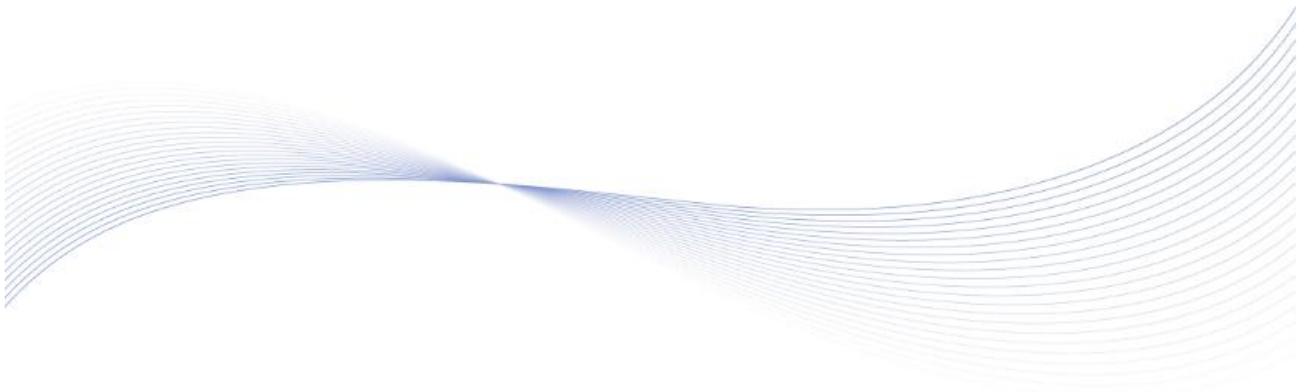

SmartGen

MAKING CONTROL SMARTER

HP16S100-10

LITHIUM BATTERY PROTECTION BOARD

COMMUNICATION PROTOCOL



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Table 1 Software Version

Date	Version	Content
2023-09-20	1.0	Original release.

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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 has 2 RS485 ports with same communication protocol.

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

Communication address: 1~15

Baud rate: 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 or 2-bit (Default: 1-bit)

Supported function code: 0X03, 0X06.

Data calibration method: CRC16.

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

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

Up to 15 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

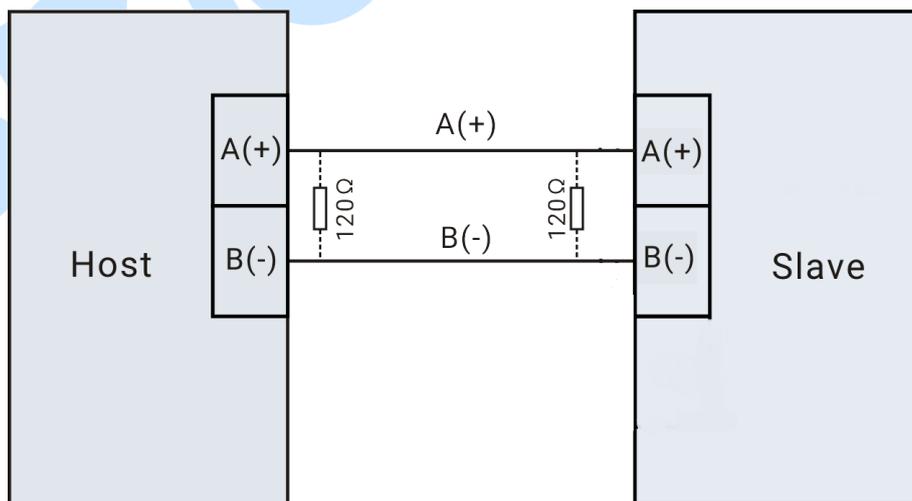


Fig.1 Single Unit Communication Wiring Diagram

NOTE1: 2 120Ω impedance resistors can be connected automatically according to site situation.

NOTE2: This is RS485-1 wiring diagram, RS485-2 wiring diagram is the same as above.

3. CONTROLLER INTERNAL REGISTER ADDRESS AND DATA

3.1 CORRESPONDING ALARM, STATUS COIL DATA FIELD OF FUNCTION CODE 03, 06

Table 2 Alarm, Status Coil Data Field

Address	PLC Address	Item	Description	Bytes	Remark
0100	40101	Battery System Alarm	1 for active (LSB)	1bit	1 represents there is alarm; 0 represents there is no alarm
		Warning	1 for active	1bit	1 represents there is warning; 0 represents there is no warning
		Reserved		1bit	
		Protection	1 for active	1bit	1 represents there is protection action; 0 represents there is no protection action
		Fault	1 for active	1bit	1 represents there is fault; 0 represents there is no fault
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved	(MSB)	1bit	
0101	40102	Single Over Voltage	1 for active (LSB)	1bit	1 represents there is over voltage; 0 represents there is no over voltage
		Single Under Voltage	1 for active	1bit	1 represents there is under voltage; 0 represents there is no under voltage
		Total Over Voltage	1 for active	1bit	1 represents there is

Address	PLC Address	Item	Description	Bytes	Remark
					over voltage; 0 represents there is no over voltage
		Total Under Voltage	1 for active	1bit	1 represents there is under voltage; 0 represents there is no under voltage
		Charge Overcurrent	1 for active	1bit	1 represents there is overcurrent; 0 represents there is no overcurrent
		Discharge Overcurrent	1 for active	1bit	1 represents there is overcurrent; 0 represents there is no overcurrent
		Charge Over Temp.	1 for active	1bit	1 represents there is over temp.; 0 represents there is no over temp.
		Discharge Over Temp.	1 for active	1bit	1 represents there is over temp.; 0 represents there is no over temp.
		Charge Under Temp.	1 for active	1bit	1 represents there is under temp.; 0 represents there is no under temp.
		Discharge Under Temp.	1 for active	1bit	1 represents there is under temp.; 0 represents there is no under temp.
		Ambient Over Temp.	1 for active	1bit	1 represents there is over temp.; 0 represents there is no over temp.
		Ambient Under Temp.	1 for active	1bit	1 represents there is under temp.; 0 represents there is no under temp.
		MOS Over Temp.	1 for active	1bit	1 represents there is over temp.; 0 represents there is no over temp.
		Low Battery	1 for active	1bit	1 represents there is

Address	PLC Address	Item	Description	Bytes	Remark
					low battery; 0 represents there is no low battery
		Reserved		1bit	
		Reserved	(MSB)	1bit	
0102	40103	Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
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		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
0103	40104	Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
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		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
0104	40105	Single Over Charge	1 for active (LSB)	1bit	1 represents there is over charge; 0 represents there is no over charge
		Single Over Discharge	1 for active	1bit	
		Total Over Charge	1 for active	1bit	

Address	PLC Address	Item	Description	Bytes	Remark
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
0107	40108	Reserved		1bit	
		Reserved		1bit	
		NTC Fault	1 for active	1bit	1 represents there is NTC fault; 0 represents there is no NTC fault
		Cell Fault	1 for active	1bit	
		Reserved		1bit	
		Reserved		1bit	
		MOS Temp. Sensor Fault	1 for active	1bit	
		Ambient Temp. Sensor Fault	1 for active	1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved	(MSB)	1bit	
0108	40109	Overcurrent Signal	1 for active	1bit	1 represents there is overcurrent signal; 0 represents there is no overcurrent signal
		Discharge MOS Continuity Signal	1 for active	1bit	
		Reserved		1bit	
		Heating Status	1 for active	1bit	
		Charger Connection Signal	1 for active	1bit	
		Charger Reverse Connection Signal	1 for active	1bit	
		Load Connection Signal	1 for active	1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	

Address	PLC Address	Item	Description	Bytes	Remark
		Reserved		1bit	
0109	40110	Main Power Supply	1 for active	1bit	1 represents there is main power supply; 0 represents there is no main power supply
		Pre-charge MOS Output	1 for active	1bit	
		CHG MOS Output	1 for active	1bit	
		DSG MOS Output	1 for active	1bit	
		Limited Current Circuit MOS Output	1 for active	1bit	
		Limited Current Circuit Supply	1 for active	1bit	
		Limited Current Circuit Value	0: 10A 1: 20A	1bit	
		Heating MOS Output	1 for active	1bit	
		MOS Disconnect for Abnormal Heating	1 for active	1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
0110	40111	DIP Switch Position 1 Status	1 for active	1bit	
		DIP Switch Position 2 Status	1 for active	1bit	
		DIP Switch Position 3 Status	1 for active	1bit	
		DIP Switch Position 4 Status	1 for active	1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
0111	40112	Aux. Output 1 Status	1 for active	1bit	1 represents there is output; 0 represents there is

Address	PLC Address	Item	Description	Bytes	Remark
					no output
		Aux. Output 2 Status	1 for active	1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
		Reserved		1bit	
0112	40113	Single 1-16 Balanced Status	bit0: Single 1 Balanced Status bit15: Single 16 Balanced Status	2Bytes	1 Active 0 Inactive
0113	40114	Single 17-32 Balanced Status (Reserved)	1 Active	2Bytes	
0114-0129	40115-40130	Reserved			

3.2 CORRESPONDING VALUE DATE FIELD OF FUNCTION CODE 03, 06

Table 3 Value Data Field

Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0130	40131	Battery Module Current	-30000~30000	100	A	Signed (*100) Negative for discharging; Positive for charging	0.01A
0131	40132	Total Module Voltage	0~8000	100	V	Unsigned (*100)	0.01V
0132	40133	Left Capacity Ah	0~60000	100	Ah	Unsigned (*100)	0.01Ah
0133	40134	Total Capacity	0~60000	100	Ah	Unsigned (*100)	0.01Ah
0134	40135	Cycle Times	0~60000	1	/	Unsigned	
0135	40136	Battery SOC	0~1000	10	/	Unsigned (*10)	0.1%
0136	40137	Battery SOH	0~1000	10	/	Unsigned (*10)	0.1%
0137	40138	Charge/Discharge Status	0~3	1	/	0: Sleep 1: Standby 2: Charge 3: Discharge	
0138	40139	Ultimate Current mA	-30000~30000	0.01	A	Signed Negative for discharging; Positive for charging	0.01A
0139	40140			/	/		
0140	40141	Ultimate Current 1 (Zero-current window is not filtered)	-30000~30000	0.01	A	Signed Negative for discharging; Positive for charging	0.01A
0141	40142			/	/		
0142	40143	Wide-range Real-time Current	-30000~30000	0.01	A	Signed Negative for discharging; Positive for charging	0.01A
0143	40144			/	/		
0144	40145	Small-range	-30000~30000	0.01	A	Signed	0.01A

Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Real-time Current				Negative for discharging; Positive for charging	
0145	40146			/	/		
0146	40147	AFE Measuring Current (Zero-current window is not filtered)	-2147483648 ~2147483647	1	mA	Signed	1mA
0147	40148						
0148	40149	Max. Charging Current A	-30000~30000	0.01	A	Unsigned*100	0.01A
0149	40150	Max. Discharging Current A	-30000~30000	0.01	A	Unsigned *100	0.01A
0150	40151	Reserved		/	/		
0151	40152	Reserved		/	/		
0152	40153	Reserved		/	/		
0153	40154	Reserved		/	/		
0154	40155	Max Single Voltage mV	0~5000	1	mV	Unsigned	1mV
0155	40156	Min Single Voltage mV	0~5000	1	mV	Unsigned	1mV
0156	40157	Average Battery Voltage mV	0~5000	1	mV	Unsigned	1mV
0157	40158	Voltage Difference of Battery Pack mV	0~5000	1	mV	Unsigned	1mV
0158	40159	Battery No. of Max Voltage		/	/	Unsigned	
0159	40160	Battery No. of Min Voltage		/	/	Unsigned	
0160	40161	Max Cell Temp. °C	-400~1250	0.1	°C	Signed*10	0.1°C
0161	40162	Min Cell Temp. °C	-400~1250	0.1	°C	Signed *10	0.1°C
0162	40163	Average Temp. °C	-400~1250	0.1	°C	Signed *10	0.1°C
0163	40164	Cell Temp. Difference °C	-400~1250	0.1	°C	Unsigned *10	0.1°C

Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0164	40165	Max Cell Temp. No.		/	/	Unsigned	
0165	40166	Min Cell Temp. No.		/	/	Unsigned	
0166-0181	40167-40182	Single Voltage 1-16 (mV)	0~5000	1	mV	Unsigned	1mV
0182	40183	Cell Temp. 1	-400~1250	0.1	°C	Signed*10	0.1°C
0183	40184	Cell Temp. 2	-400~1250	0.1	°C	Signed *10	0.1°C
0184	40185	Cell Temp. 3	-400~1250	0.1	°C	Signed *10	0.1°C
0185	40186	Cell Temp. 4	-400~1250	0.1	°C	Signed *10	0.1°C
0186	40187	MOS Temp.	-400~1250	0.1	°C	Signed *10	0.1°C
0187	40188	Ambient Temp.	-400~1250	0.1	°C	Signed *10	0.1°C
0188	40189	Cell Temp. 1 Resistance	0~4294967295	1	Ω	Unsigned	1Ω
0189	40190			/	/		
0190	40191	Cell Temp. 2 Resistance	0~4294967295	1	Ω	Unsigned	1Ω
0191	40192			/	/		
0192	40193	Cell Temp. 3 Resistance	0~4294967295	1	Ω	Unsigned	1Ω
0193	40194			/	/		
0194	40195	Cell Temp. 4 Resistance	0~4294967295	1	Ω	Unsigned	1Ω
0195	40196			/	/		
0196	40197	MOS Temp. Resistance	0~4294967295	1	Ω	Unsigned	1Ω
0197	40198			/	/		
0198	40199	Ambient Temp. Resistance	0~4294967295	1	Ω	Unsigned	1Ω
0199	40200			/	/		
0200	40201	MCU Temp.	0~4294967295	1	°C	Signed*10	0.1°C
0201	40202	Reserved		/	/		
0202	40203	Reserved		/	/		
0203	40204	Reserved		/	/		
0204	40205	Controller Model (Reserved)	0~65535	/	/	Unsigned	
0205	40206	SW Version	0~65535	/	/	Unsigned *10	
0206	40207	HW Version	0~65535	/	/	Unsigned *10	
0207	40208	Release Year	0~65535	/	/	Only save last two digits of year	
0208	40209	Release Month	0~65535	/	/	Unsigned	

Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0209	40210	Release Day	0~65535	/	/	Unsigned	
0210	40211	RTC-Year	0~65535	/	/	Unsigned	Last two digits of year
0211	40212	RTC-Month	0~65535	/	/	Unsigned	
0212	40213	RTC-Day	0~65535	/	/	Unsigned	
0213	40214	RTC-Week	0~65535	/	/	Unsigned	
0214	40215	RTC-Hour	0~65535	/	/	Unsigned	
0215	40216	RTC-Min	0~65535	/	/	Unsigned	
0216	40217	RTC-S	0~65535	/	/	Unsigned	

NOTE1: Actual value=received data*ratio. Take the voltage as the example, if the received data is 5256 (1488H), ratio is 0.01V, then the actual voltage value is 52.56V (5256*0.01V).

Example:

Read "Total Module Voltage", firstly get its address is 0131 by checking the table.

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

Table 4 Master Request Command

Slave Address	Function Code	Starting Address (0)		Request Data Qty. (2)		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	03	00	83	00	01	75	E2

The slave response command is as following:

Table 5 Slave Response Command

Slave Address	Function Code	Data Qty. (Bytes)	Data		CRC 16 Calibration	
			Data MSB of Address 0000	Data LSB of Address 0000	LSB	MSB
01	03	02	14	88	B7	22

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

Table 6 Data Analysis

Item	Address	Received Data (Hex)
Total Module Voltage	0083H	1488H

4. FAQ

4.1 COMMUNICATION LINE SHIELDING LAYER GROUNDED

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

4.2 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.

4.3 RS485 TO USB COMMUNICATION ADAPTOR

PC can communicate with SG72A module produced by our company.

4.4 EXTENDED COMMUNICATION DISTANCE

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

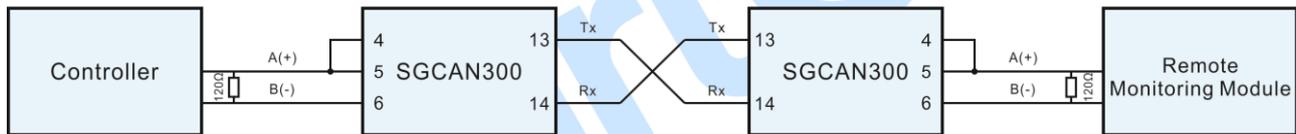


Fig.2 SGCAN300 Application Diagram

4.5 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.