SmartGen

MAKING CONTROL SMARTER

HGM9560

GENSET CONTROLLER

COMMUNICATION PROTOCOL

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Table 1 Software Version

Date	Version	Content
2015-04-27	1.0	Original release.
2023-05-05	1.1	1. Add 06 function code. 2. Modify it with the latest template.
2024-01-03	1.2	Add mains trip alarm.

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1. DESCRIPTION

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

MODBUS communication protocol allows the module to transfer information and data effectively with PLC, RTU, SCADA system of international brands (such as, Schneider, Siemens, and Modicon), and DCS or third-party monitoring system compatible with MODBUS. The monitoring system can be set up if only adding central communication master software (such as Kingview, Intouch, FIX, Synall) basing on PC (or IPC).

The 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.

Modbus basic rules:

- All RS485 communication loops should follow the master-slave mode. If so, data can be transferred between a master (e.g. PC) and 32 slaves;
- The master will initialize all the information transmitted by the device on the communication loop;
- No communication can start from slaves;
- In communication loop, all communication should be transmitted in the way of “information frame”;
- If the master and slaves receive information frame with unknown command, they shall not respond.

Data format:
Communication address: 1~254 (default: 1)
Baud rate: 9600bps
Start bit: 1-bit
Data bit: 8-bit
Parity bit: None
Stop bit: 2-bit

Supported function code: 01H, 03H, 05H, 06H. Function code 01H is used for reading single or multiple coils; 03H is used for reading controller alarm, status information and various power data; 05H is used for saving single coil data to the bit memory inside the device, 06H is used for saving single data to the memory inside the device.

Data calibration method: CRC16.

When communication command is sent to the instrument, the instrument with corresponding address code shall receive it, and then remove the address code, read the information. If nothing goes wrong, it shall execute the command, and send the result back to the sender. The backward information includes address code, function code for action execution, data after the action execution and error check code (CRC). If an error occurs, no information is sent.

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.

2. WIRING DIAGRAM

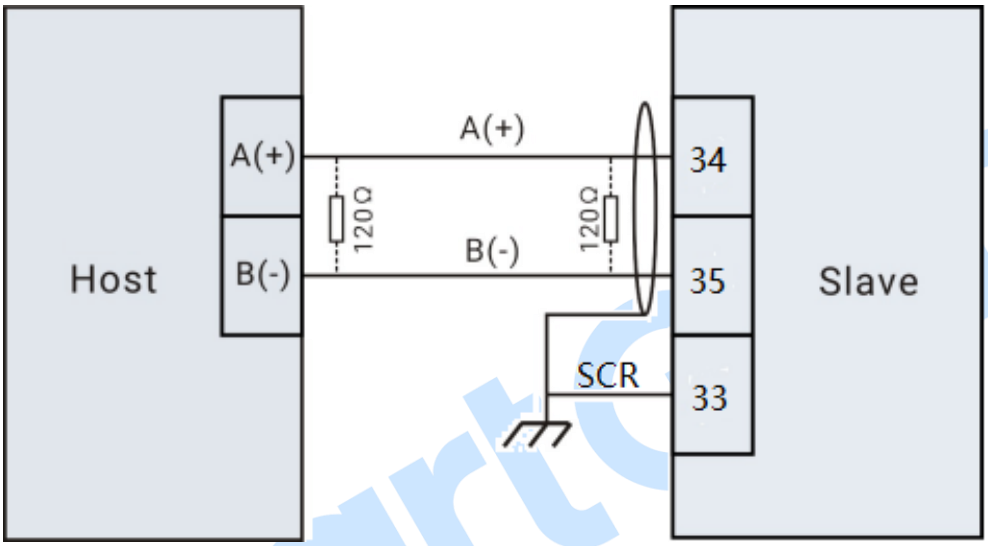

Fig.1 Single Unit Communication Wiring Diagram

NOTE1: 2 120Ω impedance resistors can be connected automatically according to site situation, details refer to the following description.

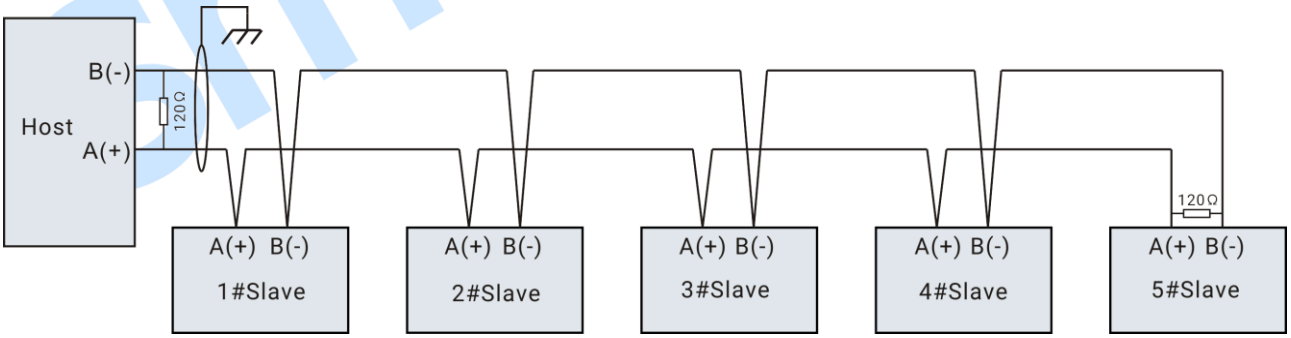

Fig.2 Multi-unit Communication Wiring Diagram

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 FUNCTION CODE 03H, 06H MAPPING DATA FIELD

06 function code only can be written for address 0199-0210 and 0225-0231, other addresses are unavailable.

Table 2 Function Coe 03H, 06H Mapping Coil Field and Data Field

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0000	40001	Common Alarm				1 for active (LSB)	1bit
		Common Shutdown Alarm				1 for active	1bit
		Common Warning Alarm				1 for active	1bit
		Common Trip and Stop Alarm				1 for active	1bit
		Common Trip				1 for active	1bit
		Common Trip and Stop Alarm & Common Stop Alarm				1 for active	1bit
		Common Mains Trip Alarm				1 for active	1bit
		Reserved				1 for active	1bit
		In Test Mode				1 for active	1bit
		In Auto Mode				1 for active	1bit
		In Manual Mode				1 for active	1bit
		In Stop Mode				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active (MSB)	1bit
0001	40002	Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Maintenance Time				1 for active	1bit

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Due Alarm Shutdown					
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0002	40003	Reserved				1 for active	1bit
		MSC ID Error Alarm Shutdown				1 for active	1bit
		Voltage Bus Error Alarm Shutdown				1 for active	1bit
		Gen Phase Error Alarm Shutdown				1 for active	1bit
		Bus (Mains) Phase Error Alarm Shutdown				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0003	40004	Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Reserved				1 for active	1bit
0004	40005	Reserved					2Bytes
0005	40006	Reserved					2Bytes
0006	40007	Reserved					2Bytes
0007	40008	Reserved					2Bytes
0008	40009	Input 1 Shutdown				1 for active	1bit
		Input 2 Shutdown				1 for active	1bit
		Input 3 Shutdown				1 for active	1bit
		Input 4 Shutdown				1 for active	1bit
		Input 5 Shutdown				1 for active	1bit
		Input 6 Shutdown				1 for active	1bit
		Input 7 Shutdown				1 for active	1bit
		Input 8 Shutdown				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0009	40010	Reserved					2Bytes
0010	40011	Reserved					2Bytes
0011	40012	Reserved					2Bytes
0012	40013	Reserved				1 for active	1bit
		Maintenance Time Due Trip and Stop				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Input 1 Trip and Stop				1 for active	1bit
		Input 2 Trip and Stop				1 for active	1bit
		Input 3 Trip and Stop				1 for active	1bit
		Input 4 Trip and Stop				1 for active	1bit
		Input 5 Trip and Stop				1 for active	1bit
		Input 6 Trip and Stop				1 for active	1bit
		Input 7 Trip and Stop				1 for active	1bit

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Input 8 Trip and Stop				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0013	40014	Reserved					2Bytes
0014	40015	Reserved					2Bytes
0015	40016	Reserved					2Bytes
0016	40017	Reserved				1 for active	1bit
		Maintenance Time Due Trip				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Input 1 Trip				1 for active	1bit
		Input 2 Trip				1 for active	1bit
		Input 3 Trip				1 for active	1bit
		Input 4 Trip				1 for active	1bit
		Input 5 Trip				1 for active	1bit
		Input 6 Trip				1 for active	1bit
		Input 7 Trip				1 for active	1bit
		Input 8 Trip				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0017	40018	Reserved					2Bytes
0018	40019	Reserved					2Bytes
0019	40020	Reserved					2Bytes
0020	40021	Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Battery Overvoltage Warning				1 for active	1bit
		Battery				1 for active	1bit

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Undervoltage Warning					
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0021	40022	Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Sync. Failure Warning				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Mains Switch Transfer Failure Warning				1 for active	1bit
		Gen Switch Transfer Failure Warning				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Mains Output Power Limit				1 for active	1bit
0022	40023	Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Reserved				1 for active	1bit
0023	40024	Reserved					2Bytes
0024	40025	Reserved					2Bytes
0025	40026	Reserved					2Bytes
0026	40027	Reserved					2Bytes
0027	40028	Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0028	40029	Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Mains Overcurrent 1 Warning				1 for active	1bit
		Mains Overcurrent 2 Warning				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0029	40030	Input 1 Warning				1 for active	1bit
		Input 2 Warning				1 for active	1bit
		Input 3 Warning				1 for active	1bit
		Input 4 Warning				1 for active	1bit

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Input 5 Warning				1 for active	1bit
		Input 6 Warning				1 for active	1bit
		Input 7 Warning				1 for active	1bit
		Input 8 Warning				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0030	40031	Input 1 Mains Trip				1 for active	1bit
		Input 2 Mains Trip				1 for active	1bit
		Input 3 Mains Trip				1 for active	1bit
		Input 4 Mains Trip				1 for active	1bit
		Input 5 Mains Trip				1 for active	1bit
		Input 6 Mains Trip				1 for active	1bit
		Input 7 Mains Trip				1 for active	1bit
		Input 8 Mains Trip				1 for active	1bit
		Mains Overcurrent 1 Mains Trip				1 for active	1bit
		Mains Overcurrent 2 Mains Trip				1 for active	1bit
		Mains Output Power Limit				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0031	40032	Reserved				1 for active	1bit
		Maintenance Time Due Indication				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0032	40033	Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Alternative Configuration 1 Indication				1 for active	1bit
		Alternative Configuration 2 Indication				1 for active	1bit
		Alternative Configuration 3 Indication				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0033	40034	Input 1 Indication				1 for active	1bit
		Input 2 Indication				1 for active	1bit
		Input 3 Indication				1 for active	1bit
		Input 4 Indication				1 for active	1bit
		Input 5 Indication				1 for active	1bit
		Input 6 Indication				1 for active	1bit
		Input 7 Indication				1 for active	1bit
		Input 8 Indication				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0034	40035	Reserved					2Bytes
0035	40036	Reserved				1 for active	1bit
		Input 1 Status				1 for active	1bit
		Input 2 Status				1 for active	1bit
		Input 3 Status				1 for active	1bit
		Input 4 Status				1 for active	1bit
		Input 5 Status				1 for active	1bit
		Input 6 Status				1 for active	1bit
		Input 7 Status				1 for active	1bit
		Input 8 Status				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0036	40037	Reserved					2Bytes
0037	40038	Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Aux. Output 1 Status				1 for active	1bit
		Aux. Output 2 Status				1 for active	1bit
		Aux. Output 3 Status				1 for active	1bit
		Aux. Output 4 Status				1 for active	1bit
		Aux. Output 5 Status				1 for active	1bit
		Aux. Output 6 Status				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0038	40039	Reserved					2Bytes
0039	40040	Reserved					2Bytes
0040	40041	Reserved					2Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0041	40042	Reserved					2Bytes
0042	40043	Reserved					2Bytes
0043	40044	Mains Normal				1 for active	1bit
		Mains Close				1 for active	1bit
		Busbar Normal				1 for active	1bit
		Busbar Close				1 for active	1bit
		Alarm Indicator Status				1 for active	1bit
		Running Indicator Status				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0044	40045	Mains Abnormal				1 for active	1bit
		Mains Overvoltage				1 for active	1bit
		Mains Undervoltage				1 for active	1bit
		Mains Overfrequency				1 for active	1bit
		Mains Underfrequency				1 for active	1bit
		Mains Loss Phase				1 for active	1bit
		Mains Reverse Phase Sequence				1 for active	1bit
		Mains Blackout				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0045	40046	Input 1 Active				1 for active	1bit
		Input 2 Active				1 for active	1bit
		Input 3 Active				1 for active	1bit

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Input 4 Active				1 for active	1bit
		Input 5 Active				1 for active	1bit
		Input 6 Active				1 for active	1bit
		Input 7 Active				1 for active	1bit
		Input 8 Active				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
		Reserved				1 for active	1bit
0046	40047	Reserved					2Bytes
0047	40048	Reserved					2Bytes
0048	40049	Reserved					2Bytes
0049	40050	Reserved					2Bytes
0050	40051	Reserved					2Bytes
0051	40052	Reserved					2Bytes
0052	40053	Reserved					2Bytes
0053	40054	Reserved					2Bytes
0054	40055	Reserved					2Bytes
0055	40056	Mains UAB	0~4294967296		V	16-bit Unsigned	2Bytes
0056	40057	Mains UBC	0~4294967296		V	16-bit Unsigned	2Bytes
0057	40058	Mains UCA	0~4294967296		V	16-bit Unsigned	2Bytes
0058	40059	Mains UA	0~4294967296		V	16-bit Unsigned	2Bytes
0059	40060	Mains UB	0~4294967296		V	16-bit Unsigned	2Bytes
0060	40062	Mains UC	0~4294967296		V	16-bit Unsigned	2Bytes
0061	40062	Mains UA Phase	0~360.0	0.1	°		2Bytes
0062	40063	Mains UB Phase	0~360.0	0.1	°		2Bytes
0063	40064	Mains UC Phase	0~360.0	0.1	°		2Bytes
0064	40065	Mains Frequency	0~100.00	0.01	Hz		2Bytes
0065	40066	Reserved					2Bytes
0066	40067	Reserved					2Bytes
0067	40068	Reserved					2Bytes
0068	40069	Reserved					2Bytes
0069	40070	Reserved					2Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0070	40071	Reserved					2Bytes
0071	40072	Reserved					2Bytes
0072	40073	Reserved					2Bytes
0073	40074	Reserved					2Bytes
0074	40075	Reserved					2Bytes
0075	70076	Busbar UAB	0~4294967296		V	16-bit Unsigned	2Bytes
0076	40077	Busbar UBC	0~4294967296		V	16-bit Unsigned	2Bytes
0077	40078	Busbar UCA	0~4294967296		V	16-bit Unsigned	2Bytes
0078	40079	Busbar UA	0~4294967296		V	16-bit Unsigned	2Bytes
0079	40080	Busbar UB	0~4294967296		V	16-bit Unsigned	2Bytes
0080	40081	Busbar UC	0~4294967296		V	16-bit Unsigned	2Bytes
0081	40082	Busbar UA Phase	0~360.0	0.1	°		2Bytes
0082	40083	Busbar UB Phase	0~360.0	0.1	°		2Bytes
0083	40084	Busbar UC Phase	0~360.0	0.1	°		2Bytes
0084	40085	Busbar Frequency	0~100.00	0.01	Hz		2Bytes
0085	40086	Reserved					2Bytes
0086	40087	Reserved					2Bytes
0087	40088	Reserved					2Bytes
0088	40089	Reserved					2Bytes
0089	40090	Reserved					2Bytes
0090	40091	Reserved					2Bytes
0091	40092	Reserved					2Bytes
0092	40093	Reserved					2Bytes
0093	40094	Reserved					2Bytes
0094	40095	Reserved					2Bytes
0095	40096	Mains A Phase Current	0~65535	0.1	A		2Bytes
0096	40097	Mains B Phase Current	0~65535	0.1	A		2Bytes
0097	40098	Mains C Phase Current	0~65535	0.1	A		2Bytes
0098	40099	Reserved					2Bytes
0099	40100	Reserved					2Bytes
0100	40101	Reserved					2Bytes
0101	40102	Reserved					2Bytes
0102	40103	Reserved					2Bytes
0103	40104	Mains A Phase	-2,147,483,	0.1	kW	32-bit Signed	4Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0104	40105	Active Power	648~2,147,483,647				
0105 0106	40106 40107	Mains B Phase Active Power	-2,147,483,648~2,147,483,647	0.1	kW	32-bit Signed	4Bytes
0107 0108	40108 40109	Mains C Phase Active Power	-2,147,483,648~2,147,483,647	0.1	kW	32-bit Signed	4Bytes
0109 0110	40110 40111	Mains Total Active Power	-2,147,483,648~2,147,483,647	0.1	kW	32-bit Signed	4Bytes
0111 0112	40112 40113	Mains A Phase Reactive Power	-2,147,483,648~2,147,483,647	0.1	kvar	32-bit Signed	4Bytes
0113 0114	40114 40115	Mains B Phase Reactive Power	-2,147,483,648~2,147,483,647	0.1	kvar	32-bit Signed	4Bytes
0115 0116	40116 40117	Mains C Phase Reactive Power	-2,147,483,648~2,147,483,647	0.1	kvar	32-bit Signed	4Bytes
0117 0118	40118 40119	Mains Total Reactive Power	-2,147,483,648~2,147,483,647	0.1	kvar	32-bit Signed	4Bytes
0119 0120	40120 40121	Mains A Phase Apparent Power	-2,147,483,648~2,147,483,647	0.1	kVA	32-bit Signed	4Bytes
0121 0122	40122 40123	Mains B Phase Apparent Power	-2,147,483,648~2,147,483,647	0.1	kVA	32-bit Signed	4Bytes
0123 0124	40124 40125	Mains C Phase Apparent Power	-2,147,483,648~2,147,483,647	0.1	kVA	32-bit Signed	4Bytes
0125 0126	40126 40127	Mains Total Apparent Power	-2,147,483,648~2,147,483,647	0.1	kVA	32-bit Signed	4Bytes
0127	40128	Mains A Phase Power Factor	-100~100	0.01	Cos Φ	16-bit Signed	2Bytes
0128	40129	Mains B Phase Power Factor	-100~100	0.01	Cos Φ	16-bit Signed	2Bytes
0129	40130	Mains C Phase Power Factor	-100~100	0.01	Cos Φ	16-bit Signed	2Bytes
0130	40131	Mains Average Power Factor	-100~100	0.01	Cos Φ	16-bit Signed	2Bytes
0131	40132	Reserved					2Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0132	40133	Reserved					2Bytes
0133	40134	Reserved					2Bytes
0134	40135	Busbar Current	0~65535	0.1	A		2Bytes
0135	40136	Reserved					2Bytes
0136	40137	Reserved					2Bytes
0137	40138	Reserved					2Bytes
0138	40139	Reserved					2Bytes
0139	40140	Reserved					2Bytes
0140	40141	Reserved					2Bytes
0141	40142	Reserved					2Bytes
0142	40143	Battery Voltage	0~65535	0.1	V		2Bytes
0143	40144	Reserved					2Bytes
0144	40145	Reserved					2Bytes
0145	40146	Reserved					2Bytes
0146	40147	Reserved					2Bytes
0147	40148	Reserved					2Bytes
0148	40149	Reserved					2Bytes
0149	40150	Reserved					2Bytes
0150	40151	Reserved					2Bytes
0151	40152	Reserved					2Bytes
0152	40153	Reserved					2Bytes
0153	40154	Reserved					2Bytes
0154	40155	Reserved					2Bytes
0155	40156	Reserved					2Bytes
0156	40157	Reserved					2Bytes
0157	40158	Reserved					2Bytes
0158	40159	Reserved					2Bytes
0159	40160	Reserved					2Bytes
0160	40161	Reserved					2Bytes
0161	40162	Reserved					2Bytes
0162	40163	Reserved					2Bytes
0163	40164	Reserved					2Bytes
0164	40165	Reserved					2Bytes
0165	40166	Reserved					2Bytes
0166	40167	Reserved					2Bytes
0167	40168	Reserved					2Bytes
0168	40169	Reserved					2Bytes
0169	40170	Reserved					2Bytes
0170	40171	Reserved					2Bytes
0171 0172	40172 40173	Reserved					4Bytes
0173	40174	Reserved					2Bytes
0174	40175	Reserved					2Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0175	40176	Reserved					2Bytes
0176	40177	Reserved					2Bytes
0177	40178	Reserved					2Bytes
0178	40179	Reserved					2Bytes
0179	40180	Reserved					2Bytes
0180	40181	Reserved					2Bytes
0181	40182	Reserved					2Bytes
0182	40183	Busbar Active Power	-2,147,483,648~2,147,483,647	0.1	kW	32-bit Signed	4Bytes
0183	40184						
0184	40185	Busbar Reactive Power	-2,147,483,648~2,147,483,647	0.1	kvar	32-bit Signed	4Bytes
0185	40186						
0186	40187	Reserved					2Bytes
0187	40188						2Bytes
0188	40189	Reserved					2Bytes
0189	40190	Reserved					2Bytes
0190	40191	Reserved					2Bytes
0191	40192	Reserved					2Bytes
0192	4019	Reserved					2Bytes
0193	40194	Busbar Switch Status				Switch Status Table	2Bytes
0194	40195	Delay Value					2Bytes
0195	40196	Mains Status				Mains Status Table	2Bytes
0196	40197	Delay Value					2Bytes
0197	40198	Mains Switch Status				Switch Status Table	2Bytes
0198	40199	Delay Value					2Bytes
0199	40200	Reserved					2Bytes
0200	40201	Reserved					2Bytes
0201	40202	Reserved					2Bytes
0202	40203	Reserved					2Bytes
0203 0204	40204 40205	Accum. Energy kWh	0~99999999	0.1	kWh	32-bit Signed	4Bytes
0205 0206	40206 40207	Accum. Energy kvarh	0~99999999	0.1	kvarh	32-bit Signed	4Bytes
0207 0208	40208 40209	Accum. Energy kVAh	0~99999999	0.1	kVAh	32-bit Signed	4Bytes
0209 0210	40210 40211	Reserved					4Bytes
0211	40212	Maint. Left Time: h	0~65535	1	h	16-bit Unsigned	2Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0212	40213	Maint. Left Time: min	0~59	1	min	16-bit Unsigned	2Bytes
0213	40214	Maint. Left Time: s	0~59	1	s	16-bit Unsigned	2Bytes
0214	40215	Multi-set Total Reactive Power	-2,147,483,648~2,147,483,647	0.1	kvarh	32-bit Signed	4Bytes
0215	40216						
0216	40217	Reserved					2Bytes
0217	40218	Reserved					2Bytes
0218	40219	Reserved					2Bytes
0219	40220	Reserved					2Bytes
0220	40221	Reserved					2Bytes
0221	40222	Reserved					2Bytes
0222	40223	Reserved					2Bytes
0223	40224	Reserved					2Bytes
0224	40225	Reserved					2Bytes
0225	40226	Controller Time: year	0~99	1	year	16-bit Unsigned	2Bytes
0226	40227	Controller Time: month	1~12	1	month	16-bit Unsigned	2Bytes
0227	40228	Controller Time: day	1~31	1	day	16-bit Unsigned	2Bytes
0228	40229	Controller Time: week	0~6	1	week	16-bit Unsigned	2Bytes
0229	40230	Controller Time: h	0~23	1	h	16-bit Unsigned	2Bytes
0230	40231	Controller Time: min	0~59	1	min	16-bit Unsigned	2Bytes
0231	40232	Controller Time: s	0~59	1	s	16-bit Unsigned	2Bytes
0232	40233	Module MSC ID	0~31			16-bit Unsigned	2Bytes
0233	40234	Module Priority	0~31			16-bit Unsigned	2Bytes
0234	40235	Reserved					2Bytes
0235	40236	Multi-set Total Active Power	-2,147,483,648~2,147,483,647	0.1	kW	32-bit Signed	4Bytes
0236	40237						
0237	40238	Reserved					2Bytes
0238	40239	Exp. AIN24-1 Sensor 15				16-bit Signed	
0239	40240	Exp. AIN24-1 Sensor 16				16-bit Signed	
0240	40241	Exp. AIN24-1 Sensor 17				16-bit Signed	
0241	40242	Exp. AIN24-1 Sensor 18				16-bit Signed	
0242	40243	Exp. AIN24-1				16-bit Signed	

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Sensor 19					
0243	40244	Exp. AIN24-1 Sensor 20				16-bit Signed	
0244	40245	Exp. AIN24-1 Sensor 21				16-bit Signed	
0245	40246	Exp. AIN24-1 Sensor 22				16-bit Signed	
0246	40247	Exp. AIN24-1 Sensor 23				16-bit Signed	
0247	40248	Exp. AIN24-1 Sensor 24				16-bit Signed	
0248	40249	Exp. AIN24-2 Sensor 15				16-bit Signed	
0249	40250	Exp. AIN24-2 Sensor 16				16-bit Signed	
0250	40251	Exp. AIN24-2 Sensor 17				16-bit Signed	
0251	40252	Exp. AIN24-2 Sensor 18				16-bit Signed	
0252	40253	Exp. AIN24-2 Sensor 19				16-bit Signed	
0253	40254	Exp. AIN24-2 Sensor 20				16-bit Signed	
0254	40255	Exp. AIN24-2 Sensor 21				16-bit Signed	
0255	40256	Exp. AIN24-2 Sensor 22				16-bit Signed	
0256	40257	Exp. AIN24-2 Sensor 23				16-bit Signed	
0257	40258	Exp. AIN24-2 Sensor 24				16-bit Signed	
0258	40259	Exhaust Oxygen Content	0~100			16-bit Signed	
0259	40260	Pre-turbo Temp.				16-bit Unsigned	
0260	40261	Fuel Valve Position				16-bit Signed	
0261	40262	Exp. 3 Sensor 4 Data				16-bit Unsigned	
0262	40263	/					
0263	40264	Exp. 4 Sensor 1 Data				16-bit Unsigned	
0264	40265	/					
0265	40266	Exp. 4 Sensor 2				16-bit Unsigned	

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Data					
0266	40267	/					
0267	40268	Exp. 4 Sensor 3 Data				16-bit Unsigned	
0268	40269	/					
0269	40270	Exp. 4 Sensor 4 Data				16-bit Unsigned	
0270	40271	A Running Hours	0~65535	1	h	16-bit Unsigned	
0271	40272	A Running Minutes	0~59	1	min	16-bit Unsigned	
0272	40273	A Running Seconds	0~59	1	s	16-bit Unsigned	
0273	40274	A Start Times	0~65535	1	time	16-bit Unsigned	
0274	40275	A Generation kWh	0~ 99999999	1	kWh	32-bit Signed	
0275	40276						
0276	40277	B Running Hours	0~65535	1	h	16-bit Unsigned	
0277	40278	B Running Minutes	0~59	1	min	16-bit Unsigned	
0278	40279	B Running Seconds	0~59	1	s	16-bit Unsigned	
0279	40280	B Start Times	0~65535	1	time	16-bit Unsigned	
0280	40281	B Generation kWh	0~ 99999999	1	kWh	32-bit Signed	
0281	40282						

NOTE1: 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);

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

NOTE3: When received data is 32766, it represents no normal data, "###" will display;

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 "Multi-set Total Active Power (current is 123456)", firstly get its address is 0235 and 0236 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 3 Master Request Command

Slave Address	Function Code	Starting Address (0235)		Request Data Qty. (2)		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**03**	**00**	**EB**	**00**	**02**	**B4**	**3F**

The slave response command is as following:

Table 4 Slave Response Command

Slave Address	Function Code	Data Qty. (Bytes)	Data				CRC 16 Calibration	
			Data MSB of Address 0235	Data LSB of Address 0235	Data MSB of Address 0236	Data LSB of Address 0236	LSB	MSB
01	**03**	**04**	**E2**	**40**	**00**	**01**	**0C**	**5F**

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

Table 5 Data Analysis

Address	Received Data (Hex)	After Combination (Hex)	Multi-set Total Active Power (Decimal)
0103	E240H	0001E240H	123456
0104	0001H		

3.2 FUNCTION CODE 05H MAPPING COIL FIELD

Table 6 Remote Coil Field

Modbus Address	PLC Address	Item	Description
0000	0001	Remote Start Key	1 for active
0001	0002	Remote Stop Key	1 for active
0002	0003	Reserved	1 for active
0003	0004	Remote Auto Key	1 for active
0004	0005	Remote Manual Key	1 for active
0005	0006	Remote Mains Close/Open Key	1 for active
0006	0007	Remote Busbar Close/Open Key	1 for active
0007	0008	Remote Up Key	1 for active
0008	0009	Remote Down Key	1 for active
0009	0010	Remote Left Key	1 for active
0010	0011	Remote Right Key	1 for active
0011	0012	Remote Confirm Key	1 for active
0012	0013	Remote Mute Key	1 for active
0013	0014	Reserved	1 for active
0014	0015	Reserved	1 for active
0015	0016	Reserved	1 for active
0016	0017	Reserved	1 for active
0017	0018	Reserved	1 for active
0018	0019	Reserved	1 for active
0019	0020	Remote Output 1 Active	1 for active, 0 for inactive
0020	0021	Remote Output 2 Active	1 for active, 0 for inactive
0021	0022	Remote Output 3 Active	1 for active, 0 for inactive
0022	0023	Remote Output 4 Active	1 for active, 0 for inactive
0023	0024	Remote Output 5 Active	1 for active, 0 for inactive
0024	0025	Remote Output 6 Active	1 for active, 0 for inactive
0025	0026	Reserved	1 for active
0026	0027	Reserved	1 for active
0027	0028	Reserved	1 for active
0028	0029	Reserved	1 for active

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

Example:

Remote control controller to work in manual mode, firstly get its remote address is 0004.

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

Table 7 Master Request Command

Slave Address	Function Code	Remote Address (0004)		Remote Data		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**05**	**00**	**04**	**FF**	**00**	**CD**	**FB**

The slave response command is as following:

Table 8 Slave Response Command

Slave Address	Function Code	Remote Address (0004)		Remote Data		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**05**	**00**	**04**	**FF**	**00**	**CD**	**FB**

3.3 FUNCTION CODE 06H MAPPING DATA FIELD

Table 9 Data Field

Modbus Address	PLC Address	Item	Description
4351	44352	Load Mode	0: Gen Control Mode; 1: Mains Control Mode; 2: Load Reception
4352	44353	Load Parallel Output Active Power Percentage	Data range: 0-1000 Percentage: 0.0%-100.0%
4354	44355	Load Parallel Output Reactive Power Percentage	Set as genset output power percentage in gen control mode; Set as mains peak clipping percentage in mains control mode.

Table 10 Master Request Command

Slave Address	Function Code	Load Mode(4351)		Load Mode		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**06**	**10**	**FF**	**00**	**00**	**BD**	**3A**

Table 11 Slave Response Command

Slave Address	Function Code	Load Mode (4351)		Load Mode		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**06**	**10**	**FF**	**00**	**00**	**BD**	**3A**

3.4 ERROR HANDLING

When the device detects other errors except the CRC code, the slave must send information to the master. The function code MSB is 1, which means the response function code by slave should add 128 based on the function code. The following codes show that unexpected errors have occurred.

CRC error received from the master will be ignored by the device.

Table 12 Error Code Format Responded by Slave (CRC excluded)

Type	Byte
Address code	1 byte
Function code	1 byte (MSB is 1)
Error code	1 byte
CRC code	2 bytes

Error code:

01 illegal function code

The function code received in the query is not an allowable action for the slave.

02 illegal data address

The data address received in the query is not an allowable address for the slave.

03 illegal data value

A value contained in the query data field is not an allowable value for the slave.

3.5 ERROR CHECK CODE (CRC)

By Error Check Code the master or slave can detect whether the receiving information is right or not. Sometimes, due to electronic noise or other interference, the information may change in the transmission process and CRC code ensures the error information does not work in the transmission process. It increases the system's safety and efficiency. CRC code adopts CRC-16 calibration method.

CRC code of 2 bytes is front low byte and behind high byte.

NOTE: All information frame formats are the same: address code, function code, data field and CRC.

Cyclic Redundancy Check (CRC) contains two bytes. That is a 16-bit binary value. The CRC code is calculated by the transmitting device, and placed at the end of the transmitted information. The receiving device recalculates the CRC code of the receiving information. If the two values are different, then something goes wrong.

CRC code computing method is: first put the 16-bit register all to “1”; and then handle the 8-bit data information each gradually. In the process of computing the CRC code only 8 data bit is used and he start bit and stop bit are not included in it.

In the process of computing the CRC code, each 8–bit data is exclusive OR with the register data; and the result obtained moves 1 bit to the least significant bit (LSB), then use 0 to make up for the most significant bit (MSB). Then the LSB is examined. If the LSB was 1, the register content is then exclusive OR with a preset fixed value. If the LSB was 0, no exclusive OR takes place.

This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive OR with the register’s current value, and the process repeats for eight times as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value.

CRC-16 Code Calculation Procedure:

1) Make 16-bit CRC register as hexadecimal FFFF;
2) Make the first 8-bit byte exclusive ORed with the low–order byte of the CRC register, and put the result in the CRC register;
3) Shift the CRC register one bit to the right, with a zero filled into the MSB. The LSB is extracted and examined.
4) If the LSB was 0: Repeat Step 3 (another shift).
   If the LSB was 1: CRC register exclusive ORed with the A001 hexadecimal;
5) Repeat Step 3 and 4 until 8 shifts have been performed. In this way eight shifts have been performed;
6) Repeat Step 2 to 5 and perform the next data handling process;
7) The final contents of the CRC register are the CRC value. When the CRC is appended to the message, the low-order Least Significant Byte first. When the 16-bit CRC (two 8-bit bytes) is transmitted in the message, the low-order byte will be transmitted first, followed by the high-order byte.

NOTE: The calculation of CRC code starts from <slave address>, exclusive of all bytes of <CRC code>.

3.6 SWITCH STATUS

Table 13 Switch Status

No.	Item	Description
0	Synchronizing	No delay value for this status
1	Close Delay	
2	Wait for Closing	No delay value for this status
3	Closed	No delay value for this status
4	Unloading	No delay value for this status
5	Open Delay	
6	Wait for Opening	No delay value for this status
7	Opened	No delay value for this status

3.7 MAINS STATUS

Table 14 Mains Status

No.	Item	Description
0	Mains Normal	No delay value for this status
1	Mains Normal Delay	
2	Mains Abnormal	No delay value for this status
3	Mains Abnormal Delay	

3.8 GENSET STATUS

Table 15 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	Crank	
4	Crank Rest	
5	Safety Run	
6	Start Idle	
7	High Speed Warming Up	
8	Wait for Load	No delay value for this status
9	Normal Running	No delay value for this status
10	High Speed Cooling	
11	Stop Idle	
12	ETS	
13	Wait for Stop	
14	Stop Failure	No delay value for this status

4. COMMUNICATION PARAMETER VIEWING AND CONFIGURATION

1) In the homepage of main interface, press Enter key to enter menu interface;
2) Press Down key to select “Parameter Setting”, then press Enter key to enter parameter password interface;
3) Input correct password (default 0318), press Enter key to enter the main interface of parameter;
4) Select “Controller Address” via , key, Press Enter key to enter parameter edit function, corresponding parameters will be in the selected status;
5) Set the current selected content via , key, then press Enter key to confirm, after editing, then the selected status will disappear;
6) Long press Esc 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.

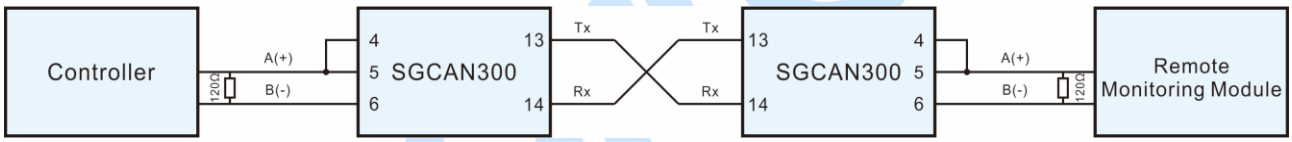

Fig.3 SGCAN300 Application Diagram

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.