SmartLi

Modbus Protocol

Issue 01

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HUAWEI TECHNOLOGIES CO., LTD.

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Huawei Technologies Co., Ltd.

Address: Huawei Industrial Base
Bantian, Longgang
Shenzhen 518129
People's Republic of China

Website: https://www.huawei.com

Email: support@huawei.com

About This Document

Purpose

This document describes the protocol for command control and data exchange between the monitoring module and its dedicated back end.

Intended Audience

This document is intended for development personnel of the monitoring module and network management system (NMS) as well as the test personnel who must:

Be familiar with the basic principles of serial port communication.

Have experience in using serial port commissioning software.

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. NOTICE is used to address practices not related to personal injury.

Symbol	Description
NOTE	Supplements the important information in the main text. NOTE is used to address information not related to personal injury, equipment damage, and environment deterioration.

Change History

Issue	Date	Description
01	2021-03-23	This issue is the first official release.

Contents

1 Description

1.1 Protocol Overview

1. In the Modbus protocol, register addresses are represented using 16 bits. The register addresses are described in decimal mode.
2. The Modbus protocol defines read-only collected signals for the system, rack, and battery modules.
3. When status and alarm signals are invalid, the Modbus transmits 0. When analog signals are invalid, the Modbus transmits 7FFF for signed numbers and FFFF for unsigned numbers.

1.2 Protocol Description

This document describes the protocol for command control and data exchange between the monitoring module and its dedicated back end.

Functions defined in the protocol include:

1. The host sends a read command to obtain relevant information.
2. The host is the master node in the communication process. The information exchange is done by a question-and-answer method.
3. The slave nodes are distinguished by address. The address ranges from 1 to 254. The default address is 80. On the same communications bus, addresses of slave nodes must be unique.

2 Definition

Master node: host computer, which is responsible for communication with slave nodes.

Slave node: UPS monitoring module, which collects information from the UPS power module.

RS485: a serial communication standard, which can support half-duplex serial short-range communication.

Read command: The master node sends a read command to the slave node, instructing the slave node to return relevant register contents.

Write command: The master node packs parameters and sends them to the slave node to configure corresponding parameters.

Register address: Each signal or parameter of the slave device corresponds to a register address, which the master device accesses to obtain relevant information or configure relevant parameters.

Slave node address: The slave node address is set in the range from 1 to 254

3 Physical Interface

3.1 MODBUS-RTU

3.1.1 Electrical Standard

The slave node communicates with the master node over the RS485 serial port.

Information transmission modes:

1. Information can be transmitted in RTU mode of the Modbus.
2. Character information can be transmitted in asynchronous mode using the format of one start bit, eight data bits, and one stop bit (totally 10 bits).

3.1.2 Data Transmission Rate

The baud rate is set to 9600 bit/s by default and can be changed to 19200 bit/s, or 115200 bit/s.

3.1.3 Cable Connection

Figure 3-1 Cable connection 1

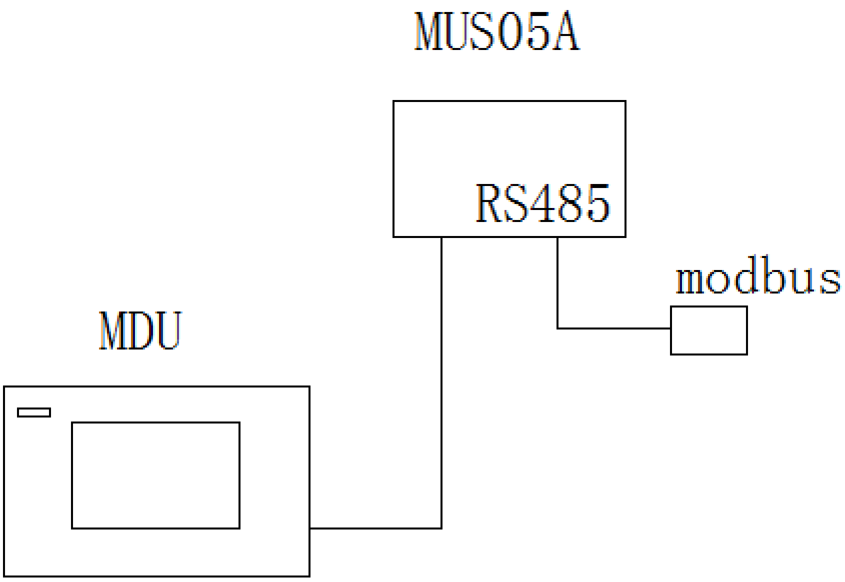


Figure 3-2 Cable connection 2

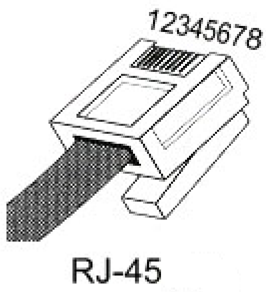
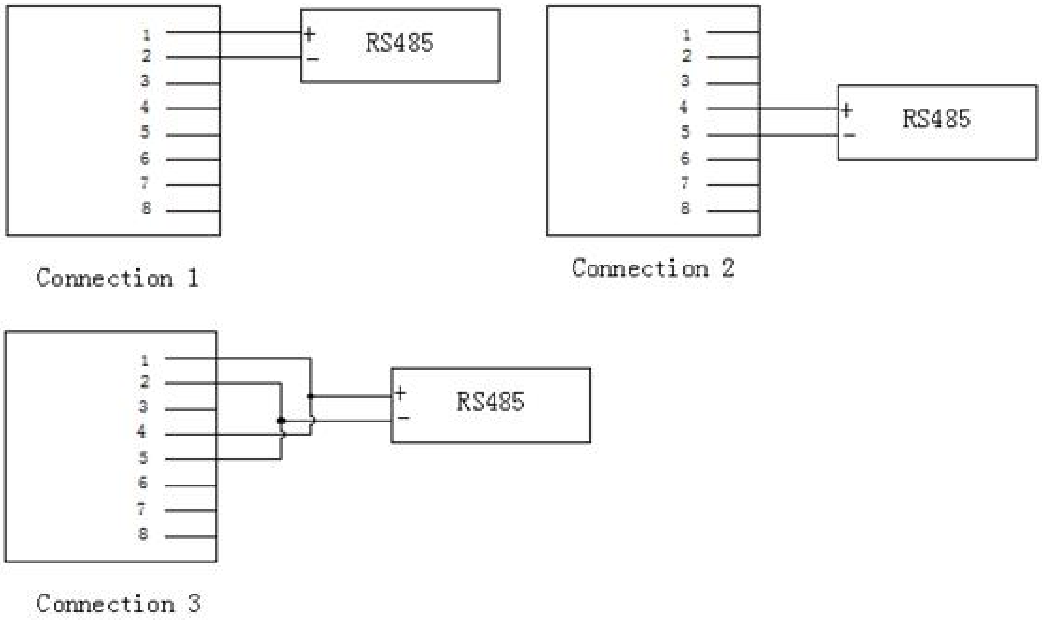


Figure 3-3 Connection of three types of data cables



NOTE

When connecting a parallel system to the network management system (NMS), use an active RS485/232 converter with the isolation function. A hot-swappable RS485/232 converter is not recommended.

3.2 MODBUS-TCP

3.2.1 Electrical Standard

The slave nodes communicate with the master node through the FE port over IP.

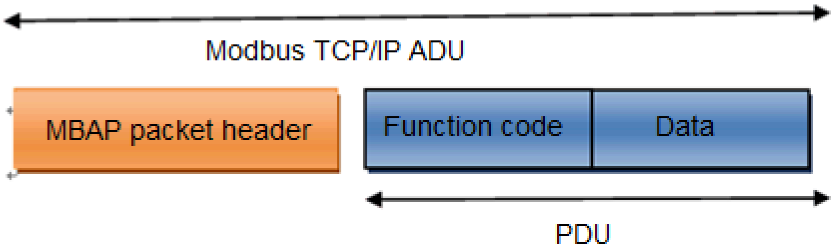
Information is transmitted in TCP transmission mode of the Modbus protocol over port 502. A maximum of two sockets can be connected.

You can enable or disable communication data encryption by choosing **Param. Settings** > **Advanced Param.** > **ModbusTCP encryption** on the WebUI or **Settings** > **Advanced Param.** > **ModbusTCP encryption** on the LCD.

3.2.2 Differences Between TCP and RTU

Modbus-TCP is a Modbus protocol carried by TCP. The difference is that MBAP packet header is added and CRC of the Modbus frame is removed.

When Modbus is applied to TCP/IP, a dedicated MBAP packet header (Modbus Application Protocol packet header) will be used to identify Modbus application data unit (ADU). The Modbus-TCP data frame format is defined as follows:



The MBAP packet header (MBAP is short for Modbus Application Protocol) is divided into four domains which include seven bytes in total.

Domain	Length	Description	Client	Server
Transmission symbol	2 bytes	Indicates transmission of a Modbus query/ response.	Generated by the client	This value is copied during response.
Protocol symbol	2 bytes	0: Modbus protocol	Generated by the client	This value is copied during response.
Length	2 bytes	Count subsequent bytes	Generated by the client	Regenerated by the server during response
Unit symbol	1 byte	Identification code of a remote slave station connected to the serial port link or other bus. 0 indicates the data collector.	Generated by the client It is actually the Modbus address.	This value is copied during response.

4 Communication Mode at the Physical Layer

After the slave nodes are powered on or reset and stably run, they respond to the read or write command sent from the master node. After the slave nodes receive related commands, the slave nodes can return requested information to the master node under normal conditions, or return specific error codes corresponding to the error types under abnormal conditions.

5 Command Type and Format at the Application Layer

5.1 Function Code List

Table 5-1 Function code list

Function Code	Meaning	Remarks
0x03	Reading	Supports continuous reading of single or multiple registers.
0x06	Writing into a single register	Supports writing into a single register.
0x10	Writing into multiple registers	Supports continuous writing into multiple registers.

5.2 Reading Command Format

Table 5-2 Command frame

0	1	2	3	4	5	6	7
ADDR	CMD	MSB	LSB	MSB	LSB	LSB	MSB
Controller address	Function Code	Register start address		Number of registers (n)		CRC checksum	

Table 5-3 Response frame

0	1	2	3	4	5	6	...	L+1	L +2	L +3	L +4
ADDR	CMD	Length	MSB	LSB	MSB	LSB	...	MSB	LSB	LSB	MSB
Controller address	Function Code	Data length (L = n x 2)	First register value		Second register value		...	Last register value		CRC checksum	

5.3 Command Format for Writing into a Single Register

Table 5-4 Command frame for writing into a single register

0	1	2	3	4	5	6	7
ADDR	CMD	MSB	LSB	MSB	LSB	LSB	MSB
Controller address	Function Code	Register address		Data		CRC checksum	

Table 5-5 Response frame for writing into a single register

0	1	2	3	4	5	6	7
ADDR	CMD	MSB	LSB	MSB	LSB	LSB	MSB
Controller address	Function Code	Register address		Data		CRC checksum	

5.4 Command Format for Writing into Multiple Registers

Table 5-6 Command frame 1 for writing into multiple registers

0	1	2	3	4	5	6	7	8
ADDR	CMD	MSB	LSB	MSB	LSB	Length	MSB	LSB
Controller address	Function Code	Register start address		Number of registers (n)		Data length (L = n x 2)	First register value	

Table 5-7 Command frame 2 for writing into multiple registers

9	10	...	L+5	L+6	L+7	L+8
MSB	LSB	...	MSB	LSB	LSB	MSB
Second register value		...	Last register value		CRC checksum	

Table 5-8 Response frame for writing into multiple registers

0	1	2	3	4	5	6	7
ADDR	CMD	MSB	LSB	MSB	LSB	LSB	MSB
Controller address	Function Code	Register start address		Number of registers (n)		CRC checksum	

5.5 Abnormal Feedback Frame

5.5.1 Abnormal Frame Format

Table 5-9 Abnormal frame format

0	1	2	3	4
ADDR	CMD	ErrCode	LSB	MSB
Controller address	Function Code +0x80	Error code	CRC checksum	

NOTE

The Function Code indicates the corresponding read or write command.

The CRC must be performed for all bytes before the CRC field.

5.5.2 Error Code Definitions

Table 5-10 Error codes returned by NEs

Code	Name	Definition	Network Process
0x01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server. This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server is in the wrong state to process a request of this type, for example because it is not configured and is being asked to return register values.	N/A
0x02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server. More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 4, then this request will successfully operate (address-wise at least) on registers 96, 97, 98, 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 5, then this request will fail with Exception Code 0x02 "Illegal Data Address" since it attempts to operate on registers 96, 97, 98, 99 and 100, and there is no register with address 100.	N/A

Code	Name	Definition	Network Process
0x03	ILLEGAL DATA VALUE	A server or slave node receives illegal data during a query, which indicates a fault in the remaining structure of a combination request, for example, the implicit length is incorrect. This does not mean that a register stores a value not expected by an application because the Modbus protocol does not understand the meaning of a special value in a register.	N/A
0x04	SERVER DEVICE FAILURE	An unrecoverable error occurred while the server was attempting to perform the requested action.	N/A
0x05	ACKNOWLEDGE	Specialized use in conjunction with programming commands. The server has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the client. The client can next issue a Poll Program Complete message to determine if processing is completed.	N/A

Code	Name	Definition	Network Process
0x06	SERVER DEVICE BUSY	The server does not accept a Modbus request PDU. A client application determines when to resend the request.	1. File upload Upon receiving this error code, the NetEco resends the command once every 10 seconds for a maximum of six times. 1. File load start Upon receiving this error code, the NetEco resends the command once every 3 seconds for a maximum of three times. If the error code persists, the upgrade process is regarded as a failure. 1. File load data Upon receiving this error code, the NetEco resends the command once every second for a maximum of three times (configurable).
0x08	MEMORY PARITY ERROR	Specialized use in conjunction with function codes 20 and 21 and reference type 6, to indicate that the extended file area failed to pass a consistency check. The server or slave node cannot read the file, but identifies a parity verification error in the register. The client can retry the request, but service may be required on the server device.	Upon receiving this error code, the NetEco resends a command for a maximum of three times.
0x0A	GATEWAY PATH UNAVAILABLE	Applies to the TCP/IP protocol.	N/A

Code	Name	Definition	Network Process
0x0B	GATEWAY TARGET DEVICE FAILED TO RESPOND	Applies to the TCP/IP protocol.	N/A
0x80	No permission	An operation is not allowed because of a permission authentication failure or permission expiration.	A device needs to be re-authenticated in the NetEco.

6 CRC Checksum Algorithm

```
unsigned short count_CRC(unsigned char *addr, int num)
{
unsigned short CRC = 0xFFFF;
int i;
while (num--)
{
CRC ^= *addr++;
for (i = 0; i < 8; i++)
{
if (CRC & 1)
{
CRC >>= 1;
CRC ^= 0xA001;
}
else
{
CRC >>= 1;
}
}
}
return CRC;
}
```


7 Acquisition Signals

7.1 Acquisition Signals

7.1.1 Analog Signals

7.1.1.1 System Analog Signals

Table 7-1 System analog signals

No.	Signal ID	Unit	Register Address	Read-write Attribute	Data Type
1	Reserved	-	0	-	-
2	Voltage	0.1 V	1	R	Unsigned
3	Reserved	-	2	-	-
4	SOC	%	3	R	Unsigned
5	SOH	%	4	R	Unsigned
6	Reserved	-	5	R	Unsigned
7	Maximum cell voltage	0.001 V	6	R	Unsigned
8	Minimum cell voltage	0.001 V	7	R	Unsigned
9	Maximum cell temperature	0.1°C	8	R	Signed
10	Minimum cell temperature	0.1°C	9	R	Signed

No.	Signal ID	Unit	Register Address	Read-write Attribute	Data Type
11	See 7.1.2.1 System Alarms.	-	10	R	Unsigned
12	Reserved	-	11~13	-	-
13	See **7.1.2.1** System Status.	-	14	R	Unsigned
14	Reserved	-	15~16	-	-
15	Battery capacity	1 Ah	17	R	Unsigned
16	Reserved	-	18	-	-
17	Total discharge times	-	19	R	Unsigned
18	Total discharge capacity H	0.1 Ah	20	R	Unsigned
19	Total discharge capacity L		21	R	Unsigned
20	Reserved	-	22~25	-	-
21	Cabinet online status	-	26	R	Unsigned
22	Running status	0: Standby 1: Charging 2: Discharging 3: Fault	27	R	Unsigned
23	Reserved	-	28	-	-
24	Battery cabinet quantity	-	29	R	Unsigned
25	Reserved	-	30~35	-	-
26	Current H	0.1 A	36	R	Signed
27	Current L		37	R	Signed
28	Reserved	-	38~39	R	-

NOTE

In the HVDC scenario, the battery cabinet online status refers to the battery string online status.

Battery cabinet online status: Bits 0 to 14 correspond to the online status of battery cabinets 1 to 15.

7.1.1.2 Rack Analog Signals

Table 7-2 Analog signals of rack 1

No.	Signal ID	Unit	Register Address	Read-write Attribute	Data Type
1	Voltage	0.1 V	40	R	Unsigned
2	Current	0.1 A	41	R	Signed
3	SOC	%	42	R	Unsigned
4	SOH	%	43	R	Unsigned
5	Maximum cell voltage	0.001 V	44	R	Unsigned
6	Minimum cell voltage	0.001 V	45	R	Unsigned
7	Maximum cell temperature	0.1°C	46	R	Signed
8	Minimum cell temperature	0.1°C	47	R	Signed
9	Temperature	0.1°C	48	R	Signed
10	Battery capacity	1 Ah	49	R	Unsigned
11	Modules per rack	-	50	R	Unsigned
12	Total discharge times	-	51	R	Unsigned
13	Total discharge capacity H	0.1 Ah	52	R	Unsigned
14	Total discharge capacity L		53	R	Unsigned
15	Running status	0: Standby 1: Charging 2: Discharging 3: Fault	54	R	Unsigned

No.	Signal ID	Unit	Register Address	Read-write Attribute	Data Type
16	Reserved	-	55~57	R	Unsigned

NOTE

In the HVDC scenario, the battery cabinet refers to the battery string.

Calculation of the analog signal address of the battery cabinet (1–12)

Start address of battery cabinet x: 40 + (x – 1) x 18, x = [1, 12]

The analog signals of each battery cabinet occupy 16 registers. The address range is 40–255.

Calculation of the analog signal address of the battery cabinet (13–15)

Start address of battery cabinet x: 20040 + (x – 12 – 1) x 18, x = [13, 15]

The analog signals of each battery cabinet occupy 16 registers. The address range is 20040–20093.

7.1.1.3 Battery Module Analog Signals

Table 7-3 Analog signals of battery cabinet 1 – battery module 1

No.	Signal ID	Unit	Register Address	Read-write Attribute	Data Type
1	Maximum cell voltage	0.001 V	260	R	Unsigned
2	Minimum cell voltage	0.001 V	261	R	Unsigned
3	Maximum cell temperature	0.1°C	262	R	Signed
4	Minimum cell temperature	0.1°C	263	R	Signed
5	Voltage	0.01 V	264	R	Unsigned
6	SOC	%	265	R	Unsigned
7	SOH	%	266	R	Unsigned

NOTE

In the HVDC scenario, the battery cabinet refers to the battery string.

Calculation of the analog signal address of the battery cabinet (1–12)

Formula for calculating the analog signal address of battery cabinet x – battery module y

Start address of battery cabinet x – battery module y: 260 + (x – 1) x 160 + (y – 1) x 10, x = [1, 12], y = [1, 16]

Each battery module occupies 10 registers. The address range is 260–2179.

Calculation of the analog signal address of the battery cabinet (13–15)

Formula for calculating the analog signal address of battery cabinet x – battery module y

Start address of battery cabinet x – battery module y: 20260 + (x – 12 – 1) x 160 + (y – 1) x 10, x = [13, 15], y = [1, 16]

Each battery module occupies 10 registers. The address range is 20260–20739.

The Huawei-developed lithium battery system supports a maximum of 15 battery cabinets, and each battery cabinet supports a maximum of 16 battery modules.

Table 7-4 Statistics of battery cabinet 1 – battery module 1

No.	Item	Unit	Register Address	R/W Attribute	Data Type
1	Total time for max. cell temperature [60,125]°C	0.1 h	5200	R	Unsigned
			5201		
2	Total time for max. cell temperature [50,60)°C	0.1 h	5202	R	Unsigned
			5203		
3	Total time for max. cell temperature [40,50)°C	0.1 h	5204	R	Signed
			5205		
4	Total time for max. cell temperature [10,40)°C	0.1 h	5206	R	Signed
			5207		
5	Total time for min. cell temperature [0,10)°C	0.1 h	5208	R	Unsigned
			5209		
6	Total time for min. cell temperature [-40,0)°C	0.1 h	5210	R	Unsigned
			5211		
7	Total cell overvoltage alarms	-	5212	R	Unsigned
8	Total cell undervoltage alarms	-	5213	R	Unsigned
9	Total high temperature alarms (charge)	-	5214	R	Unsigned
10	Total high temperature alarms (discharge)	-	5215	R	Unsigned

No.	Item	Unit	Register Address	R/W Attribute	Data Type
11	Total low temperature alarms (charge)	-	5216	R	Unsigned
12	Total low temperature alarms (discharge)	-	5217	R	Unsigned
13	Reversed	-	5218~5219	R	Unsigned

NOTE

In the HVDC scenario, the battery cabinet refers to the battery string.

Calculation of the analog signal address of the battery cabinet (1–12)

Formula for calculating the analog signal address of battery cabinet x – battery module y

Start address of battery cabinet x – battery module y: 5200 + (x – 1) x 320 + (y – 1) x 20, x = [1, 12], y = [1, 16]

Each battery module occupies 20 registers. The address range is 5200–9039.

Calculation of the analog signal address of the battery cabinet (13–15)

Formula for calculating the analog signal address of battery cabinet x – battery module y

Start address of battery cabinet x – battery module y: 25200 + (x – 12 – 1) x 320 + (y – 1) x 20, x = [13, 15], y = [1, 16]

Each battery module occupies 20 registers. The address range is 25200–26159.

The Huawei-developed lithium battery system supports a maximum of 15 battery cabinets, and each battery cabinet supports a maximum of 16 battery modules.

7.1.2 Alarms and Status Signals

7.1.2.1 System Alarms and Status

Table 7-5 System alarms

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
1	Software package not exist 2	0: Exist 1: Not exist	10	0	R	Critical
2	Batt. cabinet quantity mismatch 2	0: Matched 1: Not matched	10	1	R	Minor
3	Battery cabinet EPO 1	0: Not exist 1: Exist	10	2	R	Critical
4	-	-	-	-	-	-

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
5	Version incompatible 5	0: Normal 1: Abnormal	10	4	R	Critical
6	Version incompatible 6	0: Normal 1: Abnormal	10	5	R	Critical

Table 7-6 System status

No.	Signal ID	State Value	Register Address	Bit Field	Read-write Attribute	Severity
1	BMS test alarm	0: No 1: Yes	14	0	R	
2	Lithium battery system battery EOD 5	0: No 1: Yes	14	1	R	
3	Lithium battery system overtemperature	0: No 1: Yes	14	2	R	
4	Lithium battery system overtemperature protection	0: No 1: Yes	14	3	R	
5	Lithium battery system undertemperature	0: No 1: Yes	14	4	R	
6	Lithium battery system overvoltage	0: No 1: Yes	14	5	R	
7	Lithium battery system overvoltage protection	0: No 1: Yes	14	6	R	
8	Lithium battery system overcurrent	0: No 1: Yes	14	7	R	
9	Lithium battery system undervoltage	0: No 1: Yes	14	8	R	

No.	Signal ID	State Value	Register Address	Bit Field	Read-write Attribute	Severity
10	Lithium battery SOH abnormal	0: No 1: Yes	14	9	R	

NOTE

Items 1–10 in the system status table indicate the comprehensive status instead of actual alarms.

7.1.2.2 Battery Cabinet Alarms and Status

Table 7-7 Alarms of battery cabinet 1

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
1	BCB tripping fault 1	0: Normal 1: Abnormal	2200	0	R	Critical
2	BCB off 4	0: Normal 1: Abnormal	2200	1	R	Critical
3	Battery control unit fault 1	0: Normal 1: Abnormal	2200	2	R	Critical
4	Battery overcurrent protection 1	0: Normal 1: Abnormal	2200	3	R	Critical
5	Battery overcurrent protection 2	0: Normal 1: Abnormal	2200	4	R	Critical
6	Battery cabinet EPO 1	0: Normal 1: Abnormal	2200	5	R	Critical
7	Not ready 4	0: Normal 1: Abnormal	2200	6	R	Critical
8	Battery control unit fault 2	0: Normal 1: Abnormal	2200	7	R	Critical
9	Battery control unit fault 5	0: Normal 1: Abnormal	2200	8	R	Critical

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
10	Abnormal inter-battery cabinet parallel cable 3	0: Normal 1: Abnormal	2200	9	R	Critical
11	Battery overvoltage protection 4	0: Normal 1: Abnormal	2200	10	R	Critical
12	Battery control unit fault 3	0: Normal 1: Abnormal	2200	11	R	Critical
13	Battery control unit fault 4	0: Normal 1: Abnormal	2200	12	R	Critical
14	Abnormal signal board 1	0: Normal 1: Abnormal	2200	13	R	Critical
15	Abnormal inter-battery cabinet parallel cable 1	0: Normal 1: Abnormal	2200	14	R	Critical
16	Abnormal inter-battery cabinet parallel cable 2	0: Normal 1: Abnormal	2200	15	R	Critical
17	Abnormal intra-battery cabinet parallel cable 1	0: Normal 1: Abnormal	2201	0	R	Critical
18	Abnormal intra-battery cabinet parallel cable 2	0: Normal 1: Abnormal	2201	1	R	Critical
19	Battery control unit fault 9	0: Normal 1: Abnormal	2201	2	R	Critical
20	Abnormal signal board 2	0: Normal 1: Abnormal	2201	3	R	Critical
21	Inter-battery cabinet parallel cable alarm 1	0: Normal 1: Abnormal	2201	4	R	Minor
22	Abnormal inter-battery cabinet parallel cable 3	0: Normal 1: Abnormal	2201	5	R	Critical
23	Inter-battery cabinet parallel cable alarm 2	0: Normal 1: Abnormal	2201	6	R	Minor

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
24	Version incompatible 1	0: Normal 1: Abnormal	2201	7	R	Critical
25	Fan abnormal 14	0: Normal 1: Abnormal	2201	8	R	Critical
26	Battery overvoltage 3	0: Normal 1: Abnormal	2201	9	R	Minor
27	Battery overcurrent 2	0: Normal 1: Abnormal	2201	10	R	Minor
28	Low battery voltage 5	0: Normal 1: Abnormal	2201	11	R	Minor
29	Battery overcurrent 3	0: Normal 1: Abnormal	2201	12	R	Minor
30	Battery undervoltage protection 2	0: Normal 1: Abnormal	2201	13	R	Critical
31	Battery overcurrent protection 3	0: Normal 1: Abnormal	2201	14	R	Critical
32	Battery overvoltage protection 5	0: Normal 1: Abnormal	2201	15	R	Critical
33	Battery control unit fault 6	0: Normal 1: Abnormal	2202	0	R	Critical
34	Battery control unit fault 7	0: Normal 1: Abnormal	2202	1	R	Critical
35	Battery control unit fault 8	0: Normal 1: Abnormal	2202	2	R	Critical
36	Version incompatible 2	0: Normal 1: Abnormal	2202	3	R	Critical
37	Version incompatible 3	0: Normal 1: Abnormal	2202	4	R	Critical

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
38	Version incompatible 4	0: Normal 1: Abnormal	2202	5	R	Critical
39	Battery control unit fault 10	0: Normal 1: Abnormal	2202	6	R	Critical
40	Battery control unit fault 11	0: Normal 1: Abnormal	2202	7	R	Critical
41	Battery fuse blown 2	0: Normal 1: Abnormal	2202	8	R	Critical
42	Reserved	-	2202	9~15	R	-
43	Battery reversal 2	0: Normal 1: Abnormal	2248	0	R	Critical
44	Switch off 2	0: Normal 1: Abnormal	2248	1	R	Critical
45	Battery control unit alarm 1	0: Normal 1: Abnormal	2248	2	R	Minor
46	Version incompatible 47	0: Normal 1: Abnormal	2248	3	R	Critical
47	Battery control unit alarm 2	0: Normal 1: Abnormal	2248	4	R	Minor
48	Battery ground fault 3	0: Normal 1: Abnormal	2248	5	R	Critical
49	Reversed	-	2248	6	-	-
50	Battery contactor fault 1	0: Normal 1: Abnormal	2248	7	R	Critical
51	Reversed	-	2248	8	-	-
52	Battery control unit fault 14	0: Normal 1: Abnormal	2248	9	R	Critical
53	Battery control unit alarm 3	0: Normal 1: Abnormal	2248	10	R	Minor

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
54	Battery control unit fault 15	0: Normal 1: Abnormal	2248	11	R	Critical
55	Inner temperature alarm 2	0: Normal 1: Abnormal	2248	12	R	Minor
56	Inner temperature alarm 3	0: Normal 1: Abnormal	2248	13	R	Minor
57	Inner temperature alarm 4	0: Normal 1: Abnormal	2248	14	R	Minor
58	Inner temperature abnormal 12	0: Normal 1: Abnormal	2248	15	R	Critical
59	Inner temperature abnormal 13	0: Normal 1: Abnormal	2249	0	R	Critical
60	Inner temperature abnormal 14	0: Normal 1: Abnormal	2249	1	R	Critical
61	Inner temperature alarm 1	0: Normal 1: Abnormal	2249	2	R	Critical
62	Module quantity mismatch 3	0: Normal 1: Abnormal	2249	3	R	Critical
63	Switch abnormal alarm 1	0: Normal 1: Abnormal	2249	4	R	Minor
64	Switch off 1	0: Normal 1: Abnormal	2249	5	R	Critical
65	Water alarm 2	0: Normal 1: Abnormal	2249	6	R	Critical
66	Battery control unit fault 16	0: Normal 1: Abnormal	2249	7	R	Critical
67	Temperature sensor abnormal 1	0: Normal 1: Abnormal	2249	8	R	Minor
68	Temperature sensor abnormal 2	0: Normal 1: Abnormal	2249	9	R	Minor

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
69	Temperature sensor abnormal 3	0: Normal 1: Abnormal	2249	10	R	Minor
70	Temperature sensor abnormal 4	0: Normal 1: Abnormal	2249	11	R	Minor
71	Temperature sensor abnormal 5	0: Normal 1: Abnormal	2249	12	R	Minor
72	Temperature sensor abnormal 6	0: Normal 1: Abnormal	2249	13	R	Minor
73	Battery control unit fault 17	0: Normal 1: Abnormal	2250	0	R	Critical
74	-	-	2250	1	-	-
75	Copper bar overtemperature 2	0: Normal 1: Abnormal	2250	2	R	Minor
76	Battery control unit fault 18	0: Normal 1: Abnormal	2250	3	R	Critical
77	Incorrect battery module wiring 1	0: Normal 1: Abnormal	2250	4	R	Critical
78	Module quantity mismatch 4	0: Normal 1: Abnormal	2250	5	R	Minor

Table 7-8 Status of battery cabinet 1

No.	Signal ID	State Value	Register Address	Bit Field	Read-write Attribute	Severity
1	Battery Management Module Status	000: Standby 001: Charging 010: Discharging 011: Fault	2203	0	R	
2	Battery Management Module Updating	0: Not upgraded 1: Upgrading	2203	3	R	

No.	Signal ID	State Value	Register Address	Bit Field	Read-write Attribute	Severity
3	Battery Management Module Update Enable	0: Not allowed 1: Allowed	2203	4	R	
4	Inter-battery cabinet RS485 loopback self-check status	0: Self-check has failed or wiring is not for self-check. 1: Self-check is successful.	2203	5	R	
5	Reserved	-	2203	6–15	R	

NOTE

In the HVDC scenario, the battery cabinet refers to the battery string.

The formula for calculating the alarm address of a battery cabinet in the Huawei-developed lithium battery system is as follows:

Calculation of the alarm and status signal address of the battery cabinet (1–12)

Start address of battery cabinet x: 2200 + (x – 1) x 4, x = [1, 12]

Each battery cabinet has three alarm registers and one status register.

Address range: 2200–2247

Three alarm registers and one status register are added for each battery cabinet.

Address range: 2248–2295

Start address: 2248 + (x – 1) x 4, x = [1, 12]

Calculation of the alarm and status signal address of the battery cabinet (13–15)

Start address of battery cabinet x: 22200 + (x – 12 – 1) x 4, x = [13, 15]

Each battery cabinet has three alarm registers and one status register.

Address range: 22200–22211

Three alarm registers and one status register are added for each battery cabinet.

Address range: 22248–22259

Start address: 22248 + (x – 12 – 1) x 4, x = [13, 15]

7.1.2.3 Battery Module Alarms and Status

Table 7-9 Alarms of battery cabinet 1 – battery module 1

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
1	Battery module fault 1	0: Normal 1: Abnormal	2300	0	R	Critical

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
2	Battery module fault 2	0: Normal 1: Abnormal	2300	1	R	Critical
3	Battery module balance alarm 1	0: Normal 1: Abnormal	2300	2	R	Minor
4	Battery module balance alarm 2	0: Normal 1: Abnormal	2300	3	R	Minor
5	Battery EOD 5	0: Normal 1: Abnormal	2300	4	R	Critical
6	Battery undertemperature 2	0: Normal 1: Abnormal	2300	5	R	Minor
7	Battery overtemperature 2	0: Normal 1: Abnormal	2300	6	R	Minor
8	Battery overvoltage 2	0: Normal 1: Abnormal	2300	7	R	Minor
9	Reserved	-	2300	8		
10	Reserved	-	2300	9		
11	Reserved	-	2300	10		
12	Low battery voltage 4	0: Normal 1: Abnormal	2300	11	R	Minor
13	Battery module fault 5	0: Normal 1: Abnormal	2300	12	R	Critical
14	Battery undertemperature protection 1	0: Normal 1: Abnormal	2300	13	R	Critical
15	Battery overtemperature protection 2	0: Normal 1: Abnormal	2300	14	R	Critical
16	Battery overvoltage protection 3	0: Normal 1: Abnormal	2300	15	R	Critical
17	Battery module fault 6	0: Normal 1: Abnormal	2301	0	R	Critical
18	Reserved	-	2301	1	R	

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
19	Reserved	-	2301	2	R	
20	Battery undervoltage protection 1	0: Normal 1: Abnormal	2301	3	R	Critical
21	Battery module fault 7	0: Normal 1: Abnormal	2301	4	R	Critical
22	Battery module balance alarm 3	0: Normal 1: Abnormal	2301	5	R	Minor
23	Battery EOD 6	0: Normal 1: Abnormal	2301	6	R	Critical
24	Abnormal SOH 3	0: Normal 1: Abnormal	2301	7	R	Minor
25	Reserved	-	2301	8~15	R	-
26	Version incompatible 46	0: Normal 1: Abnormal	3068	0	R	Critical
27	Battery module fault 8	0: Normal 1: Abnormal	3068	1	R	Critical
28	Battery module fault 9	0: Normal 1: Abnormal	3068	2	R	Critical
29	Battery module alarm 1	0: Normal 1: Abnormal	3068	3	R	Minor
30	Intra-battery cabinet parallel cable alarm 1	0: Normal 1: Abnormal	3068	4	R	Minor
31	Battery module alarm 3	0: Normal 1: Abnormal	3068	5	R	Minor
32	Battery module alarm 3	0: Normal 1: Abnormal	3068	6	R	Minor
33	Battery module alarm 4	0: Normal 1: Abnormal	3068	7	R	Minor
34	Battery module alarm 5	0: Normal 1: Abnormal	3068	8	R	Minor

No.	Signal ID	Alarm Value	Register Address	Bit Field	Read-write Attribute	Severity
35	Battery module alarm 6	0: Normal 1: Abnormal	3068	9	R	Minor
36	Battery module alarm 7	0: Normal 1: Abnormal	3068	10	R	Minor
37	Battery module fault 10	0: Normal 1: Abnormal	3068	11	R	Critical
38	Inner temperature abnormal 11	0: Normal 1: Abnormal	3068	12	R	Critical
39	Inner temperature alarm 1	0: Normal 1: Abnormal	3068	13	R	Minor

Table 7-10 Status of battery cabinet 1 – battery module 1

No.	Signal ID	State Value	Register Address	Bit Field	Read-write Attribute	Severity
1	Updating	0: Upgrading 1: Not upgraded	2302	0	R	
2	Battery module not detected	0: Detected 1: Not detected	2302	1	R	
3	Reserved	-	2302	2~15	R	-
4	Reserved	-	2303	-	R	-

NOTE

In the HVDC scenario, the battery cabinet refers to the battery string.

The formula for calculating the analog signal address of a battery module in the Huawei-developed lithium battery system is as follows:

Calculation of the alarm and status signal address of the battery cabinet module (1–12)

Start address of battery cabinet x – battery module y: 2300 + (x – 1) x 64 + (y – 1) x 4, x = [1, 12], y = [1, 16]

Each battery module has two alarm registers and two status registers.

Address range: 2300–3067

Two alarm registers are added for each battery module.

Address range: 3068–3451

Start address: 3068 + (x – 1) x 2 x 16 + (y – 1) x 2, x = [1, 12], y = [1, 16]

Calculation of the alarm and status signal address of the battery cabinet module (13–15)

Start address of battery cabinet x – battery module y: 22300 + (x – 12 – 1) x 64 + (y – 1) x 4, x = [13, 15], y = [1, 16]

Each battery module has two alarm registers and two status registers.

Address range: 22300–22311

Two alarm registers are added for each battery module.

Address range: 23068–23073

Start address: 23068 + (x – 12 –1) x 2 x 16 + (y – 1) x 2, x = [13, 15], y = [1, 16]

The Huawei-developed lithium battery system supports a maximum of 15 battery cabinets, and each battery cabinet supports a maximum of 16 battery modules.

