GROWATT

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Communication Protocol of Growatt High Voltage Battery CAN

GROWATT

SHENZHEN GROWATT NEW ENERGY

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Version Record

Index	Version	Change content	Author	Date
00	V1.00	First Republic	Luo Meilin	2020.11.06
01	V1.01	1.Add 0x3020 Byte4 ISO Detection Command 2.Add 0x3110 Byte6Bit5 ISO Detection Status 3.Add 0x3030 Byte7 PCS operating status	Luo Meilin	2020.12.06
02	V1.02	1.Modify the CAN message of 0x3230 battery SN 2.Modify 0x3240 battery SOE unit to 0.1kWh 3.Add fault record messages: 0x3250, 0x3260 and 0x3270 4.Modify 0x3010; add the definition of Byte2, configure the safety certificate codes of the battery 5.Add 0x3180 BYTE6~BYTE7: the number of BIC forward/reverse encoding in the Pack	Luo Meilin	2021.01.04
03	V1.03	1.Add 0x3280 Product version information	Huang Gang	2021.03.03
04	V1.04	1.Add Byte4 Bit1: Region mismatched with the PCS protection in 0x3120 2.Add Byte4 Bit2: Low-temperature charging over-current protection in 0x3120 3.Add Byte1 Bit4: Region mismatched with the PCS alarm in 0x3120 4.Add Byte1 Bit5: Low-temperature charging over-current alarm in 0x3120	Huang Gang	2021.03.29
05	V1.05	1.Byte4-Byte7 uploads 0 by default in 0x3170 2.Add Byte6-Byte7: Cell charging cutoff voltage in 0x3200 3.Add Byte4: Forced charge mark in 0x3220	Lai Tingsheng	2021.07.12
06	V1.06	1.Byte4-Byte7 in 0x3170: upload data the backstage (for data query)	Huang Gang	2022.02.15
07	V1.07	1.CAN message: Byte 4 and Byte5 in 0x3170 is modified to Manufacturer code GT:0x4754	Huang Gang	2022.04.02
08	V1.08	1.Add Byte5 and Byte6 in 0x3220: Battery rated energy information	Huang Gang	2022.04.21
09	V1.09	1. Add Byte1 (Battery ID)=1, indicating the SN of the high-voltage controller; Byte1(Battery ID)=2-11, indicating the SN of Pack 1-10; Add the function to upload the SN of the Pack	Huang Gang	2022.05.20
10	V1.10	1.Add ID 0x3290 battery information	Huang Gang	2023.11.06

Catalog

1 Introduction

1.1 Purpose

➢ **Can bus specification**

With the extended 29-bit identifier, the bus transmission rate is 500 kbps.

➢ **Data mode**

Data is transmitted in the big-endian format, with the high byte data stored first, followed by the low byte data (e.g., for 16-bit data: Byte 0: H 1: L). The definition of the data type used in the protocol is shown below:

No.	Data type	Definition	Data length (bytes)
1	Byte	unsigned char	1
2	Uint16	unsigned short int	2
3	Uint32	unsigned int	4
4	Sint8	signed char	1
5	Sint16	signed short int	2
6	Sint32	signed int	4
7	FP32	float	4

➢ **Communication mode**

The Storage Inverter and the battery communicate through CAN communication to send the query or command control frame, the battery status and the electrical parameters. The Storage Inverter and the battery will respond to the data.

The definition of the RJ45 interface for CAN communication is shown in the figure below:
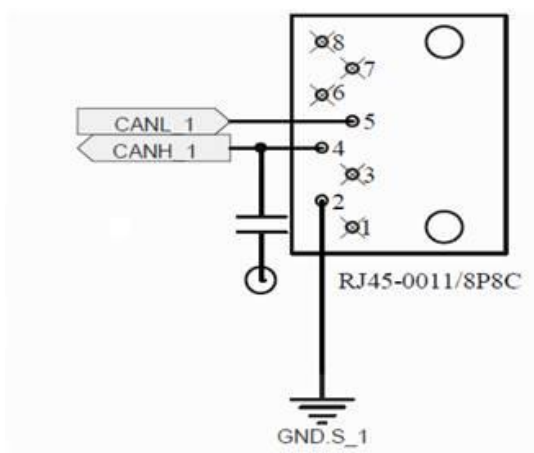
1.2 Scope

It is suitable for CAN communication between high voltage battery and inverter

1.3 Terms and abbreviations

Terms and abbreviations	Description
PCS	Power conversion system (the Storage Inverter)
Cell	A single battery cell
Module	A battery module composed of 16 strings of cells
Pack	A battery pack composed of the BMS and battery modules connected in parallel and series, which can work independently
FCC	Full charge capacity
RM	Remaining capacity
CAN	Controller area network
BMS	Battery management system
BIC	Battery Information Collector

2 Protocol Message

2.1 Storage Inverter → Battery

2.1.1 Heartbeat command

CAN ID	DLC length	Send cycle (ms)	Message type
0x3010	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Send times	[0,65535]	Cumulative number, plus 1 for each transmission
Byte1			
Byte2	Safety specifications that the Storage Inverter complies with	[0,255]	The battery will identify and use the mark of the country/region in accordance with the safety specifications that the Storage Inverter complies with. It can be ignored if distinguishing regions is not required.
Byte3	Reserved	Reserved	Reserved
Byte4	Reserved	Reserved	Reserved
Byte5	Reserved	Reserved	Reserved
Byte6	Reserved	Reserved	Reserved
Byte7	Reserved	Reserved	Reserved

2.1.2 Control command

CAN ID	DLC length	Send cycle (ms)	Message type
0x3020	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Charging command	0xAA: valid Other: invalid	Reserved
Byte1	Discharging command	0xAA: valid Other: invalid	
Byte2	Shielding external communication failure	0xAA: valid Other: invalid	Reserved
Byte3	Clearing battery fault	0xAA: valid Other: invalid	When PCS receives the forced charge Mark 1 and Cell under-voltage protection fault, it will send 0XAA
Byte4	ISO detection command	0xAA: valid Other: invalid	Reserved
Byte5	Reserved	0	Reserved
Byte6	Reserved	0	Reserved
Byte7	Sleep/wake up control	0x55: the control device enters the sleeping state;	Reserved

| | | 0xAA: the control device exits the sleeping state; Other: invalid | |

2.1.3 Time command

CAN ID	DLC length	Send cycle (ms)	Message type
0x3030	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Date and time	Epoch time	Byte0:H
Byte1			Byte3:L
Byte2			The number of seconds accumulated starting from January 1, 1970, 00:00:00
Byte3			
Byte4	Reserved	Reserved	Reserved
Byte5	Reserved	Reserved	Reserved
Byte6	Reserved	Reserved	Reserved
Byte7	PCS working status	00: Standby 01: Operating	Reserved

2.2 Battery → Storage Inverter

2.2.1 Battery operating parameters and status information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3110	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Recommended charging voltage (CV)	Unit: 0.1V Range [0.0 ~ 1000.0V] Offset: 0	Maximum permissible charging voltage
Byte1			
Byte2	Charging current limit	Unit: 0.1A Range [0.0 ~ 300.0A] Offset: 0	Maximum permissible charging current
Byte3			
Byte4	Discharge current limit	Unit: 0.1A Range [0.0~300.0A] Offset: 0	Maximum permissible discharge current
Byte5			
Byte6	Battery status	Table1	Byte6 H
Byte7			Byte7 L

Table 1: Battery status bit

Bit Index	Definition	Value	Description
Byte7 Bit0	Current state of battery	00: Soft Start 01: Standby 10: Charging 11: Discharging	Reserved Reserved
Byte7 Bit1			

Byte7 Bit2	Valid/invalid fault flag	0: Invalid 1: Valid	Reserved
Byte7 Bit3	Cell balancing state	0: Disable 1: Enable	Reserved
Byte7 Bit4	Battery sleeping state	0: Disable 1: Enable	Reserved
Byte7 Bit5	No discharging sign	0: Disable 1: Enable	Reserved
Byte7 Bit6	No charging sign	0: Disable 1: Enable	Reserved
Byte7Bit7	Battery power cable connection status	0: Connected 1: Disconnected	Reserved
Byte6 Bit0 Byte6 Bit1	Pack connection status	00: A single machine 01: Parallel connection 10: Parallel preparation 11: Reserved	Reserved
Byte6 Bit2 Byte6 Bit3	Reserved	Reserved	Reserved
Byte6 Bit4	Battery status	0: Hibernation 1: Normal	Reserved
Byte6 Bit5	ISO detection status	0: Undetected 1: Detected	Reserved
Byte6 Bit6	Reserved	Reserved	Reserved
Byte6 Bit7	Reserve	Reserved	Reserved

2.2.2 Battery protection and alarm information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3120	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Protection	Table 2	Byte0 H Byte3 L
Byte1			
Byte2			
Byte3			
Byte4	Alarm	Table 3	Byte4 H Byte7 L
Byte5			
Byte6			
Byte7			

Table 2

Bit Index	Definition	Value	Description
Byte3 Bit0	Software initialization failed	0: Normal 1: Protection	Reserved
Byte3 Bit1	Module under-voltage protection	0: Normal 1: Protection	The total pressure of the module (nominal 51.2v) is too low
Byte3 Bit2	Module over-voltage protection	0: Normal 1: Protection	The total pressure of the module (nominal 51.2v) is too high
Byte3 Bit3	Cell under-voltage	0: Normal	Unit voltage too low

	protection	1: Protection	
Byte3 Bit4	Cell over-voltage protection	0: Normal 1: Protection	Unit voltage too high
Byte3 Bit5	Discharge short-circuit protection	0: Normal 1: Protection	Reserved
Byte3 Bit6	Charging over-current protection	0: Normal 1: Protection	Software over-current + hardware over-current
Byte3 Bit7	Discharge over-current protection	0: Normal 1: Protection	Software over-current + hardware over-current
Byte2 Bit0	System discharge under-voltage protection	0: Normal 1: Protection	Pack total pressure too low
Byte2 Bit1	System charging over-voltage protection	0: Normal 1: Protection	Pack total pressure too high
Byte2 Bit2	Cell voltage difference protection	0: Normal 1: Protection	The unit pressure difference in the module is large
Byte2 Bit3	System error	0: Normal 1: Protection	There is a problem with the battery system
Byte2 Bit4	Charging low-temperature protection	0: Normal 1: Protection	System temperature too low
Byte2 Bit5	Discharge low-temperature protection	0: Normal 1: Protection	System temperature too low
Byte2 Bit6	Charging high-temperature protection	0: Normal 1: Protection	System temperature too high
Byte2 Bit7	Discharge high-temperature protection	0: Normal 1: Protection	System temperature too high
Byte1 Bit0	~~SOC low protection~~	0: Normal 1: Protection	Reserved
Byte1 Bit1	High temperature difference protection	0: Normal 1: Protection	The difference between the maximum temperature and the minimum temperature of the Cell in the system is too large
Byte1 Bit2	MOS over-temperature protection	0: Normal 1: Protection	The temperature of the power element is too high
Byte1 Bit3	Ambient temperature over-high protection	0: Normal 1: Protection	The temperature of the main control box is too high
Byte1 Bit4	Protection for region mismatched with the PCS	0: Normal 1: Protection	The region of the Storage Inverter and the battery is mismatched
Byte1 Bit5	Low-temperature charging over-current protection	0: Normal 1: Protection	When the temperature is too low, the actual charging current exceeds the charging requested current for more than 60s
Byte1 Bit6	Reserved	Reserved	Reserved
Byte1 Bit7	Reserved	Reserved	Reserved
Byte0 Bit0	Reserved	Reserved	Reserved
Byte0 Bit1	Reserved	Reserved	Reserved
Byte0 Bit2	Reserved	Reserved	Reserved
Byte0 Bit3	Reserved	Reserved	Reserved

Byte0 Bit4	Reserved	Reserved	Reserved
Byte0 Bit5	Reserved	Reserved	Reserved
Byte0 Bit6	Reserved	Reserved	Reserved
Byte0 Bit7	Reserved	Reserved	Reserved

Table 3

Bit Index	Definition	Value	Description
Byte7 Bit0	Internal communication failure alarm	0: Normal 1: Alarm	Reserved
Byte7 Bit1	Alarm of battery pack closing ahead of time	0: Normal 1: Alarm	Reserved
Byte7 Bit2	Cell voltage difference alarm	0: Normal 1: Alarm	Cell voltage difference warning in Module
Byte7 Bit3	Reserved	0: Normal 1: Alarm	Reserved
Byte7 Bit4	Low temperature alarm during charging	0: Normal 1: Alarm	System temperature low
Byte7 Bit5	Low temperature alarm during discharging	0: Normal 1: Alarm	System temperature low
Byte7 Bit6	High temperature alarm during charging	0: Normal 1: Alarm	System temperature high
Byte7 Bit7	High temperature alarm during discharging	0: Normal 1: Alarm	System temperature high
Byte6 Bit0	System discharge under-voltage alarm	0: Normal 1: Alarm	Low total pressure alarm of pack
Byte6 Bit1	Module under-voltage alarm	0: Normal 1: Alarm	Module total pressure (nominal 51.2v) low alarm
Byte6 Bit2	Module over-voltage alarm	0: Normal 1: Alarm	Module total pressure (nominal 51.2v) high alarm
Byte6 Bit3	Cell under-voltage alarm	0: Normal 1: Alarm	Unit voltage of the system is too low
Byte6 Bit4	Cell over-voltage alarm	0: Normal 1: Alarm	The voltage of single system is too high
Byte6 Bit5	System charging over-voltage alarm	0: Normal 1: Alarm	The total voltage of the Pack is high
Byte6 Bit6	Charging over-current alarm	0: Normal 1: Alarm	Software over-current
Byte6 Bit7	Discharge over-current alarm	0: Normal 1: Alarm	Software over-current
Byte5 Bit0	Battery pack software version inconsistency alarm	0: Normal 1: Alarm	Reserved (for parallel use)
Byte5 Bit1	SOC low alarm 2	0: Normal 1: Alarm	Reserved
Byte5 Bit2	High temperature difference alarm	0: Normal 1: Alarm	The difference between the maximum temperature and the minimum temperature of the cell in the system is too large
Byte5 Bit3	MOS over-temperature	0: Normal	The temperature of the power

	alarm	1: Alarm	element is too high
Byte5 Bit4	Ambient temperature over-high alarm	0: Normal 1: Alarm	The temperature of the main control box is too high
Byte5 Bit5	PCS communication loss alarm	0: Normal 1: Alarm	Communication loss between main control unit of the battery and the PCS
Byte5 Bit6	USART communication loss alarm	0: Normal 1: Alarm	Battery internal communication is lost
Byte5 Bit7	Insulation alarm	0: Normal 1: Alarm	The positive and negative poles of battery have low insulation resistance to ground
Byte4 Bit0	~~SOC low alarm 1~~	0: Normal 1: Alarm	Reserved
Byte4 Bit1	Alarm for region mismatched with the PCS	0: Normal 1: Protection	The regions of the Storage Inverter and the battery are mismatched
Byte4 Bit2	Low-temperature charging over-current alarm	0: Normal 1: Protection	When the temperature is too low, the actual charging current exceeds the charging requested current for more than 30s
Byte4 Bit3	Reserved	Reserved	Reserved
Byte4 Bit4	Reserved	Reserved	Reserved
Byte4 Bit5	Reserved	Reserved	Reserved
Byte4 Bit6	Reserved	Reserved	Reserved
Byte4 Bit7	Reserved	Reserved	Reserved

2.2.3 Battery operation information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3130	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0 Byte1	Voltage of the Pack	Unit: 0.1V Range [0.0 ~ 1000.0V] Offset: 0	Total voltage of the Pack
Byte2 Byte3	Total current of a single unit or the system	Unit: 0.1A Range [- 300.0 ~ 300.0A] Offset: 0	The battery current is positive in charge and negative in discharge
Byte4 Byte5	Maximum battery temperature	Unit: 0.1 ℃ Range [- 40.0 ~ 120.0 ℃] Offset: 0	Maximum temperature of the Cell
Byte6	SOC	Unit: 1% Range [0~100] Offset: 0	Reserved
Byte7	SOH	Unit: 1% Bit0~ Bit6: SOH Range [0~100] Offset: 0 Bit7: SOH mark	Bit7: SOH mark Indicates that the battery is in unsafe use

2.2.4 Battery capacity information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3140	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0 Byte1	Battery energy	Unit: 10mAH Range [0.0 ~ 500000.0 mAH] Offset: 0	Current battery level
Byte2 Byte3	Fully charged capacity	Unit: 10mAh Range [0.0 ~ 500000.0 mAH] Offset: 0	Battery capacity after full charge
Byte4 Byte5	Manufacturer code	Reserved	GT:0X4754
Byte6 Byte7	Number of cycles	Unit: h Range [0.0 ~ 65535]	One charge and discharge cycle is counted once

2.2.5 Battery working parameters and module number information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3150	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0 Byte1	Discharge cutoff voltage	[0.1V] Range [0.0 ~ 1000.0V] Offset: 0	Minimum discharge voltage of battery pack system
Byte2 Byte3	Main control unit temperature	[0.1℃] Range [- 40.0 ~ 120.0 ℃] Offset: 0	Temperature in main control box
Byte4 Byte5	Total number of Cells	Range [1~512]	Total number of Cells = number of Packs in parallel * number of Modules in series * number of Cells in the module
Byte6 Byte7	Number of Modules in series	Range [1~32]	Number of Modules in series

2.2.6 Battery fault and voltage number information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3160	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Fault flag bit	Table4	Reserved
Byte1	Fault extension flag bit	Table5	Reserved

Byte2	Number of Module with the maximum cell voltage	Range [1~32]	Reserved
Byte3	Number of Cell with the maximum cell voltage	Range [1~128]	The number of the cell with the maximum cell voltage
Byte4	Number of Module with the minimum cell voltage	Range [1~32]	Reserved
Byte5	Number of Cell with the minimum cell voltage	Range [1~128]	The number of the cell with the maximum cell voltage
Byte6 Byte7	Minimum cell temperature	Unit [0.1 ℃] Range [- 40.0 ~ 120.0 ℃] Offset: 0	The minimum temperature of a single cell in the battery pack

Table 4 Fault flag bit

Bit Index	Definition	Value	Description
Byte0 Bit0	Voltage sensor failure	0: Normal 1: Malfunction	Pack total voltage sampling / or module total voltage failure
Byte0 Bit1	Temperature sensor failure	0: Normal 1: Malfunction	Cell temperature sensor
Byte0 Bit2	Internal communication failure	0: Normal 1: Malfunction	Abnormal communication between the main control unit and the monitoring system
Byte0 Bit3	Input over-voltage	0: Normal 1: Malfunction	Output over-voltage (outside of the main output relay)
Byte0 Bit4	Input reverse connection	0: Normal 1: Malfunction	Output voltage is negative (outside of the main output relay)
Byte0 Bit5	Relay detection failure	0: Normal 1: Malfunction	Abnormal relay in battery pack
Byte0 Bit6	Battery fault	0: Normal 1: Malfunction	Battery cell failure
Byte0 Bit7	Others	0: Normal 1: Malfunction	Reserved

Table 5 Fault extension flag bit

Bit Index	Definition	Value	Description
Byte1 Bit0	Shutdown circuit abnormal	0: Normal 1: Malfunction	SPS power failure
Byte1 Bit1	BMIC abnormal	0: Normal 1: Malfunction	Reserved
Byte1 Bit2	Internal bus abnormal	0: Normal 1: Malfunction	Reserved
Byte1 Bit3	Startup self-check abnormal	0: Normal 1: Malfunction	Soft start failed
Byte1 Bit4	Equalization failure	0: Normal 1: Malfunction	Reserved
Byte1 Bit5	Equalizing MOS fault	0: Normal 1: Malfunction	Reserved
Byte1 Bit6	Insulation fault	0: Normal 1: Malfunction	Reserved

| Byte1 Bit7 | Reserved | Reserved | Reserved |

2.2.7 Software version and temperature number information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3170	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Number of Module with the maximum cell temperature	Range [1~32]	Reserved
Byte1	Number of Cell with the maximum cell temperature	Range [1~128]	The number of the cell with the maximum cell temperature
Byte2	Number of Module with the minimum cell temperature	Range [1~32]	
Byte3	Number of Cell with the minimum cell temperature	Range [1~128]	The number of the cell with the minimum cell temperature
Byte4	Battery actual capacity	Range [0~100]	Reserved
Byte5	Battery correction status display value	Range [0~255]	Reserved
Byte6	Remaining balancing time	Range [0~255]	Reserved
Byte7 bit0~bit3	Balancing state	Range [0~15]	Reserved
Byte8 bit4~bit7	Internal short-circuit state	Range [0~15]	Reserved

2.2.8 Battery Code and quantity information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3180	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Manufacturer code "X"	Example: 0xAA	Manufacturer code
Byte1		Example: 0xBB	
Byte2	Number of Packs in parallel	Range [1~65536]	Reserved
Byte3			
Byte4	Total number of Cells	Range [1~65536]	Reserved
Byte5			
Byte6	Pack number + BIC forward/reverse encoding number	Range [1~65536]	Bits 0 to 3: Pack number Bits 4 to 9: Max. number of BIC in forward BIC encoding in daisy-chain communication Bits 10 to 15: Max. number of BIC in reverse BIC encoding in daisy-chain communication
Byte7			

2.2.9 cell voltage and status information

CAN ID	DLC length	Send cycle (ms)	Message type

0x3190	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Battery status	Table 6	
Byte1 Byte2	Maximum voltage of Cell	Unit: 1mV Range [0.0 ~ 5000.0mV] Offset: 0	Maximum voltage value of the cell in the battery pack
Byte3 Byte4	Minimum voltage of Cell	Unit: 1mV Range [0.0 ~ 5000.0mV] Offset: 0	Minimum voltage value of the cell in the battery pack
Byte5	Reserved	Reserved	Reserved
Byte6	Faulty battery pack number	Range [1~16]	Reserved
Byte7	Faulty battery module number	Range [1~16]	Reserved

Table 6 Battery status

Bit Index	Definition	Value	Comment
Byte0 Bit0 Byte0 Bit1	Battery type	[0,3]	00: Lithium iron phosphate battery 01: Ternary battery 10: Lithium titanate battery 11: Reserved
Byte0 Bit2	Request equalizing charge	[0,1]	Reserved
Byte0 Bit3	Reserved	Reserved	Reserved
Byte0 Bit4	Forced charge Mark 2	[0,1]	Reserved
Byte0 Bit5	Forced charge Mark 1	[0,1]	0: No 1: Request for forced charge
Byte0 Bit6	Reserved	Reserved	Reserved
Byte0 Bit7	Reserved	Reserved	Reserved

2.2.10 Manufacturer name and version information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3200	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0 Byte1	Manufacturer name	Abbreviation of ASCII battery manufacturer in capital letters Byte0 =" 0x00" Byte1=" 0x01"	Reserved
Byte2	Hardware version	0: Null; 1: ver. A; 2: ver. B; Others: reserved	0: invalid; 1: ver. A; 2: ver. B; Others: reserved
Byte3	Reserved	Reserved	Reserved
Byte4 Byte5	Circulating current value	Unit: 0.1A Range [0.0 ~ 20.0A]	Circulating current difference between battery

		Offset: 0	packs
Byte6	Cell charge cutoff voltage	Unit: 1mV Range [0.0 ~ 5000.0mV] Offset: 0	Cell charge cutoff voltage
Byte7			

2.2.11 Upgrade information (reserved)

CAN ID	DLC length	Send cycle (ms)	Message type
0x3210	8	1000	Event

Data:

Byte Index	Definition	Value	Description
Byte0	Upgrade status	[0,255]	Reserved
Byte1	Reserved	Reserved	Reserved
Byte2	Reserved	Reserved	Reserved
Byte3	Reserved	Reserved	Reserved
Byte4	Reserved	Reserved	Reserved
Byte5	Reserved	Reserved	Reserved
Byte6	Reserved	Reserved	Reserved
Byte7	Reserved	Reserved	Reserved

2.2.12 De-rating and fault information (reserved)

CAN ID	DLC length	Send cycle (ms)	Message type
0x3220	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0 Byte1	Power reduction sign	Table8	Reserved
Byte2 Byte3	System fault status	Table9	Reserved
Byte4	Forced discharge mark	0x00 or 0xAA	When the battery needs a force charge, 0xAA is reported. In other cases, it is set to 0x00
Byte5 Byte6	Battery rated energy information	Unit: 0.1 kWh	Reserved
Byte7	Software subversion number	0	For internal personnel reference

Table8

Bit Index	Definition	Value	Description
Byte1 Bit0	Current drop due to high Cell voltage	0: Normal 1: Abnormal	Reserved
Byte1 Bit1	Current drop due to low Cell voltage	0: Normal 1: Abnormal	Reserved
Byte1 Bit2	Current drop due to high temperature	0: Normal 1: Abnormal	Reserved
Byte1 Bit3	Current drop due to low temperature	0: Normal 1: Abnormal	Reserved

Byte1 Bit4	Current drop due to high total voltage	0: Normal 1: Abnormal	Reserved
Byte1 Bit5	Current drop due to low total voltage	0: Normal 1: Abnormal	Reserved
Byte1 Bit6	Current drop due to large voltage difference	0: Normal 1: Abnormal	Reserved
Byte1 Bit7	Current drop due to large temperature difference	0: Normal 1: Abnormal	Reserved
Byte0 Bit1	Current drop due to hardware fault	0: Normal 1: Abnormal	Reserved
Byte0 Bit1	Current drop after full charge	0: Normal 1: Abnormal	Reserved
Byte0 Bit2	Current drop due to high MOS (MOS or relay) temperature	0: Normal 1: Abnormal	Reserved
Byte0 Bit3	Current drop due to high ambient temperature	0: Normal 1: Abnormal	Reserved
Byte0 Bit4	Current drop due to precharge failure	0: Normal 1: Abnormal	Reserved
Byte0 Bit5	Current drop due to communication failure	0: Normal 1: Abnormal	Reserved
Byte0 Bit6	Current drop due to abnormal main circuit	0: Normal 1: Abnormal	Reserved
Byte0 Bit7	Reserved	Reserved	Reserved

Table9

Bit Index	Definition	Value	Description
Byte3 Bit0	Abnormal internal communication (battery pack)	0: Normal 1: Abnormal	Reserved
Byte3 Bit1	Abnormal external communication	0: Normal 1: Abnormal	Reserved
Byte3 Bit2	Precharge failure	0: Normal 1: Abnormal	Reserved
Byte3 Bit3	Parallel operation failure	0: Normal 1: Abnormal	Reserved
Byte3 Bit4	BMS hardware fault status, support hardware diagnosis	0: Normal 1: Abnormal	Reserved
Byte3 Bit5	Front end (sampling chip) fault	0: Normal 1: Abnormal	Reserved
Byte3 Bit6	EEPROM fault diagnosis	0: Normal 1: Abnormal	Reserved
Byte3 Bit7	Fuse fault	0: Normal 1: Abnormal	Reserved
Byte2 Bit0	Diagnosis of abnormal MCU power supply	0: Normal 1: Abnormal	Reserved
Byte2 Bit1	Reserved	Reserved	Reserved
Byte2 Bit2	Reserved	Reserved	Reserved
Byte2 Bit3	Reserved	Reserved	Reserved
Byte2 Bit4	Reserved	Reserved	Reserved
Byte2 Bit5	Reserved	Reserved	Reserved

Byte2 Bit6	Reserved	Reserved	Reserved
Byte2 Bit7	Reserved	Reserved	Reserved

2.2.13 Serial number

CAN ID	DLC length	Send cycle (ms)	Message type
0x3230	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Frame number	0: first frame 2: third frame	The maximum frame number is 3.
Byte1 Byte2 Byte3 Byte4 Byte5 Byte6 Byte7	Serial number content	Serial number [ASCII]	The serial number includes the PACK number (1 byte: range [1, 11]) and serial number (16 bytes). (Reserved and filled with 0x00) Explanation: Byte 1 (Battery ID) = 0: Invalid. When Byte 1 (Battery ID) = 1, it represents the SN (Serial Number) of the high-voltage controller. When BYTE1 (Battery ID) = 2~11, it represents the SN of PACK 1~10.

Format:

Byte0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
			First frame				
FrameNo(0)	Battery ID	SN0	SN1	SN2	SN3	SN4	SN5
			Second frame				
FrameNo(1)	SN6	SN7	SN8	SN9	SN10	SN11	SN12
			Third frame				
FrameNo(2)	SN13	SN14	SN15	Reserved	Reserved	Reserved	Reserved

2.2.14 Total charge/discharge energy

CAN ID	DLC length	Send cycle (ms)	Message type
0x3240	8	1000	Cycle

Data:

Byte index	Definition	Value	Description
Byte0	PACK number	Range [1,16]	The number of the PACK composed of multiple modules connected in series
Byte1	Total discharge energy (8-bit high byte)	Unit: 0.1kWh Range [0.0 ~10000000.0kWh] Offset: 0	Reserved
Byte2 Byte3	Total discharge energy (16-bit low byte)		Reserved
Byte4	PACK number	Range [1,16]	The number of the PACK composed of

		multiple modules connected in series
Byte5	Total charge energy (8-bit high byte)	Unit: 0.1kWh Range [0.0 ~10000000.0kWh]	Reserved
Byte6	Total charge energy (16-bit low byte)	Offset: 0	Reserved
Byte7			

2.2.15 Fault history

CAN ID	DLC	Send Cycle (ms)	Message Type
0x3250	8	1000	Cycle

Data：

Byte Index	Definition	Value	Description
Byte0	The Cluster number and the specific Pack number of the first fault occurred within 15 minutes	[0,255]	1) BitBit3: Represents Cluster M. For instance, 15 indicating Cluster 15 has a fault 2) Bit4~Bit7: Represents Pack N. For instance, 15 indicating Pack 15 has a fault. Setting to 1 indicates a fault in that Cluster/Pack Clearing to 0 indicates no fault
Byte1	Specific Battery Module with fault occurred within 15 minutes	[0,31]	Represents the specific battery Module where the fault occurred in Cluster M and Pack N
Byte2	The Cluster number and the specific Pack number of the second fault occurred within 15 minutes	[0,255]	Same as Byte0
Byte3	Specific Battery Module with fault occurred within 15 minutes	[0,31]	Same as Byte1
Byte4	The Cluster number and the specific Pack number of the third fault (subsequent to the second fault) occurred within 15 minutes	[0,255]	Same as Byte0
Byte5	Specific Battery Module with fault occurred within 15 minutes	[0,31]	Same as Byte1
Byte6	The Cluster number and the specific Pack number of the fourth fault (subsequent to the third fault) occurred within 15 minutes	[0,255]	Same as Byte0

Byte7	Specific Battery Module with fault occurred within 15 minutes	[0,31]	Same as Byte1

CAN ID	DLC	Send Cycle (ms)	Message Type
0x3260	8	1000	Cycle

Data：

Byte Index	Definition	Value	Description
Byte0	Fault alarm code Byte0	[0,255]	Battery Internal Debugging Fault Message
Byte1	Fault alarm code Byte1	[0,255]	
Byte2	Fault alarm code Byte2	[0,255]	
Byte3	Fault alarm code Byte3	[0,255]	
Byte4	Fault alarm code Byte4	[0,255]	
Byte5	Fault alarm code Byte5	[0,255]	
Byte6	Fault alarm code Byte6	[0,255]	
Byte7	Fault alarm code Byte7	[0,255]	

CAN ID	DLC	Send Cycle (ms)	Message Type
0x3270	8	1000	Cycle

Data：

Byte Index	Definition	Value	Description
Byte0	Fault alarm code Byte8	[0,255]	Battery Internal Debugging Fault Message
Byte1	Fault alarm code Byte9	[0,255]	
Byte2	Fault alarm code Byte10	[0,255]	
Byte3	Fault alarm code Byte11	[0,255]	
Byte4	Fault alarm code Byte12	[0,255]	
Byte5	Fault alarm code Byte13	[0,255]	
Byte6	Fault alarm code Byte14	[0,255]	
Byte7	Fault alarm code Byte15	[0,255]	

2.2.16 Product Version Information

CAN ID	DLC	Send Cycle (ms)	Message Type
0x3280	8	1000	Cycle

Data：

Byte Index	Definition	Value	Description
Byte0	Reserved	Reserved	Reserved
Byte1	Product version number	[1,5] 0: no software version 1: Main control unit (product) version 2: Monitoring(Communication) version 3~5: reserved	Indicate that the product has multiple chip versions. E.g. the high-voltage battery has 2 chips
Byte2 Byte3 Byte4 Byte5	Product version code	4 characters [ASCII]	For example, the version code for the main control unit (product) of a high-voltage battery is QBAA, and the code for

| | | | monitoring (communication) is ZEAA |
| Byte6 | Software version | [0,65536] | Software version information |

2.2.17 Battery series information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3290	8	1000	Event

Data:

Byte index	Definition	Value	Description
Byte0	Battery DTC	Range [0,65536]	Default 12041
Byte1			
Byte2	Reserved	0	Reserved
Byte3	Reserved	0	Reserved
Byte4	Reserved	0	Reserved
Byte5	Reserved	0	Reserved
Byte6	Reserved	0	Reserved
Byte7	Reserved	0	Reserved

2.3 Internal alarm information

CAN ID	DLC length	Send cycle (ms)	Message type
0x3F00	8	1000	Cycle

Data:

Byte Index	Definition	Value	Description
Byte0	Alarm	Reserved	Battery internal debugging fault message
Byte1			
Byte2			
Byte3			
Byte4			
Byte5			
Byte6			
Byte7			

2.4 Fault, alarm and state processing

2.4.1 State processing

Number	State name	Battery action	PCS action
1	Current state of battery 00: soft start 01: standby 10: charging 11: discharging	The state switches to 10 (charging) or 11 (discharging) after the output relay of the battery is closed	Charging/discharging can only be initiated upon receiving the 10 (charging) or 11 (discharging) state
2	Valid/invalid fault flag	Set to 1 after the battery	Shut down immediately

		output relay is open	
3	No discharging sign	Set to 1 after the cell under-voltage alarm	Stop discharging immediately
4	No charging sign	Set to 1 after the cell over-voltage alarm	Stop charging immediately
5	Forced charge Mark 1	Set to 1 when battery SOC $\leqslant$ 5% or the minimum cell voltage $\leqslant$ 2.95V	Carry out forced charge immediately

2.4.2 Fault and alarm handling

Number	Fault	Battery action	PCS action
1	Voltage sensor failure	The Pack total voltage sampling or the Module total voltage is abnormal. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
2	Temperature sensor failure	Reserved	Shut down immediately
3	Internal communication failure	The communication between the main control unit and the monitoring system is abnormal. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
4	Input over-voltage fault	The output voltage is abnormal. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
5	Input reverse connection fault	The bus is reversely connected. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
6	Relay detection failure	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
7	Battery failure	The battery cell is faulty. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
8	Other faults	Reserved	Shut down immediately
9	System error	Reserved	Shut down immediately
10	Software initialization failed	Reserved	Shut down immediately
11	Alarm of battery pack closing ahead of time	Reserved	Shut down immediately
12	Abnormal shutdown circuit	SPS power failure. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
13	Abnormal BMIC	Reserved	Shut down immediately
14	Internal bus	Reserved	Shut down immediately

		exception	
15	Self-check abnormal	The soft start failed. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
16	Equalizing MOS failure	Reserved	Shut down immediately
17	Insulation fault	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
18	Single cell under-voltage protection	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
19	Single cell over-voltage protection	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
20	System discharge under-voltage protection	The total voltage of the system (multiple 16-string modules connected in series) is too low. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
21	System charging over-voltage protection	The total voltage of the system (multiple 16-string modules connected in series) is too high. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
22	Charging low-temperature protection	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
23	Charging high-temperature protection	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
24	Discharge low-temperature protection	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
25	Discharge high-temperature protection	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
26	Charging over-current protection	Software over-current + hardware over-current. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
27	Discharge over-current protection	Software over-current + hardware over-current. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
28	Module under-voltage protection	The total voltage of the 16-string module is too low (nominal value: 51.2v). Cut off the relay. Close the precharge relay after the fault is	Shut down immediately

		rectified.	
29	Module over-voltage protection	The total voltage of the 16-string module is too high (nominal value: 51.2v). Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
30	Cell voltage difference protection	The voltage difference of the Cells in the a single 16-string module is large. Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
31	Discharge short-circuit protection	Reserved	Shut down immediately
32	Region mismatched with the PCS	Reserved	Shut down immediately
33	Low-temperature charging over-current protection	Reserved	Reserved
34		Reserved	Reserved
35	Insulation protection	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
36	High temperature difference protection	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
37	MOS over-temperature protection	Reserved	Shut down immediately
38	Over-temperature protection	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
39	Internal (battery pack) communication abnormal	Reserved	Shut down immediately
40	External communication abnormal	Reserved	Shut down immediately
41	Precharge failure	Reserved	Shut down immediately
42	Parallel operation fault	Reserved	Shut down immediately
43	BMS hardware fault status	Reserved	Shut down immediately
44	Front end	Cut off the relay. Close the	Shut down immediately

	(sampling chip) failure	precharge relay after the fault is rectified.	
45	EEPROM fault diagnosis	Cut off the relay. Close the precharge relay after the fault is rectified.	Shut down immediately
46	Fuse failure	Reserved	Shut down immediately
47	Diagnosis of abnormal MCU power supply	Reserved	Shut down immediately
48	SOC low alarm 1	Reserved	Charge/discharge the battery following the corresponding current limits sent by the BMS
49	Cell under-voltage alarm	Discharge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
50	Cell over-voltage alarm	Charge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
51	System discharge under-voltage alarm	Discharge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
52	System charging over-voltage alarm	Charge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
53	Charging low-temperature alarm	Charge/discharge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
54	Charging high-temperature alarm	Charge/discharge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
55	Discharge low-temperature alarm	Charge/discharge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
56	Discharge high-temperature alarm	Charge/discharge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
57	Charging over-current alarm	Charge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
58	Discharge over-	Discharge current is limited to 0A	Charge/discharge the

	current alarm		battery following the corresponding current limits sent by the BMS
59	Module under-voltage alarm	Discharge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
60	Module over-voltage alarm	Charge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
61	Cell voltage difference alarm	Charge/discharge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
62	SOC too low alarm 2	Reserved	Charge/discharge the battery following the corresponding current limits sent by the BMS
63	PCS communication loss alarm	Charge/discharge current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
64	Temperature difference high	Reserved	Charge/discharge the battery following the corresponding current limits sent by the BMS
65	MOS over-temperature	Reserved	Charge/discharge the battery following the corresponding current limits sent by the BMS
66	Ambient temperature over-high	Charging/discharging current is limited to 0A	Charge/discharge the battery following the corresponding current limits sent by the BMS
67	Region mismatched with the PCS	Reserved	Reserved
68	Low-temperature charging over-current alarm	Reserved	Reserved

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