Rover 20A/40A Charge Controller—MODBUS Protocol

1. MODBUS RTU Communication Protocol Format and Command Parsing:

1.1 Format:

Start character	Address field	Function code	Data	Error check	End character

1.2 Descriptions:

(Data below suffixed with an "H" are hexadecimal, and the others are decimal)

1) Start character: >10ms

2) Address field: one byte, range: 01H **to** F7H (decimal 1 **to** 247). 00H is a broadcast address to which all slaves respond but do not return commands

3) Function code: 1 byte

Command name	Accessed data type	Function code	Error code
Read a Single or Multiple Word register(s)	2 bytes	03H	83H
Write a Single Word Register	2 bytes	06H	86H
Write N Word Registers in a Row	2 bytes	10H	90H
Reset to Factory Defaults	No accessed data	78H	F8H
Clear History	No accessed data	79H	F9H

4) Data: N bytes

5) Error check: 2 bytes. It's the CRC checksum of the device address, function code and each byte of the data.

6) End character: >10ms

Note:

1) The data address and the data itself are of 2 bytes, with the high byte sent first and then the low byte; for CRC, the low byte is sent first, and the high byte is sent next.

2) The error code is the error response function code returned by the client when there is some error in the frame data sent by the server; error cod = function code | 80H

1.3 Process flow chart

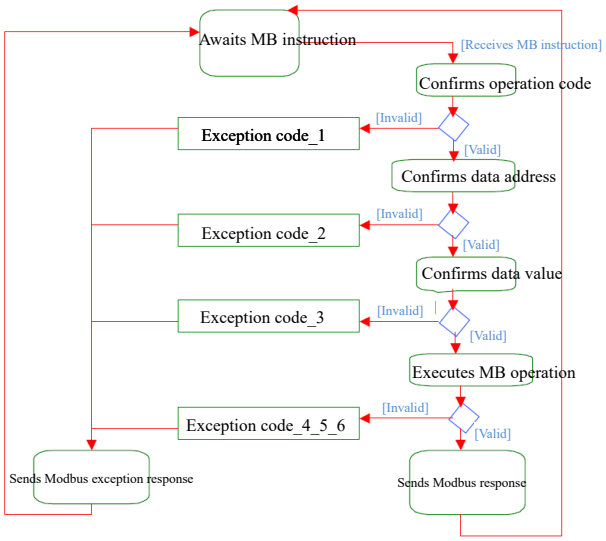

Fig. 8 Modbus process flow chart

Exception code descriptions

a、01H — Function code not supported

b、02H — PDU start address is not correct or PDU start address + data length

c、03H — Data length in reading or writing register is too large

d、04H — Client fails to read or write register — not used

e、05H — Data check code sent by server is not correct — not used

Note: the server's reception of an exception code returned by the controller indicates that the controller had received the command sent by the server, but the command was erroneous, thus the server should resend the command.

1.3.1 Flow chart of reading register

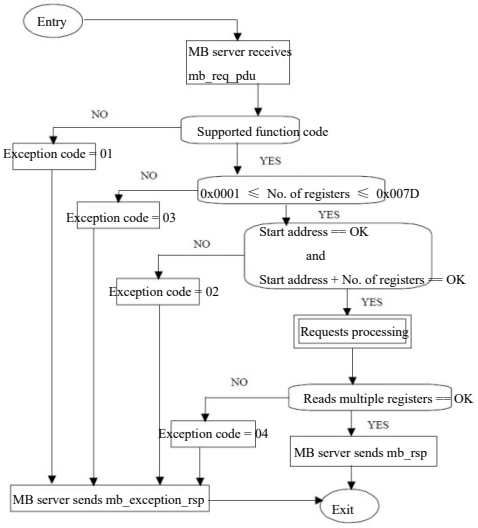

Fig. 12 Flow chart of reading holding

1.3.2 Flow chart of writing a single register

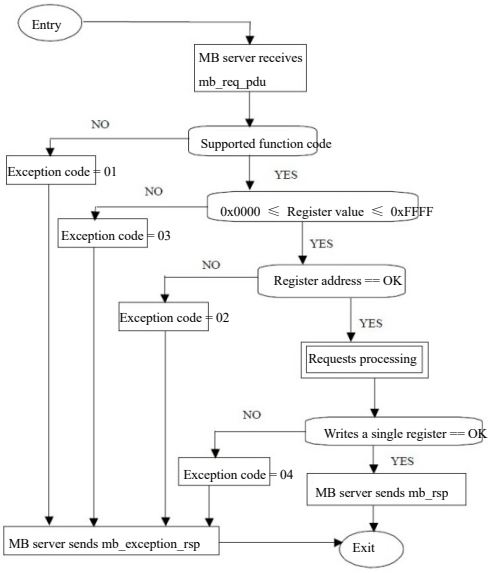

Fig. 15 Flow chart of writing a single

1.3.3 Flow chart of writing N registers in a row

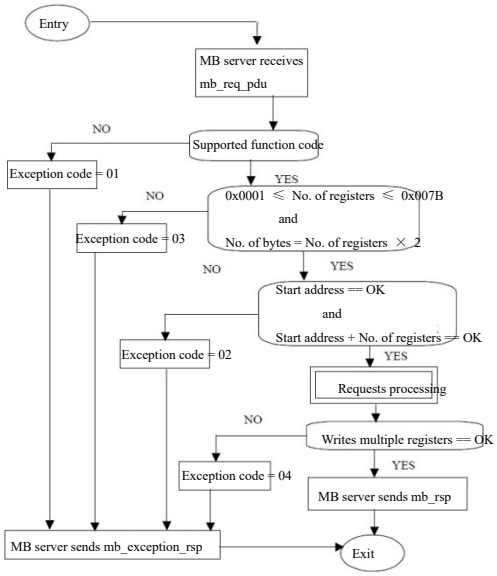

Fig. 17 Flow chart of writing multiple

1.4 Example:

1.4.1 Read register

Request:

Description	**No. of bytes**	**Command**
Device address	BYTE	01H **to** F7H
Function code	BYTE	03H
Start address	WORD	0000H **to** FFFFH
No. of read words	WORD	0001H **to** 007DH
Check code	WORD	CRC checksum of all the above bytes

Normal response:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Function code	BYTE	03H
Data length	BYTE	01H **to** FAH
Data content	WORD	Data read out (High byte sent first, low byte sent next)
...	WORD	Data read out (High byte sent first, low byte sent next)
Check code	WORD	CRC checksum of all the above bytes

Exception response:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Error code	BYTE	83H
Exception code	BYTE	N (N=1, 2, 3, 4)
Check code	WORD	CRC checksum of all the above bytes

1.4.2 Write a single register

Request:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Function code	BYTE	06H
Start address	WORD	0000H **to** FFFFH
Write data in	WORD	0000H **to** FFFFH
Check code	WORD	CRC checksum of all the above bytes

Normal response:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Function code	BYTE	06H
Start address	WORD	0000H **to** FFFFH

Write data in	WORD	0000H **to** FFFFH
Check code	WORD	CRC checksum of all the above bytes

Exception response:

Description	**No. of bytes**	**Command**
Device address	BYTE	01H **to** F7H
Error code	BYTE	86H
Exception code	BYTE	N (N=1, 2, 3, 4)
Check code	WORD	CRC checksum of all the above bytes

1.4.3 Write N registers in a row

Request:

Description	**No. of bytes**	**Command**
Device address	BYTE	01H **to** F7H
Function code	BYTE	10H
Start address	WORD	0000H **to** FFFFH
No. of written bytes	WORD	0001H **to** 007DH
No. of written words	BYTE	One time of the No. of bytes
Data content	WORD	Data written in (High byte sent first, low byte sent next)
...	WORD	Data written in (High byte sent first, low byte sent next)
Check code	WORD	CRC checksum of all the above bytes

Normal response:

Description	**No. of bytes**	**Command**
Device address	BYTE	01H **to** F7H
Function code	BYTE	10H
Start address	WORD	0000H **to** FFFFH
No. of written bytes	WORD	0001H **to** 007DH
Check code	WORD	CRC checksum of all the above bytes

Exception response:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Error code	BYTE	90H
Exception code	BYTE	N (N=1, 2, 3, 4)
Check code	WORD	CRC checksum of all the above bytes

1.4.4 Reset to factory defaults

Request:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Function code	BYTE	78H
Complementary data	WORD	0000H
Complementary data	WORD	0001H
Check code	WORD	CRC checksum of all the above bytes

Normal response:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Function code	BYTE	78H
Complementary data	WORD	0000H
Complementary data	WORD	0001H
Check code	WORD	CRC checksum of all the above bytes

Exception response:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Error code	BYTE	F8H
Exception code	BYTE	N (N=1, 2, 3, 4)
Check code	WORD	CRC checksum of all the above bytes

1.4.4 Clear history

Request:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Function code	BYTE	79H
Complementary data	WORD	0000H
Complementary data	WORD	0001H
Check code	WORD	CRC checksum of all the above bytes

Normal response:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Function code	BYTE	79H
Complementary data	WORD	0000H
Complementary data	WORD	0001H
Check code	WORD	CRC checksum of all the above bytes

Exception response:

Description	No. of bytes	Command
Device address	BYTE	01H **to** F7H
Error code	BYTE	F9H
Exception code	BYTE	N (N=1, 2, 3, 4)
Check code	WORD	CRC checksum of all the above bytes

2. PDU Address Allocation Table

Table 1: (Data below suffixed with an "H" are hexadecimal, and the others are decimal)

Description		PDU address	Bytes	R/ W	Description	Data (range)	Meaning	Unit	Remarks
		0000H to 0009H	20	-	Reserved			-	
System Information		000AH	2	R	8 higher bits: max. voltage supported by the system	0CH (decimal 12)	12V	-	
						18H (decimal 24)	24V		
						24H (decimal 36)	36V		
						30H (decimal 48)	48V		
						60H (decimal 96)	96V		
						FFH (decimal 255)	Automatic recognition of system voltage		
					8 lower bits: rated charging current	0AH (decimal 10)	10A		
						14H (decimal 20)	20A		
						1EH (decimal 30)	30A		
						2DH (decimal 45)	45A		
						3CH (decimal 60)	60A		
		000BH	2	R	8 higher bits: rated discharging current	0AH (decimal 10)	10A		
						14H (decimal 20)	20A		
						1EH (decimal 30)	30A		
						2DH (decimal 45)	45A		
						3CH (decimal 60)	60A		
					8 lower bits: product type	00 (controller) 01 (inverter) ...			
		000CH to 0013H	16	R	Product model			-	
		0014H 0015H	4	R	Software version			-	
		0016H 0017H	4	R	Hardware version			-	
		0018H 0019H	4	R	Product serial number			-	
		001AH	2	R/W	Controller, device address	1 to 247		-	8 lower bits
					RAM information				

		0100H	2	R	Battery capacity SOC	0 to 100	Current battery capacity value	%	
		0101H	2	R	Battery voltage		Battery voltage * 0.1	V	
Dynamic controller information		0102H	2	R	Charging current (to battery)		Charging current * 0.01	A	
		0103H	2	R	Controller temperature		Actual temperature value (b7: sign bit; b0-b6: temperature value)	°C	
					Battery temperature				
		0104H	2	R	Street light (load) voltage		Street light voltage * 0.1	V	
		0105H	2	R	Street light (load) current		Street light current * 0.01	A	
		0106H	2	R	Street light (load) power		Actual value	W	
	Solar panel information	0107H	2	R	Solar panel voltage		Solar panel voltage * 0.1	V	
		0108H	2	R	Solar panel current (to controller)		Solar panel current * 0.01	A	
		0109H	2	R	Charging power		Actual value	W	
		010AH	2	W	Light On/ Off command	0 or 1	1: to turn on street light, 0: to turn off street light	-	
		010BH	2	R	Battery's min. voltage of the current day		Battery's min. voltage of the current day * 0.1	V	
		010CH	2	R	Battery's max. voltage of the current day		Battery's max. voltage of the current day * 0.1	V	
		010DH	2	R	Max. charging current of the current day		Max. charging current of the current day * 0.01	A	
		010EH	2	R	Max. Discharging current of the current day		Max. discharging current of the current day * 0.01	A	
		010FH	2	R	Max. charging power of the current day		Actual value	W	
		0110H	2	R	Max. discharging power of the current day		Actual value	W	
		0111H	2	R	Charging amp-hrs of the current day		Actual value	AH	
		0112H	2	R	Discharging amp-hrs of the current day		Actual value	AH	
		0113H	2	R	Power generation of the current day		Actual value	kilowatt hour/ 10000	
		0114H	2	R	Power consumption of the day		Actual value	kilowatt hour/ 10000	
	Historical data information	0115H	2	R	Total number of operating days			days	
		0116H	2	R	Total number of battery over-discharges			-	
		0117H	2	R	Total number of battery			-	

					full-charges				
		0118H 0119H	4	R	Total charging amp-hrs of the battery			AH	
		011AH 011BH	4	R	Total discharging amp-hrs of the battery			AH	
		011CH 011DH	4	R	Cumulative power generation			kilowatt hour/ 10000	
		011EH 011FH	4	R	Cumulative power consumption			kilowatt hour/ 10000	
		0120H	2	R	Street light status	0 or 1	8 higher bits	b7: 0 indicates the street light is off, 1 indicates the street light is on	-
					Street light brightness	00 to 64H		b0 to b6: brightness value	%
					Charging state		8 lower bits	00H: charging deactivated	-
								01H: charging activated	
								02H: mppt charging mode	
								03H: equalizing charging mode	
								04H: boost charging mode	
								05H: floating charging mode	
								06H: current limiting (overpower)	
	Controller fault information	0121H 0122H	4	R	Controller fault and warning information			b31 reserved b30: circuit, charge MOS short circuit b29: anti-reverse MOS short	E.g.: A certain bit being 1 indicates some fault occurs to the corresponding item, while a certain bit being 0 indicates the corresponding item is free from faults. When all items function normally, the bits return to 00000000H.
								B28: solar panel reversely connected	
								B27: solar panel working point over-voltage	
								B26: solar panel counter-current	
								B25: photovoltaic input side over-voltage	
								B24: photovoltaic input side short circuit	
								B23: photovoltaic input overpower	
								B22: ambient temperature too high	
								B21: controller temperature too high	
								B20: load overpower or load over-current	
								B19: load short circuit	

						16 High bit	B18: battery under-voltage warning B17: battery over-voltage B16: battery over-discharge **B0**-B15 reserved		
	EEPROM								
		E001H	2	R/W	Dimming command	0000H to 0064H (decimal 0 to 100)	To set street light brightness value	%	
Controller parameter settings	Battery parameter settings	E002H	2	R	Nominal battery capacity			AH	
		E003H	2	R/W	8 higher bits: system voltage setting 8 lower bits: recognized voltage		12: 12V; 24: 24V; 36: 36V; 48: 48V; FF: automatic recognition Others: automatic recognition	-	
		E004H	2	R/W	Battery type		Open, sealed, gel, lithium, self-customized	-	
		E005H	2	R/W	Over-voltage threshold	70 to 170		V	Setting range: (7 to 17) V E.g.: when the over-voltage threshold needs to be set to 17.0 V and one decimal place is to be kept, first multiply the figure by 10, i.e. 17.0V * 10 = 170V, then convert it to a hexadecimal value 00AAH, and next write the value into 0103H.
		E006H	2	R/W	Charging voltage limit	70 to 170		V	
		E007H	2	R/W	Equalizing charging voltage	70 to 170		V	

		E008H	2	R/W	Boost charging voltage/ overcharge voltage (lithium batteries)	70 to 170		V	
		E009H	2	R/W	Floating charging voltage/ overcharge recovery voltage (lithium batteries)	70 to 170		V	
		E00AH	2	R/W	Boost charging recovery voltage	70 to 170		V	
		E00BH	2	R/W	Over-discharge recovery voltage	70 to 170		V	
		E00CH	2	R/W	Under-voltage warning level	70 to 170		V	
		E00DH	2	R/W	Over-discharge voltage	70 to 170		V	
		E00EH	2	R/W	Discharging limit voltage	70 to 170		V	
		E00FH	2	R/W	8 higher bits: end-of-charge SOC 8 lower bits: end-of-discharge SOC			-	
		E010H	2	R/W	Over-discharge time delay	0 to 120		S	
		E011H	2	R/W	Equalizing charging time	0 to 300	Step length + 10	Min	
		E012H	2	R/W	Boost charging time	10 to 300	Step length + 10	Min	
		E013H	2	R/W	Equalizing charging interval	0 to 255	0: closed, step length + 5	day	
		E014H	2	R/W	Temperature compensation factor	0 to 5	0: not compensated, step length + 1	mV/ °C/ 2V	
	Load operating duration and power settings	E015H	2	R/W	1st-stage operating duration	00H to 15H		H	
		E016H	2	R/W	1st-stage operating power	0 to 100		%	
		E017H	2	R/W	2nd-stage operating duration	00H to 15H		H	
		E018H	2	R/W	2nd-stage operating power	0 to 100		%	
		E019H	2	R/W	3rd-stage operating duration	00H to 15H		H	
		E01AH	2	R/W	3rd-stage operating power	0 to 100		%	
		E01BH	2	R/W	Morning on operating	00H to 15H		H	

					duration				
		E01CH	2	R/W	Morning on operating power	0 to 100		%	
	Mode setting	E01DH	2	R/W	Load working modes	00H	Sole light control, light control over on/ off of load	-	
						01H	Load is turned on by light control, and goes off after a time delay of 1 hour		
						02H	Load is turned on by light control, and goes off after a time delay of 2 hours		
						03H	Load is turned on by light control, and goes off after a time delay of 3 hours		
						04H	Load is turned on by light control, and goes off after a time delay of 4 hours		
						05H	Load is turned on by light control, and goes off after a time delay of 5 hours		
						06H	Load is turned on by light control, and goes off after a time delay of 6 hours		
						07H	Load is turned on by light control, and goes off after a time delay of 7 hours		
						08H	Load is turned on by light control, and goes off after a time delay of 8 hours		
						09H	Load is turned on by light control, and goes off after a time delay of 9 hours		
						0AH (decimal 10)	Load is turned on by light control, and goes off after a time delay of 10 hours		
						0BH (decimal 11)	Load is turned on by light control, and goes off after a time delay of 11 hours		
						0CH (decimal 12)	Load is turned on by light control, and goes off after a time delay of 12 hours		

						0DH (decimal 13)	Load is turned on by light control, and goes off after a time delay of 13 hours		
						0EH (decimal 14)	Load is turned on by light control, and goes off after a time delay of 14 hours		
						0FH (decimal 15)	Manual mode		
						10H (decimal 16)	Debugging mode		
						11H (decimal 17)	Normal on mode		
	Light control setting	E01EH	2	R/W	Light control delay	0 to 60		Min	
		E01FH	2	R/W	Light control voltage	1 to 40		V	
		E020H	2	R/W	LED load current setting	N		10mA	(N * 10) mA
		E021H	2	R/W	Special power control	8 higher bits	b3 to b7 not used	-	
							b2: 1—charging mode controlled by voltage 0—charging mode controlled by SOC		
							b1: 1—special power control function enabled 0—special power control function disabled		
							b0: 1—each night on function enabled 0—each night on function disabled		
						8 lower bits	b3 to b7 not used		
							b2: no charging below 0 °C (1: enabled, 0: disabled)		
							b0 to b1: charging method (00: direct charging, 01: PWM charging)		
	MES Load operating duration and power settings	E022H	2	R/W	Working hours determined by automatic sensing 1	0 to 15	Step length + +1	H	
		E023H	2	R/W	Power with people sensed 1	0 to 100	Step length + 10	%	
		E024H	2	R/W	Power with no people sensed 1	0 to 100	Step length + 10	%	
		E025H	2	R/W	Working hours determined by automatic	0 to 15	Step length + +1	H	

				sensing 2				
	E026H	2	R/W	Power with people sensed 2	0 to 100	Step length + 10	%	
	E027H	2	R/W	Power with no people sensed 2	0 to 100	Step length + 10	%	
	E028H	2	R/W	Working hours determined by automatic sensing 3	0 to 15	Step length + +1	H	
	E029H	2	R/W	Power with people sensed 3	0 to 100	Step length + 10	%	
	E02AH	2	R/W	Power with no people sensed 3	0 to 100	Step length + 10	%	
	E02BH	2	R/W	Sensing time delay	0 to 250	Step length + 10	S	
	E02CH	2	R/W	LED load current	N		10mA	(N * 10) mA
	E02DH	2	R/W	Special power control	8 higher bits	b7 to b2: not used	-	
						b1: intelligent power		
						b0: each night on		
						b7 to b4: battery type (00: lead-acid battery, 01: lithium battery)		
					8 lower bits	b3: charging method (0: PWM charging, 1: direct charging)		
						b2: no charging below 0 °C (0: disabled, 1: enabled)		
						b1 to b0: system voltage (00:12V battery, 01: 24V battery)		
Historical data	Historical data record (FLASH)							
	0xF000	2	R	Historical data of the current day				The returned data is a block of data of the day(s) to be read, and the size of the block is 20 bytes
	0xF001	2	R	Data before the current day				

3、Command Parsing and Example: (controller address 01H is taken for example, and hereinafter the actual PDU address is not taken into consideration)

3.1 To read controller's system voltage and system current

PDU address	Bytes	R/ W	Data		Meaning
000AH	2	R	8 higher bits: system voltage	0CH (decimal 12)	12V
				18H (decimal 24)	24V
				24H (decimal 36)	36V
				30H (decimal 48)	48V
				60H (decimal 96)	96V
				FFH (decimal 255)	Automatic recognition of system voltage
			8 lower bits: system current	0AH (decimal 10)	10A
				14H (decimal 20)	20A
				1EH (decimal 30)	30A
				2DH (decimal 45)	45A
				3CH (decimal 60)	60A

According to "Table 1", the PDU address is known to be 000AH. Read 1 word (2 bytes)

To send: 01 03 000A 0001 A408

To receive: 01 03 02 181E 324C

Parsing: high byte 18H indicates the controller's system voltage is 24V, and low byte 1EH indicates the system current is 30A

3.2 To read the controller's model and the PDU addresses are known to be 000CH to 0013H in sequence and occupy a total of 16 bytes. Assume these addresses store the following data (ASCII) in sequence:

’ ’, ’ ’, ’ ’, ’ ’, ’M’, ’T’, ’4’, ’8’, ’3’, ’0’, ’ ’, ’ ’, ’ ’, ’ ’, ’ ’, ’ ’, ’ ’, ’ ’

To send: 01 03 000C 0008 840F

To receive: 01 03 10 2020 2020 4D54 3438 3330 2020 2020 2020 EE98

Parsing: this controller's model is MT4830 (the ASCII corresponding to 20H is ' ', and space can be neglected)

3.3 To read the controller's software version and hardware version, and the PDU addresses are known to be 0014H, 0015H, 0016H and 0017H in sequence

To send: 01 03 0014 0004 040D

To receive: 01 03 08 0003 0201 0001 0203 8A54

Parsing: (the highest byte OOH is not used) 030201H indicates the controller's software version is V03.02.01

(the highest byte OOH is not used) 010203H indicates the controller's hardware version is V01.02.03

3.4 To read the controller's product serial number and the PDU addresses are 0018H and 0019H in sequence as shown in "Table 1"

To send: 01 03 0018 0002 740F

To receive: 01 03 04 1501 FFFF AE4F

Parsing: 1501FFFFH is the product serial number, indicating it's the 65535th (hexadecimal FFFFH) unit produced in Jan. of 2015

3.5 To read battery capacity SOC, and the PDU address is known to be 0100H

To send: 01 03 0100 0002 C5F7

To receive: 01 03 02 0064 B9AF

Parsing: (the highest byte OOH is not used) the battery capacity SOC is 64H% （decimal 100%)

3.6 To read battery voltage:

Multiply the battery voltage reading by 0.1

The PDU address is known to be 0101H

To send: 01 03 0101 0001 D436

To receive: 01 03 02 007B F867

Parsing: *formula (= battery voltage * 0.1)*

Battery voltage: (007BH, decimal 123), 007BH * 0.1 = 12.3V

3.7To read the battery's surface temperature and controller temperature, and the PDU addresses are known to be 0102H and 0103 in sequence

To send: 01 03 0102 0002 6437

To receive: 01 03 02 0020 0028 73E7

Parsing: 0020H indicates the battery's surface temperature is 30 °C, and if the figure turns out to be 800AH, then it indicates the battery's surface temperature is -10 °C

0028H indicates the controller's temperature is 40 °C, and if the figure turns out to be 800BH, then it indicates the controller's temperature is -11 °C

3.8 To read street light voltage, (discharging) current and power, and the PDU addresses are known to be 0104H, 0105H and 0106H in sequence

To send: 01 03 0104 0003 45F6

To receive: 01 03 06 0078 00C8 00F0 00C5

Parsing:

Formula: street light voltage = street light voltage reading * 0.1

0078H is the street light voltage reading, so the actual street light voltage is: 0078H * 0.1 = 120 * 0.1 = 12.0V

Formula: street light current = street light current reading * 0.01

00C8H is the street light current reading, so the actual street light current is: 00C8H * 0.01 = 200 * 0.01 = 2.00A

00F0H is the street light power (decimal 240W) which can also be calculated via formula: street light voltage * street light current

3.9To read solar panel voltage, charging current and charging power, and the PDU addresses are known to be 0107H, 0108H and 0109H in sequence

To send: 01 03 0107 0003 B5F6

To receive: 0090 0096 00D8 011E

Parsing:

Formula: solar panel voltage = solar panel voltage reading * 0.1

00AAH is the solar panel voltage reading, so the actual solar panel voltage is: 0090H * 0.1 = 144 * 0.1 = 14.4V

Formula: solar panel charging current = solar panel charging current reading * 0.01

0096H is solar panel charging current reading, so the actual solar panel charging current is: 0096H * 0.01= 150 * 0.01 = 1.50A

00D8H is solar panel charging power (decimal 216 W) which can also be calculated via formula: solar panel

voltage * solar panel charging current

3.10 To read the current day's min. battery voltage, max. battery voltage, max. charging current, max. discharging current, max. charging power, max. discharging power, charging amp-hrs, discharging amp-hrs, power generation, power consumption, and the PDU addresses are 010BH to 0114H in sequence as shown in "Table 1"

To send: 01 03 010B 0003 75F5

To receive: 01 03 06 0070 0084 00D8 20CD

Parsing: in the returned command

The 4th and 5th bytes 0070H indicate the current day's min. battery voltage: 0070H * 0.1 = 112 * 0.1 = 11.2V

The 6th and 7th bytes 0084H indicate the current day's max. battery voltage: 0084H * 0.1 = 132 * 0.1 = 13.2V

The 8th and 9th bytes 00D8H indicate the current day's max. charging current: 00D8H * 0.01 = 216 * 0.01 = 2.16V

E.g.: to read the controller's charging amp-hrs and discharging amp-hrs on the current day, and the PDU addresses are known to be 0111H and 0112H respectively

To send: 01 03 00111 0002 31D4

To receive: 01 03 04 0608 0810 7D75

Parsing: the 4th and 5th bytes 0608H are the current day's charging amp-hrs (decimal 1544AH);

Parsing: the 6th and 7th bytes 0810H are the current day's discharging amp-hrs (decimal 2064AH)

3.11 To read the number of operating days, over-discharges and full-charges, and the PDU addresses are 0115H, 0116H and 0117H respectively

To send: 01 03 0115 0003 15F3

To receive: 01 03 06 0008 0001 0006 1176

Parsing:

The 4th and 5th bytes 0008H are the number of operating days, indicating the system has operated for 8 days

The 6th and 7th bytes 0001H are the number of over-discharges, indicating th battery has been over-discharged once

The 8th and 9th bytes 0006H are the number of full-charges, indicating the battery has been fully charged for 6 times

3.12To read the battery's total charging amp-hrs and discharging amp-hrs, and the PDU addresses are known to be 0118H, 0119H, 011AH and 011BH in sequence

To send: 01 03 0118 0004 C5F2

To receive: 01 03 08 0001 0203 0000 0108 C0A3

Parsing: the 4th to 7th bytes 00010203H are the battery's total charging amp-hrs (decimal 66051AH = 66.051KAH)

The 8th to 11th bytes 00000108H are the battery's total discharging amp-hrs (decimal 264AH = 0.264KAH)

3.13 To read the controller's cumulative power generation and cumulative power consumption, and the PDU addresses are known to be 011CH to 011FH in sequence and occupy a total of 8 bytes.

To send: 01 03 011C 0004 840F

To receive: 01 03 08 0000 07D0 0000 03E8 550C

Parsing: 000007D0H are the controller's cumulative power generation (decimal 2000 kilowatt-hours)

The 8th to 11th bytes 000003E8H are the cumulative power consumption (decimal 1000 kilowatt-hours)

3.14 To read street light status, brightness and battery status, and the PDU addresses are known to be 0120H

PDU address	Bytes	R/ W	Item	Value		Meaning
0120H	2	R	Street light status	0 or 1	High byte	b7: 0 indicates the street light is off, 1 indicates the street light is on
			Street light brightness	00 to 64H		b0 to b6: brightness value
			Battery status		Low byte	00H: charging deactivated
						01H: charging activated
						02H: mppt charging mode
						03H: equalizing charging mode
						04H: boost charging mode
						05H: floating charging mode
						06H: constant current (overpower)

To send: 01 03 0120 0001 843C

To receive: 01 03 02 E402 7285

Parsing: E4H is (80H | 64H)

The 4th byte b7 being 1 indicates the street light is on, otherwise it's off, and b0 **to** b6 being 64H indicates the street light's brightness is 100%

The 5th byte 02H indicates mppt charging mode is in operation (for parsing of other statuses, refer to "PDU Address Allocation Table")

3.15To read faults and warnings, and the PDU addresses are 0121H and 0122H respectively

PDU address	Bytes	R/ W	Item	byte	Meaning
0121H 0122H	4	R	Controller fault and warning information	16 High bit	B31 reserved
					B30：circuit, charge MOS short circuit
					B29：Anti-reverse MOS short
					B28: solar panel reversely connected
					B27 solar panel working point over-voltage

					B26: solar panel counter-current
					B25: photovoltaic input side over-voltage
					B24: photovoltaic input side short circuit
					B23: photovoltaic input overpower
					B22: ambient temperature too high
					B21: controller temperature too high
					B20: load overpower or load over-current
					B19: load short circuit
					B18: battery over-voltage
					B17: battery under-voltage
					B16: battery over-discharge

To send: 01 03 0121 0002 95FD

To receive: 01 03 04 0101 0000 AA0F

Parsing:

The first four or five bytes for the fault information of the high 16 bit B24, 0101H for 1, said the photovoltaic input side short circuit, B16 1 said the battery over discharge

(for parsing of other fault codes, refer to the "Meaning" column of the "PDU Address Allocation Table")

3.16 To turn on the load, and knowing the PDU address is 010AH, you need write on/ off command into this address (0001 to turn on the load, 0000 to turn off the load)

To turn on the load:

To send: 01 06 010A 0001 69F4

To receive: 01 06 0100 0001 49F6

To turn off the load:

To send: 01 06 010A 0000 A834

To receive: 01 06 0100 0000 8836

3.17 To set street light brightness, and the PDU address is known to be E001H

If street light brightness needs to be set to 100% (hexadecimal 64H%) (the setting range is 0 **to** 100%)

To send: 01 06 E001 0064 EE21

To receive: 01 06 0101 0064 D81D

3.18 To read street light brightness, and the PDU address is known to be 0120H

To send: 01 03 0120 0001 843C

To receive: 01 03 02 E400 F344

Parsing:

The highest bit is responsible for turning on the street light, and the 7 lower bits of the high byte are for

adjusting the brightness value, E4H&7FH = 64H = 100%

3.19 To set over-voltage threshold, charging limit voltage, equalizing charging voltage, boost charging voltage, floating charging voltage, boost charging recovery voltage, over-discharge recovery voltage, over-discharge voltage, boost charging time, equalizing charging interval, temperature compensation factor

The addresses are known to be E005H to E014H in sequence, and occupy a total of 16 words or 32 bytes

(for each setting range, refer to the "Meaning" column of the "PDU Address Allocation Table")

E.g.: parameter settings need to be done according to the following table

Item to set	Data processing	Data to send
Over-voltage threshold 17.0V	Multiplied by 10	17.0 * 10 = 170, hexadecimal 00AAH
Charging limit voltage 15.5V	Multiplied by 10	15.5 * 10 = 155, hexadecimal 009BH
Equalizing charging voltage 14.6V	Multiplied by 10	14.6 * 10 = 146, hexadecimal 0092H
Boost charging voltage 14.4V	Multiplied by 10	14.4 * 10 = 144, hexadecimal 0090H
Floating charging voltage 13.8V	Multiplied by 10	13.8 * 10 = 138, hexadecimal 008AH
Boost charging recovery voltage 13.2V	Multiplied by 10	13.2 * 10 = 132, hexadecimal 0084H
Over-discharge recovery voltage 12.6V	Multiplied by 10	12.6 * 10 = 126, hexadecimal 007EH
Under-voltage threshold 17.0 V	Multiplied by 10	12.0 * 10 = 120, hexadecimal 0078H
Over-discharge voltage 11.0V	Multiplied by 10	11.0 * 10 = 110, hexadecimal 006EH
Over-discharge limit voltage 10.5V	Multiplied by 10	10.5 * 10 = 105, hexadecimal 0069H
End of charge and discharge capacity 100%|50%		100<<8|50, hexadecimal 6432H
Over-discharge time delay 5S		Hexadecimal 0005H
Equalizing charging time 60min		003CH
Boost charging time 60min		003CH
Equalizing charging interval 30 days		001EH
Temperature compensation factor 5 mV/ °C/ 2V		0005H

To send: 01 10 E005 0010 00AA 009B 0092 0090 008A 0084 007E 0078 006E 0069 6432 0005 003C 003C 001E 0005 C140

To receive: 01 10 E005 0010 E604

3.20To set the load's 1st, 2nd, 3rd and morning on stage operating durations and powers, and the PDU addresses are known to be E015H **to** E01CH and occupy a total of 8 words or 16 bytes

E.g.: parameter settings need to be done according to the following table

Item to set	Set value	Data to send
1st-stage operating duration	4 hours	0004H
1st-stage operating power	100%	0064H (decimal 100)
2nd-stage operating duration	0 hours	0000H
2nd-stage operating power	75%	004BH (decimal 75)
3rd-stage operating duration	4 hours	0004H
3rd-stage operating power	50%	0032H (decimal 50)
Morning on operating duration	0 hours	0000H
Morning on operating power	25%	0019H (decimal 25)

To send: 01 10 E015 0008 10 0004 0064 0000 004B 0004 0032 0000 0019 957F

To receive: 01 10 E015 0008 E7CB

3.21 To set load working mode, and the PDU address is known to be E01DH

PDU address	Bytes	R/ W	Item	Value	Meaning
E01DH	2	R/W	Load working modes	00H	Sole light control, light control over on/ off of load
				01H	Load is turned on by light control, and goes off after a time delay of 1 hours
				02H	Load is turned on by light control, and goes off after a time delay of 2 hours
				03H	Load is turned on by light control, and goes off after a time delay of 3 hours
				04H	Load is turned on by light control, and goes off after a time delay of 4

					hours
				05H	Load is turned on by light control, and goes off after a time delay of 5 hours
				06H	Load is turned on by light control, and goes off after a time delay of 6 hours
				07H	Load is turned on by light control, and goes off after a time delay of 7 hours
				08H	Load is turned on by light control, and goes off after a time delay of 8 hours
				09H	Load is turned on by light control, and goes off after a time delay of 9 hours
				0AH (decimal 10)	Load is turned on by light control, and goes off after a time delay of 10 hours
				0BH (decimal 11)	Load is turned on by light control, and goes off after a time delay of 11 hours
				0CH (decimal 12)	Load is turned on by light control, and goes off after a time delay of 12 hours
				0DH (decimal 13)	Load is turned on by light control, and goes off after a time delay of 13 hours
				0EH (decimal 14)	Load is turned on by light control, and goes off after a time delay of 14 hours
				0FH (decimal 15)	Manual mode
				10H (decimal 16)	Debugging mode
				11H (decimal 17)	Normal on mode

According to the "PDU Address Allocation Table", if "load is turned on by light control, and goes off after a time delay of 8 hours" needs to be set to, send command 0008H

To send: 01 06 E01D 0008 2FCA

To receive: 01 06 E01D 0008 2FCA

3.22 Reset to factory defaults

To send: 01 78 0000 0001 6000

To receive: 01 78 0000 0001 6000

Parsing: 01 is the id number, 78 is the command to reset to factory defaults, and 6000 is for checking

3.23 Clear history

To send: 01 79 0000 0001 5DC0

To receive: 01 79 0000 0001 5DC0

Parsing: 01 is the id number, 79 is the command to clear history, and 5DC0 is for checking. Be careful to use this command, as execution of it will lead to loss of all historical data and to recover the data will be impossible.

To inquire about controller addresses

1)To know the address of a certain controller, you can use a read command (write commands are not recommended) to conduct address polling. When receiving data conforming to the sent command, the address contained in the command is the address of the controller (note: this method applies to separate controller connection)

2) To seek out multiple controllers connected via communication lines, also perform address polling, and the returned command conforming to related rules contains the address information of the controllers, so you know which controllers are connected to the server.