ETICA BATTERY INC.

Tentative Specifications

ETICA DCC NO. SPE-230017

Client	
Client P/N	
Model	ETICA 儲能電池櫃
Description	電池櫃通訊協定
P/N	
Client Approval	

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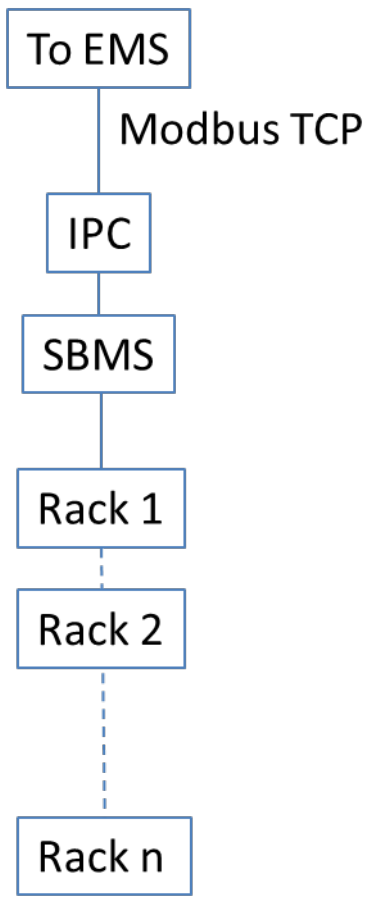
ETICA BATTERY

Revision History

Revision	Description	Date
1	Initial Release (Tentative)	2023/12/04
1.01	修正 3.1.3 register address 的 byte size ESBMM 名稱統一為 Module	2024/01/23
1.1	新增 Cell 溫度、電壓、SOC、SOH、Rack 端子溫度	2024/01/24
1.2	新增消防系統(FFS)觸發級數	2024/01/31
1.21	修正 Cell 電壓文字敘述	2024/02/01
1.22	修正 3.1.6 register address 與 3.1.7 SBMS System Level Data Information (input register) 中錯誤的 Hex Address	2024/02/17
1.3	新增環控點位	2024/05/09
1.31	新增附件 BMS 告警參數	2024/05/15
1.4	更新液位計相關告警/保護點位、貨櫃 IO 告警/保護	2024/05/21
1.5	新增 IPC 與 EMS 心跳寫入點位、DC Switch 控制點位	2024/07/17
1.51	修改附件 BMS 告警參數	2024/08/13
1.6	新增環控 Rack 冷卻系統循環狀態點位	2024/08/22
1.61	新增 BMS 告警參數的系統狀態對應行為	2024/08/23

Contents

1 System Architecture



* IPC = Industrial PC
* SBMS =Battery Management Unit
* RACK = Battery Module Cluster

2 Protocol

2.1 Modbus TCP

2.1.1 Modbus PDU Frame Format

Function Code	Function-Specific Data
1byte	N bytes(N≤253)

2.1.2 Modbus TCP Frame Format

Transaction Identifier	Protocol identifier	Data length	Unit Identifier	Data(Modbus PDUs)
2bytes	2bytes	2bytes	1byte	N bytes (N≤253)

2.1.3 Modbus Function Code

Function code (hex)	Definition	Function description
0x02h	Read discrete Inputs registers	Host computer reads data of guest computer
0x03h	Read multiple registers	Host computer reads data of guest computer
0x04h	Read input registers	Host computer reads data of guest computer
0x10h	Write multiple registers	Host computer modifies data of guest computer
0x06h	Write single register	Host computer modifies data of guest computer

2.1.4 Modbus Data Model Blocks

Memory Block	Data Type	Master Access	Slave Access
Coils	Boolean	Read/Write	Read/Write
Discrete Inputs	Boolean	Read-only	Read/Write
Holding Registers	Unsigned Word	Read/Write	Read/Write
Input Registers	Unsigned Word	Read-only	Read/Write

3 Modbus TCP Register Table

3.1 BMS Cluster Register Table

3.1.1 BMS Cluster Discrete Input Register Address Distribution

No	Target	Register address(hex)	Register address(dec)	Byte	Variable description
1	SBMS	0x0000 - 0x0050	0 ~ 80	162	SBMS system data information
2	RACK 1	0x00C8 ~ 0x0120	200 ~ 288	178	String 1 data information
3	RACK 2	0x012C ~ 0x0184	300 ~ 388	178	String 2 data information
4	RACK 3	0x0190 ~ 0x01E8	400 ~ 488	178	String 3 data information
5	RACK n	-	100 + (100 * n) ~ 100 +(100 * n) + 88	178	String n data information

3.1.2 BMS Cluster Holding Register Address Distribution

No	Target	Register address(hex)	Register address(dec)	Byte	Variable description
1	SBMS	0x01F4 - 0x212	500 ~ 530	62	SBMS system data information

3.1.3 BMS Cluster Input Register Address Distribution

No	Target	Register address(hex)	Register address(dec)	Byte	Variable description
1	SBMS	0x0001 ~ 0x002F	1 ~ 47	96	SBMS system data information
2	RACK 1	0x0064 ~ 0x0C12	100 ~ 3090	5982	String 1 data information
3	RACK 2	0x0C1C ~ 0x17CA	3100 ~ 6090	5982	String 2 data information
4	RACK 3	0x17D4 ~ 0x2382	6100 ~ 9090	5982	String 3 data information
5	RACK n	-	3000 * (n - 1) + 100 ~ 3000 * n + 90	5982	String n data information

3.1.4 BMS Cluster Overall Data Format Definition

No	Data type	Ratio factor	Range	Offset	Actual span	Data quantity	Comment
1	Alarm	-	0 ~ 1	0	0: inactive 1: active	1byte	
2	Total voltage	0.1V/bit	0 ~15000	0	0 ~ 1500v	2byte	
3	System current	0.1A/bit	0 ~ 32000	-16000	-1600 ~ 1600A	2byte	Negative current means PCS is charging the battery system, Positive current means PCS is discharging battery system.
4	Allowable current	0.1A/bit	0~16000	0	0 ~ 1600A	2byte	
5	SOC	1%/bit	0 ~ 100	0	0 ~ 100%	2byte	
6	SOH	1%/bit	0 ~ 100	0	0 ~ 100%	2byte	
7	Single cell temperature	1℃/bit	0 ~ 240	-40	-40 ~ 200℃	2byte	
8	Single cell voltage	0.001v/bit	0 ~5000	0	0 ~ 5v	2byte	
9	Heartbeats	1/bit	0 ~ 65535	0	0 ~ 65535	2byte	
10	RTC-Year	-	0 ~ 100	2000	2000 ~ 2100	2byte	
11	Charge / discharge capacity	0.1 KWh/bit	0 ~ (2^{32}-1)	0	0 ~ (2^{32}-1)*0.1KW-	4byte	
12	Charge / discharge power	0.1 KW/bit	0 ~ 65535	0	0 ~ 6553.5KW	2byte	

3.1.5 SBMS System Level Alarm Summary (discrete input register)

No	Address(hex)	Address(dec)	Byte	Description	Comment
1	0x0001	1	1	Summary of total voltage undervoltage slight alarm at each string	0: inactive 1: active
2	0x0002	2	1	Summary of total voltage undervoltage medium alarm at each string	0: inactive 1: active
3	0x0003	3	1	Summary of total voltage undervoltage serious alarm at each string	0: inactive 1: active
4	0x0004	4	1	Summary of total voltage overvoltage slight alarm at each string	0: inactive 1: active
5	0x0005	5	1	Summary of total voltage overvoltage medium alarm at each string	0: inactive 1: active
6	0x0006	6	1	Summary of total voltage overvoltage serious alarm at each string	0: inactive 1: active
7	0x0007	7	1	Summary of overcurrent slight alarm at each string	0: inactive 1: active
8	0x0008	8	1	Summary of overcurrent medium alarm at each string	0: inactive 1: active
9	0x0009	9	1	Summary of overcurrent serious alarm at each string	0: inactive 1: active
10	0x000A	10	1	Summary of low insulation resistance slight alarm at each string	0: inactive 1: active
11	0x000B	11	1	Summary of low insulation resistance medium alarm at each string	0: inactive 1: active
12	0x000C	12	1	Summary of low insulation resistance serious alarm at each string	0: inactive 1: active
13	0x000D	13	1	Summary of module Low temperature slight alarm at each string	0: inactive 1: active
14	0x000E	14	1	Summary of module Low temperature medium alarm at each string	0: inactive 1: active
15	0x000F	15	1	Summary of module Low temperature serious alarm at each string	0: inactive 1: active
16	0x0010	16	1	Summary of module over temperature slight alarm at each string	0: inactive 1: active
17	0x0011	17	1	Summary of module over temperature medium alarm at each string	0: inactive 1: active
18	0x0012	18	1	Summary of module over temperature serious alarm at each string	0: inactive 1: active
19	0x0013	19	1	Summary of cell over voltage slight alarm at each string	0: inactive 1: active
20	0x0014	20	1	Summary of cell over voltage medium alarm at each string	0: inactive 1: active
21	0x0015	21	1	Summary of cell over voltage serious alarm at each string	0: inactive 1: active
22	0x0016	22	1	Summary of cell low voltage slight alarm at each string	0: inactive 1: active
23	0x0017	23	1	Summary of cell low voltage medium alarm at each string	0: inactive 1: active
24	0x0018	24	1	Summary of cell low voltage serious alarm at each string	0: inactive 1: active
25	0x0019	25	1	Summary of cell differential voltage slight alarm at each string	0: inactive 1: active
26	0x001A	26	1	Summary of cell differential voltage medium alarm at each string	0: inactive 1: active
27	0x001B	27	1	Summary of cell differential voltage serious alarm at each string	0: inactive 1: active
28	0x001C	28	1	Summary of cell low temperature slight alarm at each string	0: inactive 1: active
29	0x001D	29	1	Summary of cell low temperature medium alarm at each string	0: inactive 1: active
30	0x001E	30	1	Summary of cell low temperature serious alarm at each string	0: inactive 1: active
31	0x001F	31	1	Summary of cell over temperature slight alarm at each string	0: inactive 1: active
32	0x0020	32	1	Summary of cell over temperature medium alarm at each string	0: inactive 1: active
33	0x0021	33	1	Summary of cell over temperature serious alarm at each string	0: inactive 1: active
34	0x0022	34	1	Summary of cell differential temperature slight alarm at each string	0: inactive 1: active
35	0x0023	35	1	Summary of cell differential temperature medium alarm at each string	0: inactive 1: active
36	0x0024	36	1	Summary of cell differential temperature serious alarm at each string	0: inactive 1: active
37	0x0025	37	1	Summary of cell SOC low slight alarm at each string	0: inactive 1: active
38	0x0026	38	1	Summary of cell SOC low medium alarm at each string	0: inactive 1: active
39	0x0027	39	1	Summary of cell SOC low serious alarm at each string	0: inactive 1: active
40	0x0028	40	1	Summary of cell SOC high slight alarm at each string	0: inactive 1: active
41	0x0029	41	1	Summary of cell SOC high medium alarm at each string	0: inactive 1: active
42	0x002A	42	1	Summary of cell SOC High serious alarm at each string	0: inactive 1: active

43	0x002B	43	1	Summary of cell SOH low slight alarm at each string	0: inactive 1: active
44	0x002C	44	1	Summary of cell SOH Low medium alarm at each string	0: inactive 1: active
45	0x002D	45	1	Summary of cell SOH low serious alarm at each string	0: inactive 1: active
46	0x002E	46	1	Summary of cell SOH high slight alarm at each string	0: inactive 1: active
47	0x002F	47	1	Summary of cell SOH high medium alarm at each string	0: inactive 1: active
48	0x0030	48	1	Summary of cell SOH high serious alarm at each string	0: inactive 1: active
49	0x0031	49	1	RACK lost communication	0: inactive 1: active
50	0x0032	50	1	Module Lost Communication	0: inactive 1: active
51	0x0033	51	1	Abnormal voltage of each string in the system (the total voltage difference between strings is greater than 20V)	0: inactive 1: active
52	0x0034	52	1	Abnormal disconnection of contactor	0: inactive 1: active
53	0x0035	53	1	Abnormal closing of contactor	0: inactive 1: active
54	0x0036	54	1	Charging prohibited	0: inactive 1: active
55	0x0037	55	1	Discharging prohibited	0: inactive 1: active
56	0x0038	56	1	BMS system alarm summary	0: inactive 1: active
57	0x0039	57	1	Summary of BMS system faults	0: inactive 1: active
58	0x003A ~ 0x0045	58~69	12	Reserved	0: inactive 1: active
59	0x0046	70	1	Summary of terminal over temperature slight alarm at each string	0: inactive 1: active
60	0x0047	71	1	Summary of terminal over temperature medium alarm at each string	0: inactive 1: active
61	0x0048	72	1	Summary of terminal over temperature serious alarm at each string	0: inactive 1: active
62	0x0049	73	1	Summary of pack voltage overvoltage slight alarm at each string	0: inactive 1: active
63	0x004A	74	1	Summary of pack voltage overvoltage medium alarm at each string	0: inactive 1: active
64	0x004B	75	1	Summary of pack voltage overvoltage serious alarm at each string	0: inactive 1: active
65	0x004C	76	1	Summary of pack voltage undervoltage slight alarm at each string	0: inactive 1: active
66	0x004D	77	1	Summary of pack voltage undervoltage medium alarm at each string	0: inactive 1: active
67	0x004E	78	1	Summary of pack voltage undervoltage serious alarm at each string	0: inactive 1: active
68	0x004F	79	1	Cell voltage acquisition fault	0: inactive 1: active
69	0x0050	80	1	Cell Temperature acquisition fault	0: inactive 1: active

3.1.6 SBMS System Level Data Information (holding register)

No	Address(hex)	Address(dec)	Byte	Description	Comment
1	0x01F4	500	2	String number	1 ~ 20
2	0x01F5	501	2	System fault reset	0: Do not reset 1: Reset other values: Invalid
3	0x01F6	502	2	Main circuit braker control	0: No operation 1: Closing 2: Opening Other values: Invalid
4	0x01F7	503	2	System power up and down control command	0: No operation 1: Power on 2: Power off Other values: Invalid Note: It is not used by default, and the reactor is powered on automatically after power supply. If necessary, please specify in the project docking stage

5	0x01F8	504~523	2 (per string)	String N maintenance mode control	0: invalid 1: power on 2: power off N range: 1~20 ---only one cluster can be maintained at the same time;
6	0x020C	524	2	RTC-Year	data field: 0 ~ 100
7	0x020D	525	2	RTC-Month	data field: 1 ~ 12
8	0x020E	526	2	RTC-Day	data field: 1 ~ 31
9	0x020F	527	2	RTC-Hour	data field: 0 ~ 23
10	0x0210	528	2	RTC-Minute	data field: 0 ~ 60
11	0x0211	529	2	RTC-Second	data field: 0 ~ 60
12	0x0212	530	2	HeartBeat	

3.1.7 SBMS System Level Data Information (input register)

No	Address(hex)	Address(dec)	Byte	Description	Comment
1	0x0001	1	2	System circuit braker status	1: Closing 0: opening (the project needs electric operation feedback node)
2	0x0002	2	2	System total voltage	0.1V/bit
3	0x0003	3	2	System Current	0.1A/bit Offset: -1600.0A
4	0x0004	4	2	System SOC	1%/bit
5	0x0005	5	2	System SOH	1%/bit
6	0x0006	6	2	Maximum cell voltage	0.001V/bit
7	0x0007	7	2	String number of maximum voltage cell	
8	0x0008	8	2	Point number of maximum voltage cell	
9	0x0009	9	2	Minimum cell voltage	0.001V/bit
10	0x000A	10	2	String number of minimum voltage cell	
11	0x000B	11	2	Point number of minimum voltage cell	
12	0x000C	12	2	Maximum cell temperature	1℃/bit Offset: -40℃
13	0x000D	13	2	String number of maximum cell temperature	
14	0x000E	14	2	Point number of maximum cell temperature	
15	0x000F	15	2	Minimum cell temperature	1℃/bit Offset: -40℃
16	0x0010	16	2	String number of minimum cell temperature	
17	0x0011	17	2	Point number of minimum cell temperature	
18	0x0012 ~ 0x0013	18~19	4	System Accumulated charging capacity	0.1KWh/bit
19	0x0014 ~ 0x0015	20~21	4	System Accumulated discharging capacity	0.1KWh/bit
20	0x0016 ~ 0x0017	22~23	4	System Accumulated charge quantity for a single time	0.1KWh/bit
21	0x0018 ~ 0x0019	24~25	4	System Accumulated discharge quantity for a single time	0.1KWh/bit
22	0x001A ~ 0x001B	26~27	4	System Rechargeable capacity	0.1KWh/bit
23	0x001C ~ 0x001D	28~29	4	System Discharge capacity	0.1KWh/bit
24	0x001E ~ 0x001F	30~31	4	Reserved	
25	0x0020	32	2	Allowable maximum discharge power	0.1KW/bit

26	0x0021	33	2	Allowable maximum charge power	0.1KW/bit
27	0x0022	34	2	Allowable maximum discharge current	0.1A/bit
28	0x0023	35	2	Allowable maximum charge current	0.1A/bit
29	0x0024	36	2	Discharge times of the day	
30	0x0025	37	2	charge times of the day	
31	0x0026 ~ 0x0027	38~39	4	Discharge quantity of the day	0.1KWh/bit
32	0x0028 ~ 0x0029	40~41	4	Charge quantity of the day	0.1KWh/bit
33	0x002A	42	2	Operating temperature	1℃/bit offset：-40℃
34	0x002B	43	2	System State	0x00: initial state 0x01: charging 0x02: discharging 0x03: ready 0x04: cluster maintenance 0x05: charge prohibition 0x06: discharge prohibition 0x07: Charging and discharging prohibited 0x08: Fault 0x09: Fault recovery 0x0A: test mode 0x0B: power-off 0x0C: Power-off complete Other values: reserved
35	0x002C	44	2	Charge discharge state	0x00: Others 0x01: Discharge 0x02: Charge
36	0x002D	45	2	System Insulation resistance	1KΩ/bit
37	0x002E	46	2	PCS and BMS communication failure	0x01: communication loss 0x00: communication is normal
38	0x002F	47	2	EMS and BMS communication failure	0x01: communication loss 0x00: communication is normal

3.1.8 RACK String Level Warning (discrete input register)

Address field exemplified by string 1					
No	Address(hex)	Address(dec)	Byte	Description	Comment
1	0x00C8	200	1	String N RACK lost communication	0: inactive 1: active
2	0x00C9	201	1	String N total voltage undervoltage slight alarm	0: inactive 1: active
3	0x00CA	202	1	String N total voltage undervoltage medium alarm	0: inactive 1: active
4	0x00CB	203	1	String N total voltage undervoltage serious alarm	0: inactive 1: active
5	0x00CC	204	1	String N total voltage overvoltage slight alarm	0: inactive 1: active
6	0x00CD	205	1	String N total voltage overvoltage medium alarm	0: inactive 1: active
7	0x00CE	206	1	String N total voltage overvoltage serious alarm	0: inactive 1: active
8	0x00CF	207	1	String N overcurrent slight alarm	0: inactive 1: active
9	0x00D0	208	1	String N overcurrent medium alarm	0: inactive 1: active
10	0x00D1	209	1	String N overcurrent serious alarm	0: inactive 1: active
11	0x00D2	210	1	String N cell voltage undervoltage slight alarm	0: inactive 1: active
12	0x00D3	211	1	String N cell voltage undervoltage medium alarm	0: inactive 1: active

13	0x00D4	212	1	String N cell voltage undervoltage serious alarm	0: inactive 1: active
14	0x00D5	213	1	String N cell voltage overvoltage slight alarm	0: inactive 1: active
15	0x00D6	214	1	String N cell voltage overvoltage medium alarm	0: inactive 1: active
16	0x00D7	215	1	String N cell voltage overvoltage serious alarm	0: inactive 1: active
17	0x00D8	216	1	String N cell low temperature slight alarm	0: inactive 1: active
18	0x00D9	217	1	String N cell low temperature medium alarm	0: inactive 1: active
19	0x00DA	218	1	String N cell low temperature serious alarm	0: inactive 1: active
20	0x00DB	219	1	String N cell over temperature slight alarm	0: inactive 1: active
21	0x00DC	220	1	String N cell over temperature medium alarm	0: inactive 1: active
22	0x00DD	221	1	String N cell over temperature serious alarm	0: inactive 1: active
23	0x00DE	222	1	String N cell SOC low slight alarm	0: inactive 1: active
24	0x00DF	223	1	String N cell SOC low medium alarm	0: inactive 1: active
25	0x00E0	224	1	String N cell SOC low serious alarm	0: inactive 1: active
26	0x00E1	225	1	String N cell SOC High slight alarm	0: inactive 1: active
27	0x00E2	226	1	String N cell SOC High medium alarm	0: inactive 1: active
28	0x00E3	227	1	String N cell SOC High serious alarm	0: inactive 1: active
29	0x00E4	228	1	String N cell SOH Low slight alarm	0: inactive 1: active
30	0x00E5	229	1	String N cell SOH Low medium alarm	0: inactive 1: active
31	0x00E6	230	1	String N cell SOH Low serious alarm	0: inactive 1: active
32	0x00E7	231	1	String N cell voltage different slight alarm	0: inactive 1: active
33	0x00E8	232	1	String N cell voltage different medium alarm	0: inactive 1: active
34	0x00E9	233	1	String N cell voltage different serious alarm	0: inactive 1: active
35	0x00EA	234	1	String N cell temperature different slight alarm	0: inactive 1: active
36	0x00EB	235	1	String N cell temperature different medium alarm	0: inactive 1: active
37	0x00EC	236	1	String N cell temperature different serious alarm	0: inactive 1: active
38	0x00ED ~ 0x0114	237 ~ 276	1	Reserved	0: inactive 1: active
39	0x0115	277	1	String N terminal temperature high slight alarm	0: inactive 1: active
40	0x0116	278	1	String N terminal temperature high medium alarm	0: inactive 1: active
41	0x0117	279	1	String N terminal temperature high serious alarm	0: inactive 1: active
42	0x0118	280	1	String N pack voltage overvoltage slight alarm	0: inactive 1: active
43	0x0119	281	1	String N pack voltage overvoltage medium alarm	0: inactive 1: active
44	0x011A	282	1	String N pack voltage overvoltage serious alarm	0: inactive 1: active
45	0x011B	283	1	String N pack voltage undervoltage slight alarm	0: inactive 1: active
46	0x011C	284	1	String N pack voltage undervoltage medium alarm	0: inactive 1: active
47	0x011D	285	1	String N pack voltage undervoltage serious alarm	0: inactive 1: active
48	0x011E	286	1	String N cell voltage acquisition fault	0: inactive 1: active
49	0x011F	287	1	String N cell temperature acquisition fault	0: inactive 1: active

3.1.9 RACK String Level Data Information (input register)

Address field exemplified by string 1					
No	Address(hex)	Address(dec)	Byte	Description	Comment
1	0x0064	100	2	String N state	0x00: initial state 0x01: charging 0x02: discharging 0x03: ready 0x04: cluster maintenance

					0x05: charge prohibition 0x06: discharge prohibition 0x07: Charging and discharging prohibited 0x08: Fault 0x09: Fault recovery 0x0A: test mode Other values: reserved
2	0x0065	101	2	String N maximum allowable charging power	
3	0x0066	102	2	String N maximum allowable discharging power	
4	0x0067	103	2	String N maximum allowable charging voltage	
5	0x0068	104	2	String N maximum allowable discharging voltage	
6	0x0069	105	2	String N maximum allowable charging current	
7	0x006A	106	2	String N maximum allowable discharging current	
8	0x006B ~ 0x0072	107 ~ 114	16	Reserved	
9	0x0073	115	2	String N total voltage	
10	0x0074	116	2	String N current	
11	0x0075	117	2	Sting N`s RACK module temperature	
12	0x0076	118	2	String N SOC	
13	0x0077	119	2	String N SOH	
14	0x0078	120	2	String N insulation resistance	
15	0x0079	121	2	String N average cell voltage	
16	0x007A	122	2	String N average cell temperature	
17	0x007B	123	2	String N maximum cell voltage	
18	0x007C	124	2	Cell Number of string N maximum cell voltage	
19	0x007D	125	2	String N minimum cell voltage	
20	0x007E	126	2	Number of string N minimum cell voltage	
21	0x007F	127	2	String N maximum cell temperature	
22	0x0080	128	2	Number of string N maximum cell temperature	
23	0x0081	129	2	String N minimum cell temperature	
24	0x0082	130	2	Number of string N minimum cell temperature	
25	0x0083	131	2	String N maximum cell SOC	
26	0x0084	132	2	Number of String N maximum cell SOC	
27	0x0085	133	2	String N minimum cell SOC	
28	0x0086	134	2	Number of string N minimum cell SOC	
29	0x0087	135	2	String N maximum cell SOH	
30	0x0088	136	2	Number of String N maximum cell SOH	
31	0x0089	137	2	String N minimum cell SOH	
32	0x008A	138	2	Number of string N minimum cell SOH	
33	0x008B ~ 0x008C	139 ~ 140	4	String N accumulated charging capacity	
34	0x008D ~ 0x008E	141 ~ 142	4	String N accumulated discharging capacity	
35	0x008F ~ 0x0090	143 ~ 144	4	String N accumulated charge quantity for a single time	
36	0x0091 ~ 0x0092	145 ~ 146	4	String accumulated discharge quantity for a single time	
37	0x0093 ~ 0x0094	147 ~ 148	4	String N rechargeable capacity	
38	0x0095 ~ 0x0096	149 ~ 150	4	String N discharge capacity	
39	0x0097	151	2	String N pack 1 SOC	1, 2, 3... sequentially arranged in ascending order up to 40.

40	0x0098	152	2	String N pack 2 SOC	
41	0x00BE	190	2	String N pack 40 SOC	
42	0x00BF	191	2	String N cell voltage 001	1, 2, 3... sequentially arranged in ascending order up to 700.
…					
43	0x037A	890	2	String N cell voltage 700	
44	0x037B	891	2	String N cell 001 temperature	1, 2, 3... sequentially arranged in ascending order up to 700.
45	0x037C	892	2	String N cell 002 temperature	
…					
46	0x0636	1590	2	String N cell 700 temperature	
47	0x0637	1591	2	String N cell 001 SOC	
48	0x0638	1592	2	String N cell 002 SOC	1, 2, 3... sequentially arranged in ascending order up to 700
…					
49	0x08F2	2290	2	String N cell 700 SOC	
50	0x08F3	2291	2	String N cell 001 SOH	1, 2, 3... sequentially arranged in ascending order up to 700
51	0x08F4	2292	2	String N cell 002 SOH	
…					
52	0x0BAE	2990	2	String N cell 700 SOH	
…					
55	0x0C12	3090	2	Reserved	

3.2 Fire Fighting System Register Table

3.2.1 FFS Holding Register Address Distribution

No	Target	Register address(hex)	Register address(dec)	Byte	Variable description
1	FFS	0x100	256	2	FFS Alarm Information

3.2.2 FFS Data Formation

No	Data type	Ratio factor	Range	Offset	Actual span	Data quantity	Comment
1	Alarm	-	bit 0 ~ bit 15	-	0: all bits inactive 1: bit 0 active 2: bit 1 active 3: bit0 & bit1 active	2byte	

3.2.3 FFS Alarm Information(holding register)

No	Address(hex)	Address(dec)	Byte	Description	Comment
1	0x0100	256	2	Fire Fighting System Alarm	bit 0: level 1 triggered bit 1: level 2 triggered bit 2: level 3 triggered bit 3: level 4 triggered

3.3 Environmental Controls Register Table

3.3.1 Environmental Controls Holding Register Address Distribution

No	Target	Register address(hex)	Register address(dec)	Byte	Variable description
1	PLC	0x000 ~ 0x009	0 ~ 9	20	Environmental controls writable variables
2	PLC	0x00A ~ 0x0FF	10 ~ 255	490	Environmental controls Information

3.3.2 Environmental Controls Holding Data Formation

No	Data type	Ratio factor	Range	Offset	Actual span	Data quantity	Comment
1	Heartbeats	1/bit	0 ~ 255	0	0 ~ 255	2byte	Heartbeats
2	溫度	0.1℃/bit	0 ~ 1000	0	0 ~ 100℃	2byte	
3	濕度	0.1%/bit	0 ~ 1000	0	0 ~ 100%	2byte	
4	氣體濃度	1ppm/bit	0~65535	0	0 ~ 65535ppm	2byte	

3.3.3 Environmental Controls Writable Variables(holding register)

No	Address(hex)	Address(dec)	Byte	Description	Comment
1	0x000	0	2	空調遠端操作	0=OFF 1=ON bit0=遠端操作-空調 A bit1=遠端操作-空調 B
2	0x001	1	2	排風扇遠端操作	0=OFF 1=ON bit0=遠端操作-排風扇 A bit1=遠端操作-排風扇 B
3	0x002	2	2	貨櫃溫度上限設定	0.1℃/bit 數值範圍:0~1000
4	0x003 ~ 0x004	3~4	4	保留	
5	0x005	5	2	DC Switch 遠端操作	Bit0=遠端操作 DC Switch OFF(斷開) Bit1-遠端操作 DC Switch ON(投入)
6	0x006 ~ 0x009	6~9	8	保留	

3.3.4 Environmental Controls Information(holding register)

No	Address(hex)	Address(dec)	Byte	Description	Comment
1	0x00A	10	2	告警 01-貨櫃 IO	bit0=告警-貨櫃緊急停止 bit1=告警-消防故障 bit2=告警-消防 1 階火警 bit3=告警-消防 2 階火警 bit4=告警-貨櫃淹水 bit5=告警-貨櫃門禁異常 bit6=預留 bit7=預留 bit8=告警-甲丙烷濃度過高 bit9=預留 bit10=預留 bit11=告警-SPD 觸發 bit12=預留 bit13=預留

					bit14=預留 bit15=預留
2	0x00B	11	2	告警 02-貨櫃 IO	bit0=告警-RACK1 油箱液位異常 bit1=告警-RACK2 油箱液位異常 bit2=告警-RACK3 油箱液位異常 bit3=告警-RACK4 油箱液位異常 bit4=告警-RACK5 油箱液位異常 bit5=告警-RACK6 油箱液位異常 bit6=告警-RACK7 油箱液位異常 bit7=告警-RACK8 油箱液位異常 bit8=告警-RACK9 油箱液位異常 bit9=預留 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
3	0x00C	12	2	告警 03-溫溼度	bit0=告警-溫溼度計 A 溫度過高 bit1=告警-溫溼度計 A 溫度過低 bit2=告警-溫溼度計 A 濕度過高 bit3=預留 bit4=告警-溫溼度計 B 溫度過高 bit5=告警-溫溼度計 B 溫度過低 bit6=告警-溫溼度計 B 濕度過高 bit7=預留 bit8=告警-溫室度計 A 通訊異常 bit9=告警-溫室度計 B 通訊異常 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
4	0x00D	13	2	告警 04-氫氣偵測	bit0=告警-氫氣濃度過高 bit1=告警-氫氣偵測器通訊異常 bit2=預留 bit3=預留 bit4=預留 bit5=預留 bit6=預留 bit7=預留 bit8=預留 bit9=預留 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
5	0x00E	14	2	保護 05-AC/DC 電錶	bit0=預留 bit1=保護-輔電停電異常 bit2=告警-AC 電錶通訊異常 bit3=預留 bit4=保護-DC 電錶通訊異常 bit5=預留

					bit6=預留 bit7=預留 bit8=保護-BCU 已上電輔電電壓異常 bit9=保護--BCU 已上電輔電停電異常 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
6	0x00F	15	2	告警 06-UPS	bit0=告警-UPS 機組故障 bit1=告警-UPS 容量過低 bit2=告警-UPS 市電異常 bit3=告警-UPS 通訊異常 bit4=預留 bit5=預留 bit6=預留 bit7=預留 bit8=告警-BCU 已上電 UPS 容量過低 bit9=告警-BCU 已上電 UPS 通訊異常 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
7	0x010	16	2	告警 07-空調	bit0=告警-空調 A 設備故障 bit1=告警-空調 A 通訊異常 bit2=告警-空調 B 設備故障 bit3=告警-空調 B 通訊異常 bit4=預留 bit5=預留 bit6=預留 bit7=預留 bit8=告警-BCU 已上電空調 A 通訊異常 bit9=告警-BCU 已上電空調 B 通訊異常 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
8	0x011	17	2	告警 08(預留)	
9	0x012	18	2	告警 09-系統	bit0=告警-IPC 通訊異常 bit1=告警-SBMS 通訊異常 bit2=預留 bit3=預留 bit4=預留 bit5=預留 bit6=預留 bit7=預留 bit8=告警-BCU 已上電 IPC 通訊異常 bit9=告警-BCU 已上電 SBMS 通訊異常 bit10=預留 bit11=預留 bit12=預留

					bit13=預留 bit14=預留 bit15=預留
10	0x013 ~ 0x01D	19~29	22	預留	
11	0x01E	30	2	保護 01-貨櫃 IO	bit0=保護-貨櫃緊急停止 bit1=保護-消防故障 bit2=保護-消防 1 階火警 bit3=保護-消防 2 階火警 bit4=保護-貨櫃淹水 bit5=保護-貨櫃門禁異常 bit6=預留 bit7=預留 bit8=保護-甲丙烷濃度過高 bit9=預留 bit10=預留 bit11=保護-SPD 觸發 bit12=預留 bit13=預留 bit14=預留 bit15=預留
12	0x01F	31	2	保護 02-貨櫃 IO	bit0=保護-RACK1 油箱液位異常(預留) bit1=保護-RACK2 油箱液位異常(預留) bit2=保護-RACK3 油箱液位異常(預留) bit3=保護-RACK4 油箱液位異常(預留) bit4=保護-RACK5 油箱液位異常(預留) bit5=保護-RACK6 油箱液位異常(預留) bit6=保護-RACK7 油箱液位異常(預留) bit7=保護-RACK8 油箱液位異常(預留) bit8=保護-RACK9 油箱液位異常(預留) bit9=預留 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
13	0x020	32	2	保護 03-溫溼度	bit0=保護-溫溼度計 A 溫度過高 bit1=保護-溫溼度計 A 溫度過低 bit2=保護-溫溼度計 A 濕度過高 bit3=預留 bit4=保護-溫溼度計 B 溫度過高 bit5=保護-溫溼度計 B 溫度過低 bit6=保護-溫溼度計 B 濕度過高 bit7=預留 bit8=保護-溫室度計 A 通訊異常 bit9=保護-溫室度計 B 通訊異常 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
14	0x021	33	2	保護 04-氫氣偵測	bit0=保護-氫氣濃度過高 bit1=保護-氫氣偵測器通訊異常 bit2=預留 bit3=預留

					bit4=預留 bit5=預留 bit6=預留 bit7=預留 bit8=預留 bit9=預留 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
15	0x022	34	2	保護 05-AC/DC 電錶	bit0=預留 bit1=保護-輔電停電異常 bit2=告警-AC 電錶通訊異常 bit3=預留 bit4=保護-DC 電錶通訊異常 bit5=預留 bit6=預留 bit7=預留 bit8=保護-BCU 已上電輔電電壓異常 bit9=保護--BCU 已上電輔電停電異常 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
16	0x023	35	2	保護 06-UPS	bit0=保護-UPS 機組故障 bit1=保護-UPS 容量過低 bit2=保護-UPS 市電異常 bit3=保護-UPS 通訊異常 bit4=預留 bit5=預留 bit6=預留 bit7=預留 bit8=保護-BCU 已上電 UPS 容量過低 bit9=保護-BCU 已上電 UPS 通訊異常 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
17	0x024	36	2	保護 07-空調	bit0=保護-空調 A 設備故障 bit1=保護-空調 A 通訊異常 bit2=保護-空調 B 設備故障 bit3=保護-空調 B 通訊異常 bit4=預留 bit5=預留 bit6=預留 bit7=預留 bit8=保護-BCU 已上電空調 A 通訊異常 bit9=保護-BCU 已上電空調 B 通訊異常 bit10=預留 bit11=預留

					bit12=預留 bit13=預留 bit14=預留 bit15=預留
18	0x025	37	2	保護 08(預留)	
19	0x026	38	2	保護 09-系統	bit0=保護-IPC 通訊異常 bit1=保護--SBMS 通訊異常 bit2=預留 bit3=預留 bit4=預留 bit5=預留 bit6=預留 bit7=預留 bit8=保護-BCU 已上電 IPC 通訊異常 bit9=保護-BCU 已上電 SBMS 通訊異常 bit10=預留 bit11=預留 bit12=預留 bit13=預留 bit14=預留 bit15=預留
20	0x027 ~ 0x031	39~49	22	預留	
21	0x032	50	2	設備異常訊息 01-空調 A	bit0=空調 A-高溫警報 bit1=空調 A-內部風扇故障警報 bit2=空調 A-外部風扇故障警報 bit3=空調 A-壓縮機故障警報 bit4=空調 A-機櫃回風溫度探頭故障 bit5=空調 A-系統高壓警報 bit6=空調 A-低溫警報 bit7=空調 A-交流過壓警報 bit8=空調 A-交流欠壓警報 bit9=空調 A-蒸發器溫度感知器故障 bit10=空調 A-冷凝器溫度感知器故障 bit11=空調 A-環境溫度感測器故障 bit12=空調 A-蒸發器結冰警報 bit13=空調 A-頻繁高壓警報 bit14=空調 A-高濕度警報 bit15=空調 A-濕度感測器故障警報
22	0x033	51	2	設備異常訊息 02-空調 A	bit0=空調 A-排氣超溫警報 bit1=空調 A-廢氣溫度感知器故障警報 bit2=空調 A-排氣超溫鎖定警報 其他預留
23	0x034	52	2	設備異常訊息 03-空調 B	bit0=空調 B-高溫警報 bit1=空調 B-內部風扇故障警報 bit2=空調 B-外部風扇故障警報 bit3=空調 B-壓縮機故障警報 bit4=空調 B-機櫃回風溫度探頭故障 bit5=空調 B-系統高壓警報 bit6=空調 B-低溫警報 bit7=空調 B-交流過壓警報 bit8=空調 B-交流欠壓警報 bit9=空調 B-蒸發器溫度感知器故障 bit10=空調 B-冷凝器溫度感知器故障 bit11=空調 B-環境溫度感測器故障 bit12=空調 B-蒸發器結冰警報

					bit13=空調 B-頻繁高壓警報 bit14=空調 B-高濕度警報 bit15=空調 B-濕度感測器故障警報
24	0x035	53	2	設備異常訊息 04-空調 B	bit0=空調 B-排氣超溫警報 bit1=空調 B-廢氣溫度感知器故障警報 bit2=空調 B-排氣超溫鎖定警報 其他預留
25	0x036 ~ 0x03B	54~59	12	預留	
26	0x03C	60	2	貨櫃溫度上限	0.1℃/bit
27	0x03D ~ 0x03E	61~62	4	預留	
28	0x03F	63	2	排風扇狀態	0=已關閉 1=已開啟 bit0=排風扇 A bit1=排風扇 B
29	0x040	64	2	Rack 高水位狀態	0=未觸發 1=觸發 bit0=RACK1 高水位 bit1=RACK2 高水位 bit2=RACK3 高水位 bit3=RACK4 高水位 bit4=RACK5 高水位 bit5=RACK6 高水位 bit6=RACK7 高水位 bit7=RACK8 高水位 bit8=RACK9 高水位 bit9=RACK10 高水位(預留) bit10=RACK11 高水位(預留) bit11=RACK12 高水位(預留) bit12=RACK13 高水位(預留) bit13=RACK14 高水位(預留) bit14=RACK15 高水位(預留) bit15=RACK16 高水位(預留)
30	0x041	65	2	Rack 低水位狀態	0=未觸發 1=觸發 bit0=RACK1 低水位 bit1=RACK2 低水位 bit2=RACK3 低水位 bit3=RACK4 低水位 bit4=RACK5 低水位 bit5=RACK6 低水位 bit6=RACK7 低水位 bit7=RACK8 低水位 bit8=RACK9 低水位 bit9=RACK10 低水位(預留) bit10=RACK11 低水位(預留) bit11=RACK12 低水位(預留) bit12=RACK13 低水位(預留) bit13=RACK14 低水位(預留) bit14=RACK15 低水位(預留) bit15=RACK16 低水位(預留)
31	0x042	66	2	DC Switch 狀態	0: OFF(斷開) 1: ON(投入)
32	0x043 ~ 0x045	67	2	Rack 冷卻系統循環狀態	0=停止 1=運轉 bit0=RACK1 循環狀態 bit1=RACK2 循環狀態 bit2=RACK3 循環狀態 bit3=RACK4 循環狀態 bit4=RACK5 循環狀態

					bit5=RACK6 循環狀態 bit6=RACK7 循環狀態 bit7=RACK8 循環狀態 bit8=RACK9 循環狀態 bit9=(預留) bit10=(預留) bit11=(預留) bit12=(預留) bit13=(預留) bit14=(預留) bit15=(預留)
33	0x044 ~ 0x045	68~69	4		
34	0x046	70	2	貨櫃溫度 A	0.1℃/bit
35	0x047	71	2	貨櫃濕度 A	0.1%/bit
36	0x048	72	2	貨櫃溫度 B	0.1℃/bit
37	0x049	73	2	貨櫃濕度 B	0.1%/bit
38	0x04A	74	2	氫氣濃度	1ppm/bit
39	0x04B ~ 0x084	75~132	116	預留	
40	0x085	133	2	UPS 輸出電流	1A/bit
41	0x086 ~ 0x087	134~135	4	預留	
42	0x088	136	2	UPS 輸入電壓	1VAC/bit
43	0x089 ~ 0x08A	137~138	4	預留	
44	0x08B	139	2	UPS 輸出電壓	1VAC/bit
45	0x08C ~ 0x08D	140~141	4	預留	
46	0x08E	142	2	UPS 輸出功率	1W/bit
47	0x08F	143	2	UPS 電池剩餘時間	1Mins/bit
48	0x090	144	2	UPS 電池充電程度	1%/bit
49	0x091	145	2	UPS 輸出負載	1%/bit
50	0x092	146	2	UPS 電池電壓	1V/bit
51	0x093 ~ 0x095	147~149	6	預留	
52	0x096	150	2	空調 1 室內溼度	0.1%/bit
53	0x097	151	2	空調 1 室內溫度	0.1℃/bit
54	0x098	152	2	空調 1 送風機狀態	bit0=0(OFF) bit0=1(ON)
55	0x099	153	2	空調 1 內風機狀態	bit0=0(OFF) bit0=1(ON)
56	0x09A	154	2	空調 1 外風機狀態	bit0=0(OFF) bit0=1(ON)
57	0x09B	155	2	空調 1 壓縮機狀態	bit0=0(OFF) bit0=1(ON)
58	0x09C	156	2	空調 1 加熱器狀態	bit0=0(OFF) bit0=1(ON)
59	0x09D	157	2	空調 1 製冷溫度設定	0.1℃/bit
60	0x09E	158	2	空調 1 除溼濕度設定	0.1%/bit
61	0x09F	159	2	空調 1 製熱溫度設定	0.1℃/bit
62	0x0A0	160	2	空調 1 遠端開關機設定	bit0=0(OFF) bit0=1(ON)
63	0x0A1	161	2	空調 1 控制模式設定	bit0=平均回風 bit1=平均送風 bit2=回風熱點 bit3=送風熱點 bit4=監控溫度
64	0x0A2	162	2	空調 2 室內溼度	0.1%/bit
65	0x0A3	163	2	空調 2 室內溫度	0.1℃/bit

66	0x0A4	164	2	空調 2 送風機狀態	bit0=0(OFF)　bit0=1(ON)
67	0x0A5	165	2	空調 2 內風機狀態	bit0=0(OFF)　bit0=1(ON)
68	0x0A6	166	2	空調 2 外風機狀態	bit0=0(OFF)　bit0=1(ON)
69	0x0A7	167	2	空調 2 壓縮機狀態	bit0=0(OFF)　bit0=1(ON)
70	0x0A8	168	2	空調 2 加熱器狀態	bit0=0(OFF)　bit0=1(ON)
71	0x0A9	169	2	空調 2 製冷溫度設定	0.1℃/bit
72	0x0AA	170	2	空調 2 除溼濕度設定	0.1%/bit
73	0x0AB	171	2	空調 2 製熱溫度設定	0.1℃/bit
74	0x0AC	172	2	空調 2 遠端開關機設定	bit0=0(OFF)　bit0=1(ON)
75	0x0AD	173	2	空調 2 控制模式設定	bit0=平均回風 bit1=平均送風 bit2=回風熱點 bit3=送風熱點 bit4=監控溫度

3.4 IPC Register Table

3.4.1 IPC Holding Register Address Distribution

No	Target	Register address(hex)	Register address(dec)	Byte	Variable description
1	IPC	01000 ~ 0x102F	4096~4143	94	IPC data information

3.4.2 IPC Holding Data Formation

No	Data type	Ratio factor	Range	Offset	Actual span	Data quantity	Comment
1	Heartbeats	1/bit	0 ~ 255	0	0 ~ 255	2byte	Heartbeats
2	Teperature	1℃/bit	0 ~ 1000	0	0 ~ 100℃	2byte	
3	Usage	1%/bit	0 ~ 1000	0	0 ~ 100%	2byte	

3.4.3 IPC Data Information(holding register)

No	Address(hex)	Address(dec)	Byte	Description	Comment
1	0x1000	4096	2	IPC heartbets	0 ~ 255
2	0x1001	4097	2	IPC error flag	bit 0: SBMS/PLC 通訊錯誤 bit 1: Modbus Mapping 錯誤 bit 2: Modbus 指令轉送錯誤 bit 3: Log 數據寫入錯誤 bit 6: EMS 心跳數據異常
3	0x1002~0x1004	4098~4100	6	Reserved	
4	0x1005	4101	2	Modbus forwarding queue flag	1: 佇列中有指令等待轉送 0: 指令轉送佇列為空
5	0x1006	4102	2	Modbus forwarding queue length	指令轉送佇列的長度
6	0x1007	4103	2	IPC CPU temperature	1℃/bit
7	0x1008	4104	2	IPC CPU usage	1%/bit
8	0x1009	4105	2	IPC RAM usage	1%/bit
9	0x100A	4106	2	IPC storage usage	1%/bit
10	0x100B~0x100F	4107~4112	12	Reserved	
11	0x1010	4112	2	Allowed operation rate	環控邏輯運算後允許充放的比例(%)

12	0x1011	4113	2	BMS and PCS stop flag	通知 PCS 與 BMS 下電旗標 1: 需要下電 0: 不需下電
13	0x1012	4114	2	IPC software version	
14	0x1013	4115	2	IPC software checksum	
15	0x1014~0x101F	4116~4127	24	Reserved	
16	0x1020	4128	2	EMS heartbeats detection enable	EMS 心跳偵測功能開關 1: 開啟 other: 關閉
17	0x1021	4129	2	EMS heartbeats	供 EMS 心跳寫入點位
18	0x1022~0x102F	4130~4143	28	Reserved	

1 Appendix

1.1 BMS Cluster Alarm Parameter List

Alarm	Level	Threshold	Hysteresis	System Mode Action
Total voltage undervoltage	Slight	1026V	10V	N / A
	Medium	988V	10V	Deny discharging
	Serious	950V	10V	Protection (relay opened)
Total voltage overvoltage	Slight	1349V	10V	N / A
	Medium	1368V	10V	Deny charging
	Serious	1406V	10V	Protection (relay opened)
Overcurrent [Discharge] (Per Rack)	Slight	280A	10A	N / A
	Medium	290A	10A	Deny discharging
	Serious	310A	10A	Protection (relay opened)
Overcurrent [Charge] (Per Rack)	Slight	140A	10A	N / A
	Medium	150A	10A	Deny charging
	Serious	160A	10A	Protection (relay opened)
Low insulation resistance	Slight	1000kΩ	10kΩ	N / A
	Medium	500kΩ	10kΩ	Deny discharging Deny charging
	Serious	100kΩ	10kΩ	Protection (relay opened)
Module low temperature	Slight	-	-	
	Medium	-	-	
	Serious	-	-	
Module over temperature	Slight	-	-	
	Medium	-	-	
	Serious	-	-	
Cell over voltage	Slight	3.55V	0.2V	N / A
	Medium	3.6V	0.2V	Deny charging
	Serious	3.7V	0.2V	Protection (relay opened)
Cell low voltage	Slight	2.7V	0.2V	N / A
	Medium	2.6V	0.2V	Deny discharging

	Serious	2.5V	0.2V	Protection (relay opened)
Cell differential voltage	Slight	0.4V	0.05V	N / A
	Medium	0.6V	0.05V	Deny discharging Deny charging
	Serious	1V	0.05V	Protection (relay opened)
Cell low temperature [Discharge]	Slight	0°C	5°C	N / A
	Medium	-10°C	5°C	Deny discharging
	Serious	-20°C	5°C	Protection (relay opened)
Cell low temperature [Charge]	Slight	10°C	5°C	N / A
	Medium	5°C	5°C	Deny charging
	Serious	0°C	5°C	Protection (relay opened)
Cell over temperature [Discharge]	Slight	50°C	5°C	N / A
	Medium	55°C	5°C	Deny discharging
	Serious	60°C	5°C	Protection (relay opened)
Cell over temperature [Charge]	Slight	50°C	5°C	N / A
	Medium	55°C	5°C	Deny charging
	Serious	60°C	5°C	Protection (relay opened)
Cell differential temperature	Slight	15°C	5°C	N / A
	Medium	20°C	5°C	Deny discharging Deny charging
	Serious	25°C	5°C	Protection (relay opened)
Cell SOC low	Slight	-	-	
	Medium	-	-	
	Serious	-	-	
Cell SOC high	Slight	-	-	
	Medium	-	-	
	Serious	-	-	
Cell SOH low	Slight	-	-	
	Medium	-	-	
	Serious	-	-	
Cell SOH high	Slight	-	-	
	Medium	-	-	
	Serious	-	-	