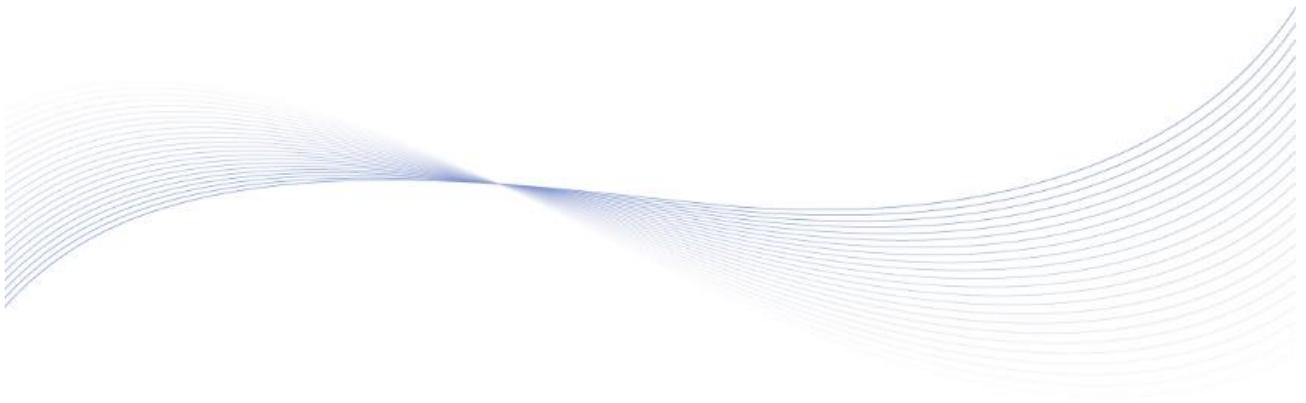# HGM6100N-5
GENSET CONTROLLER
COMMUNICATION PROTOCOL

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SmartGen **Registered trademark**

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Table 1 Software Version

Date	Version	Content
2020-12-18	V1.0	Original release.

CONTENTS

1 DESCRIPTION

This protocol describes read and write command format of RS485 half-duplex serial port communication and definition of internal information data for the third-party to develop and use.

The HGM6100N-5 controller has 1 RS485 port, which can be used as the slave, using Modbus-RTU protocol, and does not support other protocols such as Modbus-ASCII.

Data format:

Communication address: 1~254 (default: 1)

Baud rate: 2400/4800/9600/19200/115200bps (default: 9600bps)

Start bit: 1-bit

Data bit: 8-bit

Parity bit: None, odd parity, even parity (default: none)

Stop bit: 1-bit

Supported function code: 01H, 03H, 05H and 06H. Function code 01H is used for reading various coils inside the device (such as breaker close, open, fault, auto or manual status, etc.); 03H is used for reading value register inside the device (value register saves measured set value of various analog and parameters); 05H is used for sending remote command. 05H is used for saving the single-point data into the device's internal memory.

Data calibration method: CRC16.

Internal registers of controller are in the unit of "byte (double bytes)".

Communication timeout period: over 200ms.

Communication distance: 9600 baud rate, the longest distance can reach 1,000m when using 120Ω shielding twisted pair line.

Once maximum 120 data of byte register can be read.

Up to 32 controllers can be deployed for network communication.

When RS485 is connected, 120Ω twisted pair line with shielding layer shall be used, and the shielding layer shall be grounded at one end.

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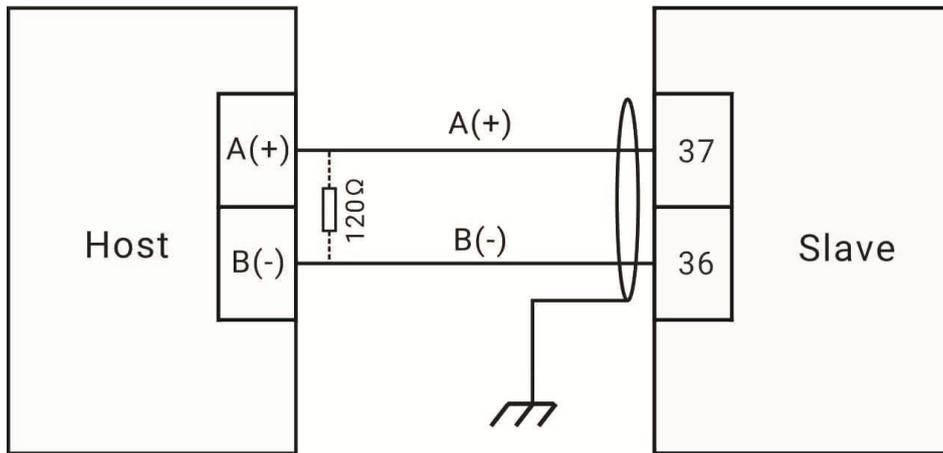
2 WIRING DIAGRAM

Fig.1 Single Unit Communication Wiring Diagram

NOTE: 120Ω resistor at controller side is controlled by setting match resistor enable item. When it is enabled, controller internal 120Ω resistor is connected to controller's RS485A, RS485B terminal. (configuration item is defaulted as enable)
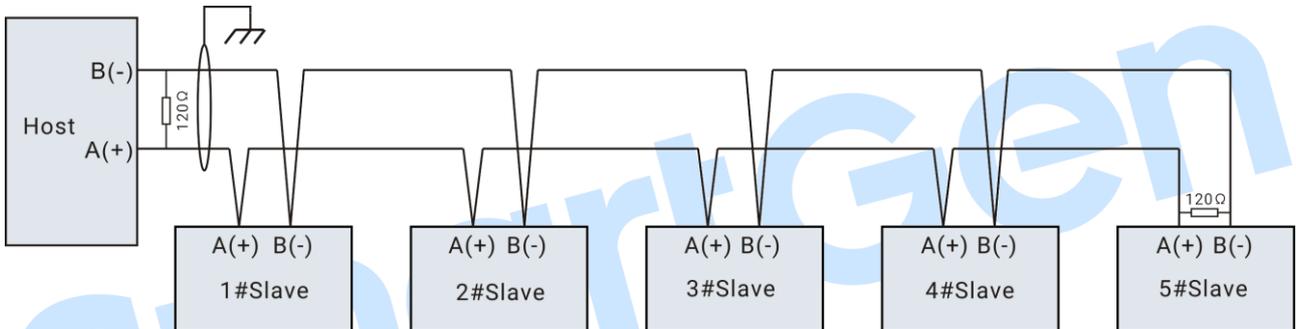
Fig.2 Multi-unit Communication Wiring Diagram

NOTE 1: Please set each controller's communication module address before networking. Same module address is inhibited in the same network.

NOTE 2: The shielding layer of communication line is single-end grounded on the host side.

3 CONTROLLER INTERNAL REGISTER ADDRESS AND DATA

3.1 FUNCTION CODE 01H MAPPLING COIL FIELD

Table 2 Alarm, Status Coil Data Field

| Modbus Address	PLC Address	Item	Description
0000	0001	Common Alarm	0 represents there is no common alarm; 1 represents there is common alarm, and so on.
0001	0002	Common Warning Alarm	1 for active
0002	0003	Common Shutdown Alarm	1 for active
0003	0004	Remote Control Mode	1 for active
0004	0005	Remote Lock	1 for active
0005	0006	Reserved	1 for active
0006	0007	Mains On Load	1 for active
0007	0008	Gens On Load	1 for active
0008	0009	Emergency Stop	1 for active
0009	0010	Over Speed Alarm	1 for active
0010	0011	Under Speed Alarm	1 for active
0011	0012	Lost Speed Alarm	1 for active
0012	0013	Over Frequency Alarm	1 for active
0013	0014	Under Frequency Alarm	1 for active
0014	0015	Over Voltage Alarm	1 for active
0015	0016	Under Voltage Alarm	1 for active
0016	0017	Gens Over Current Alarm	1 for active
0017	0018	Failed to Start Alarm	1 for active
0018	0019	High Temp. Alarm (IN)	1 for active
0019	0020	Low Pressure Alarm (IN)	1 for active
0020	0021	No Gens Freq. Alarm	1 for active
0021	0022	External Shutdown	1 for active
0022	0023	Fuel Level Alarm	1 for active
0023	0024	Coolant Level Alarm	1 for active
0024	0025	High Temp. Warn	1 for active
0025	0026	Low Pressure Warn	1 for active
0026	0027	Gens Over Current Warn	1 for active
0027	0028	Failed to Stop Warn	1 for active
0028	0029	Fuel Level Warn	1 for active
0029	0030	Failed to Charge Warn	1 for active
0030	0031	Under Battery Warn	1 for active
0031	0032	Over Battery Warn	1 for active
0032	0033	External Warn	1 for active
0033	0034	Loss Speed Warn	1 for active
0034	0035	Coolant Level Warn	1 for active
0035	0036	Temp. Sensor Open Warn	1 for active

Modbus Address	PLC Address	Item	Description
0036	0037	Oil Sensor Open Warn	1 for active
0037	0038	Maintenance Warn	1 for active
0038	0039	Fail to Charge IN	1 for active
0039	0040	Over Power Warn	1 for active
0040	0041	Test Mode	1 for active
0041	0042	Auto Mode	1 for active
0042	0043	Manual Mode	1 for active
0043	0044	Stop Mode	1 for active
0044	0045	Temp. Sensor Open Alarm	1 for active
0045	0046	Oil Sensor Open Alarm	1 for active
0046	0047	Maintenance Shutdown	1 for active
0047	0048	Over Power Shutdown	1 for active
0048	0049	Emergency Stop Input	1 for active
0049	0050	Digit Input 1	1 for active
0050	0051	Digit Input 2	1 for active
0051	0052	Digit Input 3	1 for active
0052	0053	Digit Input 4	1 for active
0053	0054	Digit Input 5	1 for active
0054	0055	Liquid Leakage Shutdown	1 for active
0055	0056	Reserved	1 for active
0056	0057	Crank Relay Output	1 for active
0057	0058	Fuel Relay Output	1 for active
0058	0059	Output 1	1 for active
0059	0060	Output 2	1 for active
0060	0061	Output 3	1 for active
0061	0062	Output 4	1 for active
0062	0063	IDMT Fault Shutdown	1 for active
0063	0064	Mech. Over Speed Shut	1 for active
0064	0065	Mains Abnormal	1 for active
0065	0066	Mains Normal	1 for active
0066	0067	Mains Over Voltage	1 for active
0067	0068	Mains Under Voltage	1 for active
0068	0069	Mains Miss Phase	1 for active
0069	0070	No Mains	1 for active
0070	0071	Analog High Temp. Alarm	1 for active Alarm of analog temperature sensor
0071	0072	Low Pressure Alarm	1 for active Alarm of analog oil pressure sensor
0072	0073	Gens Normal	1 for active
0073	0074	Gens Over Voltage	1 for active
0074	0075	Gens Under Voltage	1 for active
0075	0076	Gens Over Freq.	1 for active
0076	0077	Gens Under Freq.	1 for active

Modbus Address	PLC Address	Item	Description
0077	0078	Gens Over Current	1 for active
0078	0079	Scheduler Not Run Time Indication	1 for active
0079	0080	Liquid Leakage Warn	1 for active
0080	0081	OP Sensor Wrong	1 for active
0081	0082	FL Sensor Wrong	1 for active
0082	0083	Reserved	1 for active
0083	0084	Reserved	1 for active
0084	0085	Reserved	1 for active
0085	0086	Reserved	1 for active
0086	0087	Reserved	1 for active
0087	0088	Reserved	1 for active

Example:

If the status of "Emergency Stop" and "External Warn" needs to be read, firstly get their corresponding addresses are 0008 and 0032 by checking the table above, then it is known that 40 coils need to be read.

Assume the slave (controller) address is 01, the master (can be computer) request command is as following:

Table 3 Master (Computer) Request Command

Slave Address	Function Code	Starting Address (0000)		Request Data Qty. (40)		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	01	00	00	00	28	3C	14

The slave response command is as following:

Table 4 Slave (Controller) Response Command

Slave Address	Function Code	Data Qty. (Bytes)	Data					CRC 16 Calibration	
			Content of Address 07-00	Content of Address 15-08	Content of Address 23-16	Content of Address 31-24	Content of Address 39-32	LSB	MSB
01	01	05	07	01	00	00	01	E4	AE

Table 5 Data Analysis

Address	Received Data (Hex)	Binary	Data Signification
Data of Address 15-08	01H	0000 0000 0000 0001	Data of bit 08 is 1, represents Emergency Stop is active.
Data of Address 39-32	01H	0000 0000 0000 0001	Data of bit 32 is 1, represents External Warn is active.

3.2 FUNCTION CODE 03H MAPPING DATA FIELD

Table 6 Value Data Field

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remarks
0000	40001	Mains UA		1	V	Unsigned	2Bytes
0001	40002	Mains UB		1	V	Unsigned	2Bytes
0002	40003	Mains UC		1	V	Unsigned	2Bytes
0003	40004	Mains UAB		1	V	Unsigned	2Bytes
0004	40005	Mains UBC		1	V	Unsigned	2Bytes
0005	40006	Mains UCA		1	V	Unsigned	2Bytes
0006	40007	Mains Freq.		0.1	Hz	Unsigned	2Bytes
0007	40008	Gen UA		1	V	Unsigned	2Bytes
0008	40009	Gen UB		1	V	Unsigned	2Bytes
0009	40010	Gen UC		1	V	Unsigned	2Bytes
0010	40011	Gen UAB		1	V	Unsigned	2Bytes
0011	40012	Gen UBC		1	V	Unsigned	2Bytes
0012	40013	Gen UCA		1	V	Unsigned	2Bytes
0013	40014	Gen Freq.		0.1	Hz	Unsigned	2Bytes
0014	40015	A Phase Current		0.1	A	Unsigned	2Bytes
0015	40016	B Phase Current		0.1	A	Unsigned	2Bytes
0016	40017	C Phase Current		0.1	A	Unsigned	2Bytes
0017	40018	Water Temp. Value		1	°C	Unsigned	2Bytes
0018	40019	Water Temp. Resist. Value		0.1		Unsigned	2Bytes
0019	40020	OP Value		1	kPa	Unsigned	2Bytes
0020	40021	OP Sampling Value		Ω: 0.1 V/mA: 0.001		Unsigned	2Bytes
0021	40022	Level Value		1	%	Unsigned	2Bytes
0022	40023	Level Sampling Value		Ω: 0.1 V/mA: 0.001		Unsigned	2Bytes
0023	40024	Speed		1	RPM	Unsigned	2Bytes
0024	40025	Battery Voltage		0.1	V	Unsigned	2Bytes
0025	40026	D+ Voltage		0.1	V	Unsigned	2Bytes
0026	40027	Active Power		1	kW	Signed	2Bytes
0027	40028	Reactive Power		1	kvar	Signed	2Bytes
0028	40029	Apparent Power		1	kVA	Signed	2Bytes
0029	40030	Power Factor		0.01		Signed	2Bytes
0030	40031	Maintenance Countdown h		1	h	Unsigned	2Bytes
0031	40032	Maintenance Countdown min	0~59	1	min	Unsigned	2Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remarks
0032	40033	Reserved				Unsigned	2Bytes
0033	40034	Reserved				Unsigned	2Bytes
0034	40035	Controller Running Status		No.		Genset Status	2Bytes
0035	40036	Delay			s	Unsigned	2Bytes
0036	40037	Auto Running Status 0 Start 1 Stop 2 No Delay				Remote Start Status	2Bytes
0037	40038	Delay			s	Unsigned	2Bytes
0038	40039	ATS Running Status				Unsigned	2Bytes
0039	40040	Delay			s	Unsigned	2Bytes
0040	40041	Mains Status 0 Normal 1 Abnormal 2 No Delay				Unsigned	2Bytes
0041	40042	Delay			s	Unsigned	2Bytes
0042	40043	Accum. Oil Engine Running Time (h) MSB	0~9000	1	h	Unsigned	2Bytes
0043	40044	Accum. Oil Engine Running Time (h) LSB	0~9999	1	h	Unsigned	2Bytes
0044	40045	Accum. Oil Engine Running Time (min)	0~59	1	min	Unsigned	2Bytes
0045	40046	Accum. Oil Engine Running Time (s)	0~59	1	s	Unsigned	2Bytes
0046	40047	Accum. Start Times MSB	0~9000			Unsigned	2Bytes
0047	40048	Accum. Start Times LSB	0~9999			Unsigned	2Bytes
0048	40049	Accum. Energy MSB	0~9000	1	kWh	Unsigned	2Bytes
0049	40050	Accum. Energy LSB	0~9999	1	kWh	Unsigned	2Bytes
0050	40051	SW		0.1		Unsigned	2Bytes
0051	40052	HW		0.1		Unsigned	2Bytes
0052	40053	A Phase Active Power		1	kW	Signed	2Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remarks
0053	40054	B Phase Active Power		1	kW	Signed	2Bytes
0054	40055	C Phase Active Power		1	kW	Signed	2Bytes
0055	40056	Load Output Percentage				Unsigned	2Bytes
0056	40057	Reserved				Unsigned	2Bytes
0057	40058	Reserved				Unsigned	2Bytes
0058	40059	Reserved				Signed	2Bytes
0059	40060	Reserved				Signed	2Bytes
0060	40061	Reserved				Signed	2Bytes
0061	40062	Reserved				Signed	2Bytes
0062	40063	Reserved				Signed	2Bytes
0063	40064	Reserved				Signed	2Bytes
0064	40065	Reserved				Signed	2Bytes
0065	40066	Reserved				Signed	2Bytes
0066	40067	Reserved				Signed	2Bytes
0067	40068	Reserved				Unsigned	2Bytes
0068	40069	Reserved				Signed	4Bytes
0069	40070						
0070	40071	Reserved				Signed	2Bytes
0071	40072	Controller Model				Unsigned	2Bytes
0072	40073	Controller Date: Year	0~99	1		Unsigned	2Bytes
0073	40074	Controller Date: Month	1~12	1		Unsigned	2Bytes
0074	40075	Controller Date: Day	1~31	1		Unsigned	2Bytes
0075	40076	Controller Date: Week	0~6	1		Unsigned	2Bytes
0076	40077	Controller Time: h	0~23	1		Unsigned	2Bytes
0077	40078	Controller Time: min	0~59	1		Unsigned	2Bytes
0078	40079	Controller Time: s	0~59	1		Unsigned	2Bytes
0079	40080	Release Year	0~99	1		Unsigned	2Bytes
0080	40081	Release Month	1~12	1		Unsigned	2Bytes
0081	40082	Release Day	1~31	1		Unsigned	2Bytes
0082	40083	Reserved		1		Unsigned	2Bytes
0083	40084	Reserved				Unsigned	2Bytes
0084	40085	Reserved				Signed	2Bytes
0085	40086	Reserved				Signed	2Bytes
0086	40087	Reserved				Signed	4Bytes
0087	40088						

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remarks
0088	40089	Reserved				Unsigned	2Bytes
0089	40090	Reserved				Unsigned	2Bytes
0090	40091	Reserved				Unsigned	2Bytes
0091	40092	Reserved				Unsigned	2Bytes
0092	40093	Gen UA Phase	0~360	1	°	Signed	2Bytes
0093	40094	Gen UB Phase	0~360	1	°	Signed	2Bytes
0094	40095	Gen UC Phase	0~360	1	°	Signed	2Bytes
0095	40096	Mains UA Phase	0~360	1	°	Signed	2Bytes
0096	40097	Mains UB Phase	0~360	1	°	Signed	2Bytes
0097	40098	Mains UC Phase	0~360	1	°	Signed	2Bytes
0098-0112	40099-40113	Reserved				Unsigned	2Bytes
0113	40114	PC Version High 16-bit				Unsigned	2Bytes
0114	40115	PC Version Low 16-bit				Unsigned	2Bytes
0115	40116	Reserved				Unsigned	2Bytes
0116	40117	A Phase Current				Unsigned	4Bytes
0117	40118						
0118	40119	B Phase Current				Unsigned	4Bytes
0119	40120						
0120	40121	C Phase Current				Unsigned	4Bytes
0121	40122						
0122	40123	A Phase Active Power				Signed	4Bytes
0123	40124						
0124	40125	B Phase Active Power				Signed	4Bytes
0125	40126						
0126	40127	C Phase Active Power				Signed	4Bytes
0127	40128						

NOTE 1: Actual value=received data*ratio. Take the frequency as the example, if the received data is 5000 (1388H), ratio is 0.01Hz, then the actual frequency value is 50.00Hz (5000*0.01Hz);

NOTE 2: For 4-byte data, actual value=received data MSB*65536+received data LSB;

NOTE 3: When received data is 32766, it represents no normal data, "###" will display;

NOTE 4: Definition of signed number. Take received data 8000H as the example, transfer it to binary 1000 0000 0000 0000b, the MSB is 1, which is a negative number. One's complement is obtained by subtracting 1 from it, which is inverted to obtain the absolute value of the negative number. Then transfer it to -32768 in decimal.

NOTE 5: If the high 16-bit of the PC Version is 0x0601 and the low 16-bit is 0x0407, so the compatible PC Version number is 6.1.4.7.

Example:

If need to read "Battery Voltage", and "D+ Voltage" data, firstly get its address is 0024 and 0025 by checking the table, then it is known that you need to read 2 bytes of data.

Assume the slave (controller) address is 01, the master (can be computer) request command is as following:

Table 7 Master (Computer) Request Command

Slave Address	Function Code	Starting Address (0024)		Request Data Qty. (2)		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	03	00	18	00	02	44	0C

The slave response command is as following:

Table 8 Slave (Controller) Response Command

Slave Address	Function Code	Data Qty. (Bytes)	Data				CRC 16 Calibration	
			Data MSB of Address 0024	Data LSB of Address 0024	Data MSB of Address 0025	Data LSB of Address 0025	LSB	MSB
01	03	04	01	12	00	00	5B	CA

Fill the received data into the corresponding address, as shown in the table below:

Table 9 Data Analysis

Address	Data Received (Hex)	Decimal	Data Signification
0024	0112H	274	Ratio is 0.1, Battery Voltage is 27.4V.
0025	0000H	0	Ratio is 0.1, D+ Voltage is 0V.

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3.3 FUNCTION CODE 05H MAPPING COIL FIELD

Table 10 Remote Coil Field

Modbus Address	PLC Address	Item	Description	
0000	0001	Remote Engine in Start Status	Only send 00FFH for active	
0001	0002	Remote Engine in Stop Status	Only send 00FFH for active	
0002	0003	Reserved		
0003	0004	Remote Engine in Auto Status	Only send 00FFH for active	
0004	0005	Remote Engine in Manual Status	Only send 00FFH for active	
0005	0006	Remote Gen Close/Open	Only send 00FFH for active	HGM6120
0006	0007	Remote Mains Close/Open	Only send 00FFH for active	
0005	0006	Remote Gen Open	Only send 00FFH for active	HGM6110
0006	0007	Remote Gen Close	Only send 00FFH for active	

NOTE: The above remote command only can be sent once only.

Example:

Remote control controller to work in auto mode, firstly get its remote address is 0003.

Assume the slave address is 01, the master request command is as following:

Table 11 Master Request Command

Slave Address	Function Code	Remote Address (0003)		Remote Data		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**05**	**00**	**03**	**FF**	**00**	**7C**	**3A**

The slave response command is as following:

Table 12 Slave Response Command

Slave Address	Function Code	Remote Address (0003)		Remote Data		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**05**	**00**	**03**	**FF**	**00**	**7C**	**3A**

Whether the remote command is active can be checked by sending function code 01H to read the status of address 0041.

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3.4 GENSET STATUS

Table 13 Genset Status

No.	Item	Description
0	Standby	No delay value for this status
1	Preheat	
2	Fuel Output	No delay value for this status
3	Cranking	
4	Crank Rest	
5	Safe Time	
6	Start Idle	
7	Start Warm Up	
8	Gens Waiting Load	No delay value for this status
9	Gens Normal Running	No delay value for this status
10	Cooling	
11	Stop Idle	
12	ETS Hold	
13	Wait Stop	
14	Failed to Stop	No delay value for this status
15	After Stop	

3.5 REMOTE START STATUS

Table 14 Remote Start Status

Value (No.)	Item	Description
0	No Delay	No delay value for this status
1	Start Delay	
2	Stop Delay	

4 COMMUNICATION PARAMETER VIEWING AND CONFIGURATION

1) press [⚙/OK] key, input correct password (default 0318) can enter the parameter setting menu;

2) Select "Module Address" via [▼] key,

3) Press [⚙/OK] key again, corresponding parameters will be in the selected status;

4) Set the current selected content via [▲], [▼] key, then press [⚙/OK] key to confirm, after editing, then the selected status will disappear;

5) Press [⌂/↩] key to return the main interface.

NOTE: After parameter setting is completed, the configuration takes effect.

5   FAQ

5.1 COMMUNICATION LINE SHIELDING LAYER GROUNDED

In order to prevent coupled interference signal on communication line, its single end needs to be grounded.

5.2 TERMINAL RESISTOR

At both ends of the linear network (on the two communication ports furthest apart), it is necessary to connect 120Ω terminal resistor in parallel on a pair of communication lines. According to the transmission line theory, the terminal resistor can absorb reflected waves on the network, effectively enhancing the signal strength. The value of two terminal resistors in parallel should be approximately equal to the characteristic impedance of the transmission line at the communication frequency.

A regular RS485 network usually uses terminal resistor. It can also be not used in the case of network connection line is very short, temporary or laboratory test.

5.3 RS485 TO USB COMMUNICATION ADAPTOR

PC can communicate with SG72A module produced by our company.

5.4 EXTENDED COMMUNICATION DISTANCE

Long distance (up to 10km) communication can be realized by a pair of SGCAN300 fiber optical relay modules.

Fig.3 SGCAN300 Application Diagram

5.5 COMMON SOLUTIONS OF COMMUNICATION FAILURE

1) Check whether the positive and negative of RS485 is correctly connected;
2) Check whether the communication parameter in parameter setting is correct;
3) Check whether the RS485 converter (if configured) is normal;
4) Check whether the terminal resistor is correctly connected;
5) Disconnect the connection line of controller's RS485, measure the voltage difference of RS485's A and B terminal. If the difference is between ±200mV, it means communication port has abnormal situation;
6) It is recommended to download third-party communication software such as modscan32, modbus poll to check whether communication is normal.

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