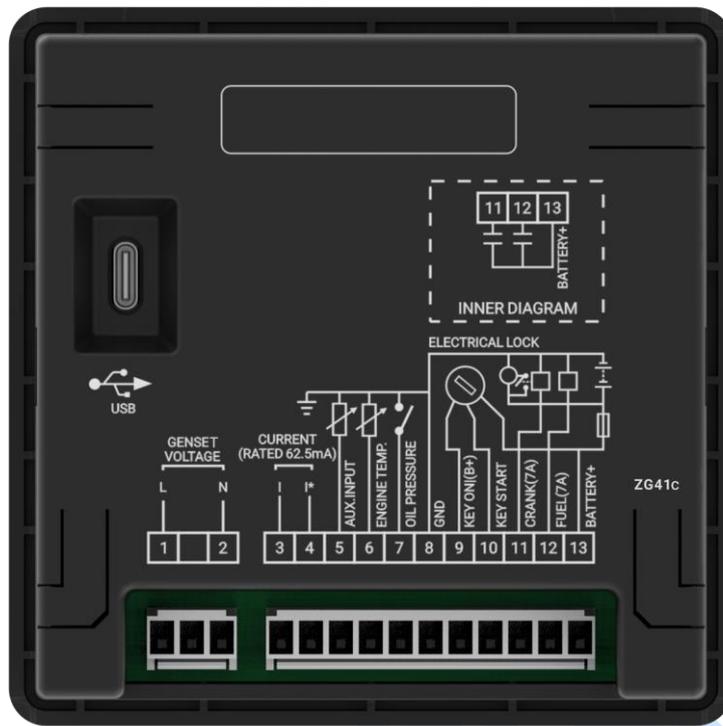


Fig.2 – HGM401 Back Panel

Table 5 -Terminal Connections Description

Terminal	Function	Cable size	Remarks
1	Generator Voltage L	1.0mm ²	
2	Generator Voltage N	1.0mm ²	
3	Load CT Secondary Side I (out)	1.0mm ²	The maximum current of current transformer secondary side is 62.5mA
4	Load CT Secondary Side I* (in)	1.0mm ²	
5	Aux. Input 1	1.0mm ²	It can be configured as programmable digital input port (active when connected to B-); It can also be configured as generator temp. sensor.
6	Engine Temperature Sensor Input	1.0mm ²	
7	Low Oil Pressure Input	1.0mm ²	Low oil pressure digital or sensor signal input port; Active when connected to B-
8	Battery Negative Input B-	1.5mm ²	Controller power supply input B-
9	Electric Switch ON Signal Input B+	1.5mm ²	Controller power supply input B+ and fuel relay output (activates when starter key is turned to ON position)
10	Electric Switch START Input	1.5mm ²	Manual start, start relay output (Output activates when starter key is

Terminal	Function	Cable size	Remarks
			turned to START position)
11	Start Relay Output	1.5mm ²	Rated current 7A; it is supplied by Terminal 13
12	Fuel Relay Output	1.5mm ²	Rated current 7A; it is supplied by Terminal 13
13	Fuel/Start Relay Common Port	2.5mm ²	It is connected to the positive of the starting battery through a fuse.

▲NOTE 1: The USB port on the back panel is used for parameter programming, allowing the controller to be configured via the host PC.

Specifications for cable size:

Power supply (B+, B-): 2.5 mm²;

AC current input: 1.5 mm²;

Digital inputs, analog inputs, AC voltage inputs: 1.0 mm²;

Output based on the relay load currents:

10–16 A: 2.5 mm²;

5–10 A: 1.5 mm²;

Below 5 A: 1.0 mm².

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7 CONFIGURABLE PARAMETERS

7.1 CONFIGURABLE PARAMETERS TABLE

Table 6 – Configurable Parameters

No	Parameter	Range	Default	Description
P1	AC system	1P 2P 3P 4P	1P	1P: 1P2W 2P: 2P3W 3P: 3P4W 4P: Dual power
P2	Rated voltage	110 V 115 V 120 V 130 V 220 V 230 V 240V	220	Generator rated voltage value selection
P3	Rated power	(0.0-99.9)kw	5.0	Generator rated active power
P4	Rated frequency	50Hz 60Hz	50	Generator rated frequency selection
P5	Auto protection enable	Enable (64) Disable (0)	64	Whether genset auto protection is enabled
P6	CT Ratio	(0-999)/62.5	50/62.5	Unit: A/62.5mA (It must correspond to the used current transformer)
P7	Engine temperature sensor type	L-0 L-1 L-2 L-3 L-4 L-5	L-4	L-0: Not used L-1: TE1 (SGX Sensor) L-2: TE2 (SGD Sensor) L-3: TE3 (PT100 Sensor) L-4: TE4 (See TE4/TG4 Sensor Curve in Fig. 3) L-5: TE5 (Mingzhihui SGD_NPT Sensor) When connecting the temperature sensor, select the curve according to the used sensor.
P8	Generator temperature sensor type	L-0 L-1 L-2 L-3 L-4 L-5	L-0	L-0: Not used L-1: TG1 (SGX Sensor) L-2: TG2 (SGD Sensor) L-3: TG3 (PT100 Sensor) L-4: TG4 (See TE4/TG4 Sensor Curve in Fig. 3) L-5: TG5 (Mingzhihui SGD_NPT Sensor) When connecting the temperature

No	Parameter	Range	Default	Description
				sensor, select the curve according to the used sensor.
P9	High engine temperature shutdown threshold	(1-600)	98	The threshold setting for high engine temperature shutdown
P10	Password set	(0-999)	318	The password to access the parameter setting

NOTE 1: Parts of parameters can only be configured via PC software, such as Digital input port 1.

NOTE 2: AC system selected "Dual Power" means the generator can output two kinds of rated voltage via a switch, and the controller can provide separate protection for both rated voltage settings.

TE4/TG4 sensor curve as below:

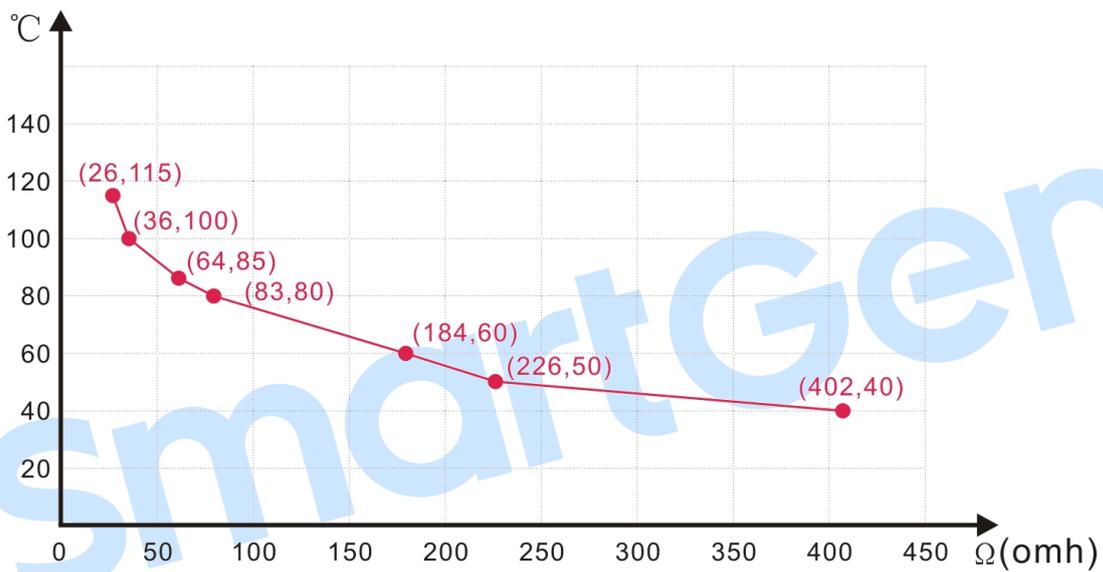


Fig.3 - TE4/TG4 Sensor Curve

8 PARAMETER CONFIGURATION

8.1 MENU ITEMS

Before initial use, the controller requires parameter setting, including rated voltage, rated frequency, and rated power, to match the generator's specifications. Additionally, the current transformer (CT) ratio must be set to align with the actual CT ratio in use.

8.2 CONTROLLER PARAMETER SETTING

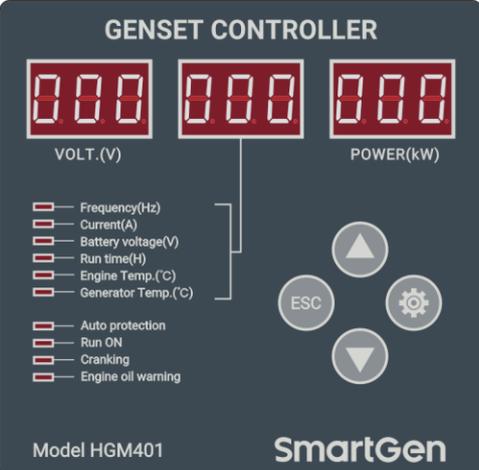
When entering the password, input "00318" to access all parameter settings. If the default password (00318) has been changed, the same password as the controller must be entered via PC software to modify parameters. If the password is forgotten, please contact the manufacturer.

1) When the controller is powered on, press and hold the  key for more than 1 second to enter the password interface. Press the  key to enter the password. At this time, press the  or  key to select digits from 0 to 9, then press the  key to confirm the password. After successful verification, you will enter the parameter setting interface.

2) After entering the parameter setting interface, press the  or  key to select a parameter setting item, then press the  key to confirm and enter the setting. The LED tube will begin flashing, press the  or  key to select, then finally press the  key to confirm. The system will automatically switch back to the parameter setting item selection interface.

Example 1 for parameter setting:

Table 7 – Procedure for AC System Setting

Panel Display	Description
 <p>The image shows the SmartGen Genset Controller panel display. It features three red LED displays at the top labeled 'VOLT.(V)', 'CURRENT(A)', and 'POWER(kW)'. Below these are several status indicators with corresponding icons: Frequency(Hz), Current(A), Battery voltage(V), Run time(H), Engine Temp.(C), and Generator Temp.(C). There are also indicators for Auto protection, Run ON, Cranking, and Engine oil warning. The panel includes three navigation buttons: an up arrow, a gear icon, and a down arrow, along with an 'ESC' button. The model number 'Model HGM401' and the 'SmartGen' logo are visible at the bottom.</p>	<p>Step 1:</p> <p>Press and hold the  key for more than 1 second to enter the password interface.</p>



Step 2:

a) In the password interface, the LED tube display is “PIN 000”.

b) When the first digit of “000” starts flashing, press the  or  key to select numbers from 0 to 9, then

press the  key to confirm. Then the second digit of “000” starts flashing.

c) Repeat the operation of operation b) above.

d) After the third digit is confirmed, the controller will verify the password. After successful verification, you will enter the parameter setting interface.

If the password is not correct, the LED tube of “000” will continue to flash, please repeat the operations from b) to d).



Step 3:

a) In the parameter setting interface, the left LED tube display window will show the parameter setting item, the middle display window will show the setting content or value for this parameter, and the right display window will show the unit of this parameter (No display is there is no unit).

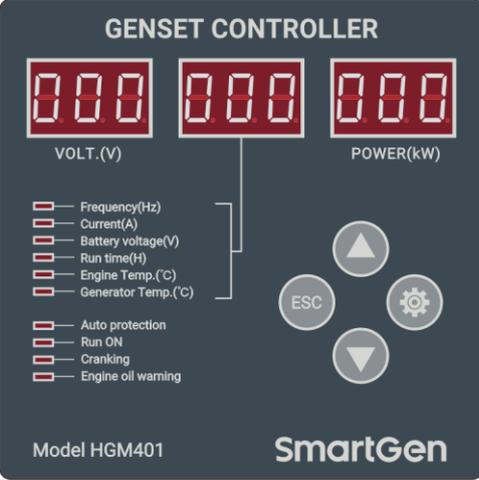
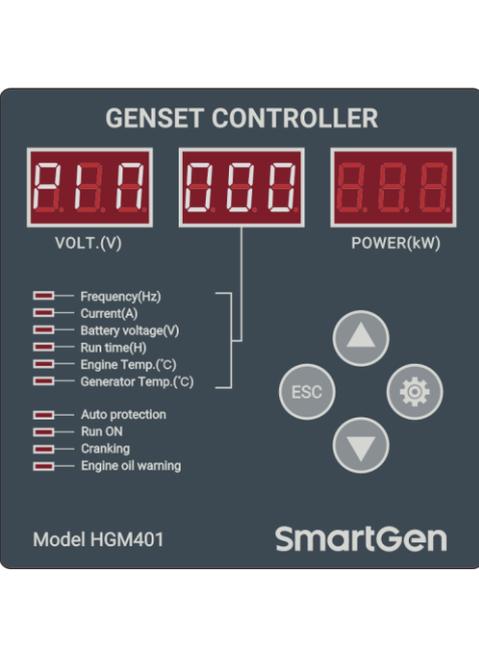
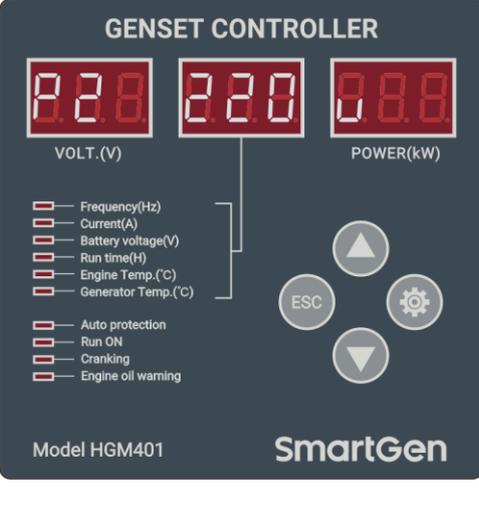
b) After entering the parameter setting interface, the “P1” will flash, press the  or  key to select the setting item, then press the  key to confirm and enter the setting of this parameter.

c) Press the  or  key to select the content or value, then press the  key to confirm the setting.

d) Press the  key to return the previous menu.

Example 2 for parameter setting:

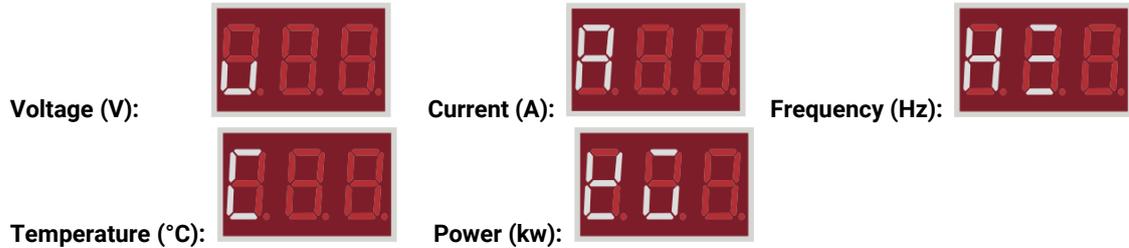
Table 8 – Procedure for Rated Voltage Setting

Panel Display	Description
 <p>The panel display shows three LED tube displays, each showing '000'. The left display is labeled 'VOLT.(V)' and the right display is labeled 'POWER(kW)'. Below the displays is a legend with 12 items, each with a red bar icon: Frequency(Hz), Current(A), Battery voltage(V), Run time(H), Engine Temp.(°C), Generator Temp.(°C), Auto protection, Run ON, Cranking, and Engine oil warning. The panel also features an 'ESC' button, an up arrow button, a down arrow button, and a gear icon button. The model number 'Model HGM401' and the 'SmartGen' logo are at the bottom.</p>	<p>Step 1:</p> <p>Press and hold the  key for more than 1 second to enter the password interface.</p>
 <p>The panel display shows the first digit of the first LED tube flashing. The display shows 'PIN 000'. The rest of the panel, including the legend, buttons, and branding, is identical to the previous image.</p>	<p>Step 2:</p> <p>a) In the password interface, the LED tube display is “PIN 000”.</p> <p>b) When the first digit of “000” starts flashing, press the  or  key to select numbers from 0 to 9, then press the  key to confirm. Then the second digit of “000” starts flashing.</p> <p>c) Repeat the operation of operation b) above.</p> <p>d) After the third digit is confirmed, the controller will verify the password. After successful verification, you will enter the parameter setting interface.</p> <p>If the password is not correct, the LED tube of “000” will continue to flash, please repeat the operations from b) to d).</p>
 <p>The panel display shows the parameter setting interface. The left LED tube shows 'P1', the middle LED tube shows '220', and the right LED tube shows 'V'. The rest of the panel, including the legend, buttons, and branding, is identical to the previous images.</p>	<p>Step 3:</p> <p>a) In the parameter setting interface, the left LED tube display window will show the parameter setting item, the middle display window will show the setting content or value for this parameter, and the right display window will show the unit of this parameter (No display is there is no unit).</p> <p>b) After entering the parameter setting interface, the “P1” will flash, press the  or  key to select the “P2”, then press the  key to confirm and enter the setting of this parameter.</p>

Panel Display	Description
	<p>c) Press the  or  key to select the content or value, then press the  key to confirm the setting.</p> <p>d) Press the  key to return the previous menu.</p>

NOTE 1: For other parameter settings, refer to the procedures for AC System Setting or Rated Voltage Setting.

NOTE 2: The unit displayed in the right LED tube window:



⚠ CAUTION: Please modify the inner controller parameters (rated generator voltage, generator frequency etc.) only in standby mode, otherwise it can lead to shutdown or other abnormal condition.

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9 COMMISSIONING

It is recommended that the following checks are made before starting the system:

- 1) Inspect that all the wiring connections are correct and cable sizes are suitable.
- 2) Ensure all parameters are configured correctly and oil pressure indicator is on.
- 3) Ensure the controller DC power supply is fused and correctly connected to the positive and negative of starting battery.
- 4) Take proper measures to prevent the engine from starting (e. g. unplug the fuel valve wiring). After checking that there are no faults, connect the starting battery, change switch key position from OFF to ON, and the controller will execute the program.
- 5) Then change switch key position to START and hold it to start cranking. After the engine is fired, release the switch key; voltage, frequency and power windows will show real-time sampling values.
- 6) To restore the measures preventing successful engine starting (reconnect the fuel valve wiring), turn the switch key again from ON to START. The genset will begin cranking, and if all conditions are normal, it will operate properly. During this period, observe the engine operation status and AC generator voltage and frequency. If any abnormalities occur, stop the genset immediately and refer to this manual to inspect all wiring connections.
- 7) For further information, please contact SmartGen services.

10 TYPICAL WIRING DIAGRAM

Typical wiring diagram is shown below:

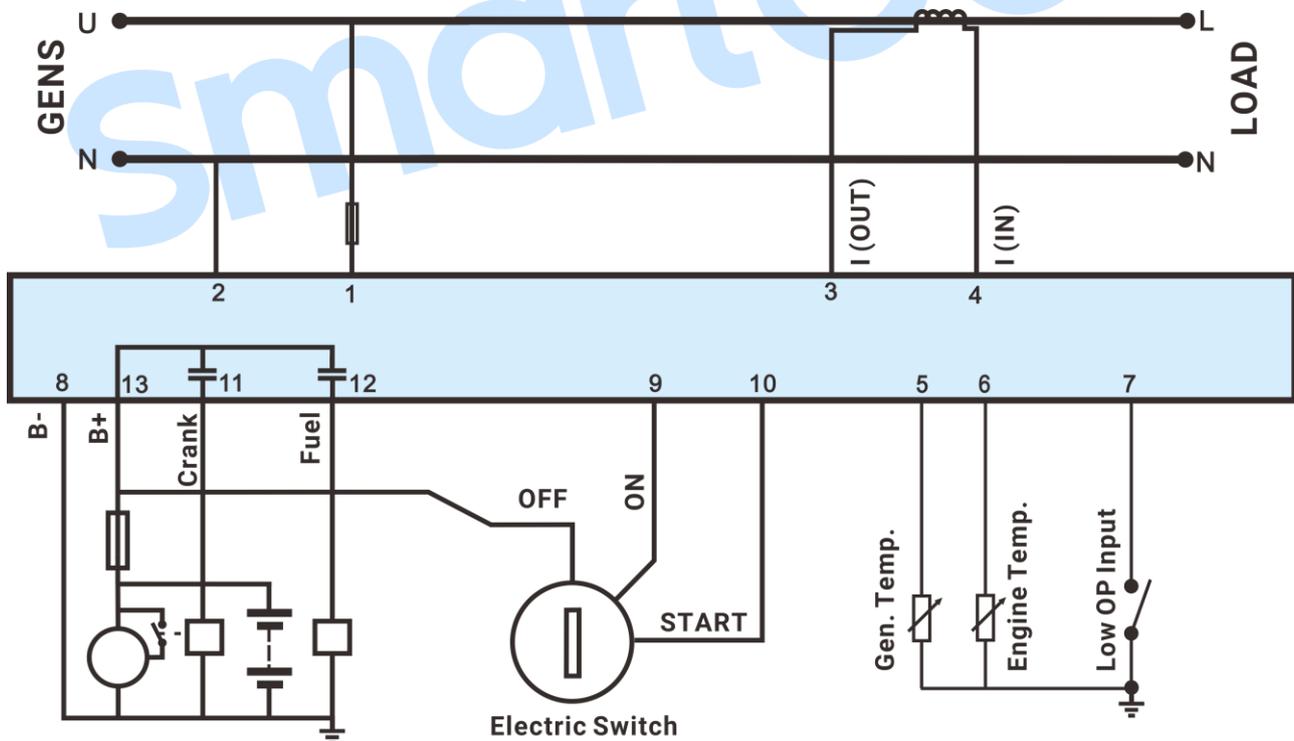


Fig.4 – HGM401 Typical Application Diagram

NOTE: When the AC system is 3P4W or 2P3W, connect the U-phase and N-phase to the controller, and set the controller's AC system to the corresponding configuration.

11 INSTALLATION

11.1 FIXING CLIPS

- 1) The controller is panel mounting design, which is fixed by clips when installed.
- 2) Withdraw the fixing clip screw (turn anticlockwise) until it reaches proper position.
- 3) Pull the fixing clip backwards (towards the back of the module) ensuring four clips are inside their allotted slots.
- 4) Turn the fixing clip screws clockwise until they are fixed on the panel.
- 5) Do not over tighten the screws of fixing clips.

11.2 OVERALL DIMENSIONS AND PANEL CUTOUT

Unit: mm

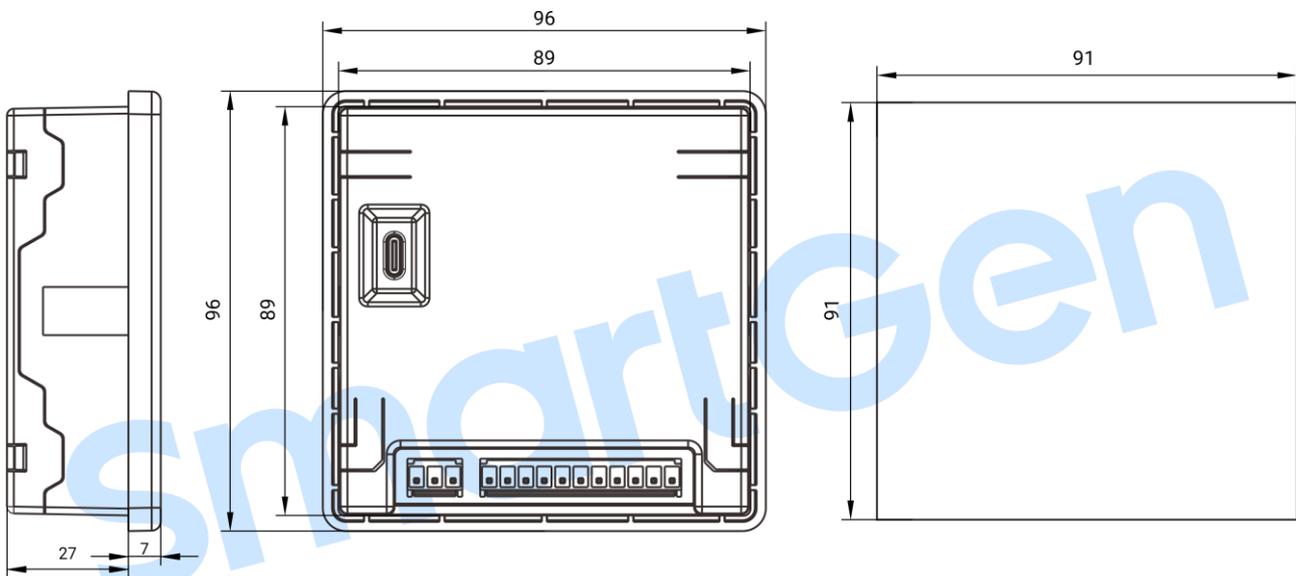


Fig.5 – Overall Dimensions and Panel Cutout

1) Battery Voltage Input

NOTE: HGM401 controller is suitable for 9-16 VDC battery voltage. Battery negative must be reliably connected to the enclosure of the engine. The controller power supply B+ and B- must be connected to battery positive and negative, and the wire size must not be less than 1.5mm². In case of floating charger connect charger output to battery positive and negative directly, then, connect battery positive and negative poles to controller positive and negative power supply input port using single lines to prevent charger interference into normal operation of the controller.



WARNING: When the engine is running, starting battery must not be removed.

2) AC input

Current transformer with rated secondary current 62.5mA must be externally connected to the controller current input.



WARNING! When generator is on-load, C. T. secondary must not be open circuit.

3) Withstanding voltage test

CAUTION: If withstanding voltage test is conducted after the controller has already been installed onto the control panel, please unplug all controller terminal connections in order to prevent high voltage from damaging it.

12 TROUBLESHOOTING

Table 9 - Troubleshooting

Problem	Possible solution
Controller does not respond on power on	Check the starting battery; Check the wiring to the controller; Check the DC fuse.
Genset shutdown	Check the water/cylinder temperature is too high or not; Check the AC generator voltage; Check the DC fuse.
Low oil pressure alarm after crank disconnection	Check the oil pressure sensor and its wiring.
High water temperature alarm after crank disconnection	Check the water temperature sensor and its wiring.
Shutdown during running	Check the corresponding switch and wiring in accordance with the information on the front panel.
Fail to start	Check the fuel circuit and wiring; Check the starting battery; Refer to the user manual of engine.
Starter does not respond	Check the wiring to the starter; Check the starting battery.