

SmartGen

MAKING CONTROL SMARTER

HGM6100N/HGM6100CAN GENSET CONTROLLER COMMUNICATION PROTOCOL

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SmartGen 众智 Chinese trademark

SmartGen English trademark

SmartGen – make your generator *smart*

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Table 1 – Software Version

Date	Version	Content
2013-01-05	V1.0	Original release.
2014-01-20	V1.1	Added coil values and maintenance countdown according to HGM6100E HMI V2.5.
2015-08-11	V1.2	Added HGM6100N protocol.
2018-10-26	V1.3	Added HGM6100LT.
2022-05-12	V1.4	Modified it according to new protocol format; Modified it according to the latest program (HGM6100N, HGM6100CAN).

CONTENT

1. DESCRIPTION	4
2. WIRING DIAGRAM	4
3. CONTROLLER INTERNAL REGISTER ADDRESS AND DATA	5
3.1 ILLUSTRATION.....	5
3.2 ALARM, STATUS COIL DATA FIELD CORRESPONDING TO FUNCTION CODE 03H.....	5
3.3 VALUE DATA FIELD CORRESPONDING TO FUNCTION CODE 03H.....	8
3.4 REMOTE COIL FIELD CORRESPONDING TO FUNCTION CODE 05H.....	12
3.5 GENERATOR STATUS TABLE	13
3.6 REMOTE START STATUS TABLE.....	13
4. COMMUNICATION PARAMETERS CONFIGURATION	13
5. FAQ.....	14
5.1 COMMUNICATION LINE SHIELDING LAYER GROUNDED.....	14
5.2 TERMINAL RESISTOR.....	14
5.3 RS485 TO USB COMMUNICATION ADAPTOR.....	14
5.4 EXTENDED COMMUNICATION DISTANCE	14
5.5 COMMON SOLUTIONS OF COMMUNICATION FAILURE	14

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 controller is used as a slave, using Modbus-RTU protocol, and does not support other protocols such as Modbus-ASCII.

Communication address: 1~254 (default: 1)

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

Start bit: 1-bit

Data bit: 8-bit

Parity bit: No parity

Stop bit: 1-bit

Supported function code: 01H, 03H, 05H. Function code 01H is used for reading various coils (such as breaker close, open, fault, auto/manual status, etc.) inside the device; 03H is used for reading value register inside the device (The set value of various analogs and parameters are stored in the value register); while function code 05H is used for sending remote command.

Data check mode: CRC16.

Internal registers of controller are in the unit of "word (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.

Once maximum 120 data of word register can be read.

Up to 32 controllers can be connected together for network communication.

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

2. WIRING DIAGRAM

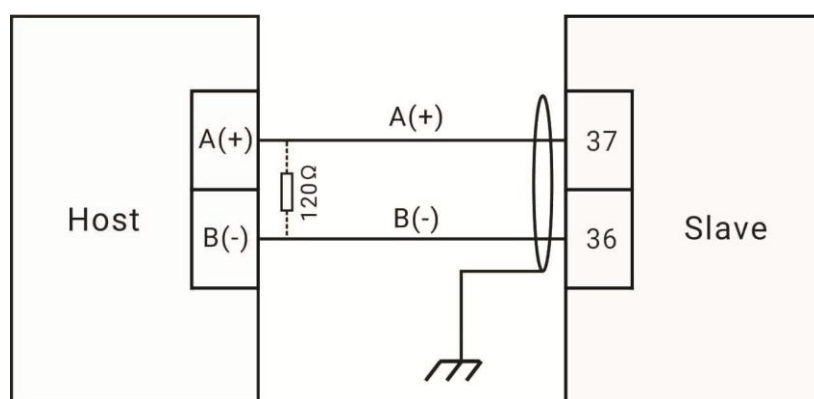


Fig.1 Single Unit Communication Wiring Diagram

NOTE1: 120Ω impedance resistor at controller side can be selected via enable choice. After it is enabled, 120Ω resistor inside the controller is paralleled in RS485A and RS485B two ports (configuration item is defaulted as enable)..

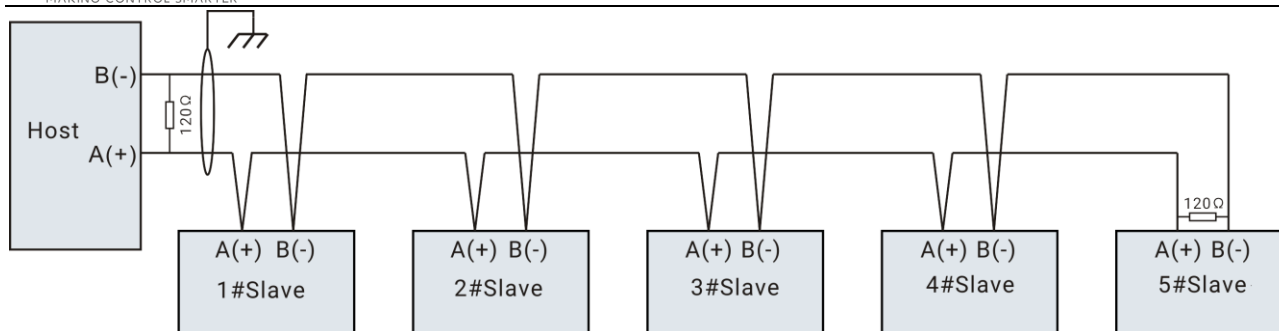


Fig.2 Multi-unit Communication Wiring Diagram

NOTE1: Please set each controller's communication module address before networking. Same module address is inhibited in the same network.

NOTE2: The shielding layer of communication line is single-end grounded on the host side.

3. CONTROLLER INTERNAL REGISTER ADDRESS AND DATA

3.1 ILLUSTRATION

"/" in the table means that this item is reserved.

3.2 ALARM, STATUS COIL DATA FIELD CORRESPONDING TO FUNCTION CODE 03H

Table 2 – Alarm, Status Coil Data Field

Modbus Address	PLC Address	Item	Description	Bytes
0000	0001	Common Alarm	1 for active	1bit
0001	0002	Common Warning Alarm	1 for active	1bit
0002	0003	Common Shutdown Alarm	1 for active	1bit
0003	0004	Remote Mode	1 for active	1bit
0004	0005	Remote Lock	1 for active	1bit
0005	0006	/	1 for active	1bit
0006	0007	Mains with Load	1 for active	1bit
0007	0008	Gen with Load	1 for active	1bit
0008	0009	Emergency Stop	1 for active	1bit
0009	0010	Overspeed Alarm Shutdown	1 for active	1bit
0010	0011	Underspeed Alarm Shutdown	1 for active	1bit
0011	0012	Speed Signal Loss Shutdown	1 for active	1bit
0012	0013	Overfrequency Shutdown	1 for active	1bit
0013	0014	Underfrequency Shutdown	1 for active	1bit
0014	0015	Overvoltage Shutdown	1 for active	1bit
0015	0016	Undervoltage Shutdown	1 for active	1bit
0016	0017	Gen Overcurrent Shutdown	1 for active	1bit
0017	0018	Crank Failure	1 for active	1bit
0018	0019	High Temperature Shutdown	1 for active	1bit
0019	0020	Low Oil Pressure Shutdown	1 for active	1bit
0020	0021	Frequency Loss Alarm	1 for active	1bit

Modbus Address	PLC Address	Item	Description	Bytes
0021	0022	Input Port Shutdown Alarm	1 for active	1bit
0022	0023	Low Fuel Level Shutdown Alarm	1 for active	1bit
0023	0024	Low Coolant Level Shutdown Alarm	1 for active	1bit
0024	0025	High Water Temperature Warn Alarm	1 for active	1bit
0025	0026	Low Oil Pressure Warn Alarm	1 for active	1bit
0026	0027	Gen Overcurrent Warn Alarm	1 for active	1bit
0027	0028	Stop Failure Warn	1 for active	1bit
0028	0029	Low Oil Level Warn	1 for active	1bit
0029	0030	Charge Failure Warn	1 for active	1bit
0030	0031	Battery Volt Low Warn Alarm	1 for active	1bit
0031	0032	Battery Volt High Warn Alarm	1 for active	1bit
0032	0033	Input Port Warn Alarm	1 for active	1bit
0033	0034	Speed Signal Loss Warn	1 for active	1bit
0034	0035	Low Coolant Level Warn	1 for active	1bit
0035	0036	Temp Sensor Open Warn	1 for active	1bit
0036	0037	Oil Pressure Sensor Open Warn	1 for active	1bit
0037	0038	Maintenance Due Warn	1 for active	1bit
0038	0039	Charger Fails to Charge Warn	1 for active	1bit
0039	0040	Over Power Warn	1 for active	1bit
0040	0041	Test Mode	1 for active	1bit
0041	0042	Auto Mode	1 for active	1bit
0042	0043	Manual Mode	1 for active	1bit
0043	0044	Stop Mode	1 for active	1bit
0044	0045	Temp Sensor Open Shutdown	1 for active	1bit
0045	0046	Oil Pressure Sensor Open Shutdown	1 for active	1bit
0046	0047	Maintenance Due Shutdown Alarm	1 for active	1bit
0047	0048	Over Power Shutdown Alarm	1 for active	1bit
0048	0049	Emergency Stop Input	1 for active	1bit
0049	0050	Aux. Input 1	1 for active	1bit
0050	0051	Aux. Input 2	1 for active	1bit
0051	0052	Aux. Input 3	1 for active	1bit
0052	0053	Aux. Input 4	1 for active	1bit
0053	0054	Aux. Input 5	1 for active	1bit
0054	0055	Gen Switch Failure Warn	1 for active	1bit
0055	0056	Mains Switch Failure Warn	1 for active	1bit
0056	0057	Start Relay Output	1 for active	1bit
0057	0058	Fuel Relay Output	1 for active	1bit
0058	0059	Aux. Output 1	1 for active	1bit
0059	0060	Aux. Output 2	1 for active	1bit
0060	0061	Aux. Output 3	1 for active	1bit
0061	0062	Aux. Output 4	1 for active	1bit
0062	0063	/	1 for active	1bit
0063	0064	/	1 for active	1bit

Modbus Address	PLC Address	Item	Description	Bytes
0064	0065	Mains Fault	1 for active	1bit
0065	0066	Mains Normal	1 for active	1bit
0066	0067	Mains Overvoltage	1 for active	1bit
0067	0068	Mains Undervoltage	1 for active	1bit
0068	0069	Mains Loss of Phase	1 for active	1bit
0069	0070	Mains Blackout	1 for active	1bit
0070	0071	/	1 for active	1bit
0071	0072	/	1 for active	1bit
0072	0073	Gen Normal	1 for active	1bit
0073	0074	Gen Overvoltage	1 for active	1bit
0074	0075	Gen Undervoltage	1 for active	1bit
0075	0076	Gen Overfrequency	1 for active	1bit
0076	0077	Gen Underfrequency	1 for active	1bit
0077	0078	Gen Overcurrent Warn	1 for active	1bit
0078	0079	In Scheduled Not Run	1 for active	1bit
0079	0080	ECU Warn	1 for active	1bit
0080	0081	ECU Shutdown Alarm	1 for active	1bit
0081	0082	ECU Comm. Failure Alarm	1 for active	1bit

Example:

If need to read "Emergency Stop Alarm" and "Input Port Warn Alarm", firstly get their corresponding coil addresses are 0008 and 0032 by checking the table, it is known that you need to read 40 coils.

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)		Data Qty. (40)		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	01	00	00	00	28	3C	14

Slave response command is as following:

Table 4 – Slave (Controller) Response Command

Slave Address	Function Code	Data Qty. (Bytes)	Data					CRC 16 Calibration	
			Data of Address 07-00	Data of Address 15-08	Data of Address 23-16	Data of Address 31-17	Data of Address 39-32	LSB	MSB
01	01	052	07	01	00	00	01	E4	AE

Table 5 – Data Analysis

Address	Received Data (Hex)	Convert to Binary	Data Signification
Data of Address 15-08	01H	0000 0000 0000 0001	Data of bit 08 is 1 indicates that emergency stop alarm is active.
Data of Address 39-32	01H	0000 0000 0000 0001	Data of bit 32 is 1 indicates that input port warn alarm is active.

3.3 VALUE DATA FIELD CORRESPONDING TO FUNCTION CODE 03H

Table 6 – Value Data Field

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

Modbus Address	PLC Address	Name	Range	Ratio	Unit	Description	Remark
0031	40032	Maintenance Countdown (min)			min	Unsigned	
0032	40033	/					
0033	40034	/					
0034	40035	Controller Running Status		No		Generator Status Table	
0035	40036	Delay			s	Unsigned	
0036	40037	Auto Running Status 0 Start 1 Stop 2 No Delay				Remote Start Status	
0037	40038	Delay			s	Unsigned	
0038	40039	ATS Running Status 0 No Delay 1 Transfer Rest				Unsigned	
0039	40040	Delay			s	Unsigned	
0040	40041	Mains Status 0 Normal 1 Abnormal 2 No Delay				Unsigned	
0041	40042	Delay			s	Unsigned	
0042	40043	Oil Engine Run Accum. Time (h) MSB	(0-9999)		h	Unsigned	
0043	40044	Oil Engine Run Accum. Time (h) LSB	(0-9999)		h	Unsigned	
0044	40045	Oil Engine Run Accum. Time (min)	(0-9999)		min	Unsigned	
0045	40046	Oil Engine Run Accum. Time (s)	(0-9999)		s	Unsigned	
0046	40047	Accum. Start Times MSB	(0-9999)			Unsigned	
0047	40048	Accum. Start Times LSB	(0-9999)			Unsigned	
0048	40049	Accum. Energy MSB	(0-9999)		kWh	Unsigned	
0049	40050	Accum. Energy LSB	(0-9999)		kWh	Unsigned	
0050	40051	Software Version		0.1		Unsigned	
0051	40052	Hardware Version		0.1		Unsigned	
0052	40053	A Phase Active Power			kW	Signed	
0053	40054	B Phase Active Power			kW	Signed	
0054	40055	C Phase Active Power			kW	Signed	
0055	40056	Load Output Percentage				Unsigned	
0056	40057	Air-fuel Ratio		0.01		Signed	Only support ECU
0057	40058	Throttle Percentage		0.1	%	Signed	
0058	40059	Coolant Level			%	Signed	
0059	40060	Oil Temperature			°C	Signed	
0060	40061	Coolant Pressure			kPa	Signed	
0061	40062	Fuel Pressure			kPa	Signed	

Modbus Address	PLC Address	Name	Range	Ratio	Unit	Description	Remark
0062	40063	Fuel Temperature			°C	Signed	
0063	40064	Inlet Temperature			°C	Signed	
0064	40065	Exhaust Temperature			°C	Signed	
0065	40066	Turbo Pressure			kPa	Signed	
0066	40067	Fuel Consumption			L/h	Signed	
0067	40068	Inlet Pressure			kPa	Signed	
0068	40069	Accum. Fuel Consumption			L	Signed	
0069	40070						
0070	40071	SCM Internal Temperature				Signed	
0071	40072	Controller Model				Unsigned	
0072	40073	Controller Time: Year				Unsigned	
0073	40074	Controller Time: Month				Unsigned	
0074	40075	Controller Time: Day				Unsigned	
0075	40076	Controller Time: Week				Unsigned	
0076	40077	Controller Time: Hour				Unsigned	
0077	40078	Controller Time: Minute				Unsigned	
0078	40079	Controller Time: Second				Unsigned	
0079	40080	Release Year				Unsigned	
0080	40081	Release Month				Unsigned	
0081	40082	Release Day				Unsigned	
0082	40083	Ignition Speed			RPM	Unsigned	Only support ECU
0083	40084	Urea Level		0.1	%	Unsigned	
0084	40085	ECU Temperature			°C	Signed	
0085	40086	Environment Pressure			kPa	Signed	
0086	40087	ECU Running Time		0.1	h	Signed	
0087	40088						
0088	40089	MTU FC			RPM	Unsigned	
0089	40090	MTU Droop		0.1	%	Unsigned	
0090	40091	MTU Demand Source				Unsigned	
0091	40092	MTU SSD				Unsigned	
0092	40093	Gen UA Phase	0~360	1	°	Signed	
0093	40094	Gen UB Phase	0~360	1	°	Signed	
0094	40095	Gen UC Phase	0~360	1	°	Signed	
0095	40096	Mains UA Phase	0~360	1	°	Signed	
0096	40097	Mains UB Phase	0~360	1	°	Signed	
0097	40098	Mains UC Phase	0~360	1	°	Signed	
0098 -0107	40099 -40108	DM1 Alarm					Only support ECU
0108 -0117	40109 -40118	DM2 Alarm					
0118	40119	ECU Alarm Numbers				Unsigned	
0119	40120	ECU Warn Numbers				Unsigned	
0120	40121	Instaneous Oil Consumption		0.1	Km/L	Unsigned	

Modbus Address	PLC Address	Name	Range	Ratio	Unit	Description	Remark
0121	40122	Gas Pressure			kPa	Unsigned	
0122	40123	Exhaust Oxygen Content		0.01	%	Unsigned	
0123	40124	Turbo Temperature			°C	Signed	
0124	40125	Fuel Valve Position			%	Unsigned	

NOTE1: Actual value=Received Data*Ratio. Take frequency as the example, received data is 5000 (1388H), ratio is 0.01Hz, so the actual frequency value is 50.00Hz (5000*0.01Hz);

NOTE2: For 4-byte data, the actual value=Received Data MSB*65536 + Received Data LSB;

NOTE3: When received data is 32766, it means no normal data, "###" can be displayed;

NOTE4: 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.

Example:

Read battery voltage and D+ voltage data, firstly get their corresponding addresses are 0024 and 0025 by checking the table, then it is known that you need to read 2 bytes' data.

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

Table 7 – Master Request Command

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

Slave response command is as following:

Table 8 – Slave 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	Received Data (Hex)	Decimal Number	Data Signification
0024	0112H	274	The ratio is 0.1, battery voltage is 27.4V.
0025	0000H	0	The ratio is 0.1, D+ voltage is 0V.

3.4 REMOTE COIL FIELD CORRESPONDING TO FUNCTION CODE 05H

Table 10 – Remote Coil Field

Modbus Address	PLC Address	Name	Description
0000	0001	Remote Oil Engine in Start Status	Send 00FFH active
0001	0002	Remote Oil Engine in Stop Status	Send 00FFH active
0002	0003	Remote Oil Engine in Test Status	Send 00FFH active
0003	0004	Remote Oil Engine in Auto Status	Send 00FFH active
0004	0005	Remote Oil Engine in Manual Status	Send 00FFH active
0005	0006	Remote Oil Engine Gen Close/Open	Send 00FFH active
0006	0007	Remote Oil Engine Mains Close/Open	Send 00FFH active
0005	0006	Remote Oil Engine Gen Open	Send 00FFH active
0006	0007	Remote Oil Engine Gen Close	Send 00FFH active

NOTE: Remote command in the above table can be sent once only.

Example:

Remote control it in auto mode, firstly get its remote address is 0003 by checking the table.

Assume that 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	00	FF	7D	8A

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	00	FF	7D	8A

3.5 GENERATOR STATUS TABLE

Table 13 – Generator Status Table








No.	Content	Description
0	Standby	No delay for this status
1	Preheat	
2	Fuel Output	No delay for this status
3	Crank	
4	Crank Rest	
5	Safety Delay	
6	Start Idle	
7	High-speed Warming Up	
8	Wait for Load	No delay for this status
9	Normal Running	No delay for this status
10	High-speed Cooling	
11	Stop Idle	
12	ETS	
13	Wait for Stop	
14	Stop Failure	No delay for this status
15	After Stop	

3.6 REMOTE START STATUS TABLE

Table 14 – Remote Start Status Table

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

4. COMMUNICATION PARAMETERS CONFIGURATION

- 1) Press  key, enter correct password (default 0318), then parameter configuration menu will display;
- 2) Select "Module Address" via  key;
- 3) Press  key again, corresponding parameter will be in selected status;
- 4) Set current selected contents via , , press  key to confirm; after editing, selected status disappear;
- 5) Press  key to return to main screen.

NOTE: The configuration will be active immediately after parameter setting is completed.

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 CANBUS relay modules.

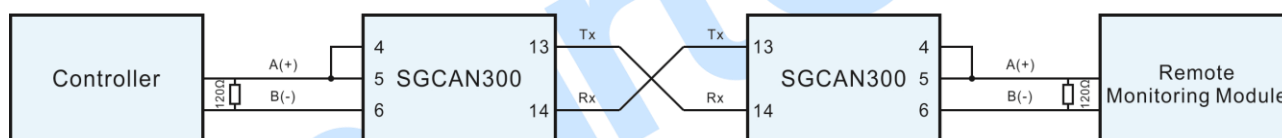


Fig.3 SGCAN300 Application Diagram

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 setting 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 $\pm 200\text{mV}$, 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.