Energy-Z BMS CAN Protocol

V1.4

Version	Date	Created by / Revised by	Revision description	Revision reason
V1.0	April 8, 2021		1. First version	
V1.1	May 27, 2021		1. Increase of instruction of inquiry circulation times 2. Revision of the definition of PF value in Section 6.3	
V1.2	November 16, 2021		1. Modification of the calculation range of multi-packet frame verification 2. Modification of unit description in analog quantity 3. Improvement of battery type information	
V1.3	December 8, 2021		1. Increase of instruction of other SOP values	
V1.4			1. 500kbits->1000kbits	

1 Terms and Definitions

1.1

Extended frame

CAN data frame defined in CAN bus using 29-bit identifier

1.2

Priority (P)

In a 3-bit field in the identifier, set the arbitration priority of the transmission process, with the highest priority being level 0 and the lowest priority being level 7.

1.3

Protocol data unit (PDU)

A specific CAN data frame format, which contains CAN ID and data field.

1.4

Lithium battery BMS

Built-in management system of battery pack.

1.5

Control module

Equipment with active communication with lithium battery BMS in the system.

2 General Provisions

2.1 CAN2.0B protocol is adopted for the communication network between lithium battery BMS and other devices.

2.2 Extended frame format is used for communication.

2.3 The format of low byte first transmission is adopted for data transmission.

2.4 Lithium battery BMS will stop actively sending the heartbeat frame after it has not received the heartbeat frame sent by the control module for more than 20 minutes, and recover after receiving the heartbeat frame again.

3 Physical Layer

The physical layer using this protocol shall comply with the provisions of ISO 11898-1:2003 and SAE J1939-11:2006 on the physical layer. The communication rate between control module and lithium battery BMS should be 1000 kbit/s.

4 Data Link Layer

4.1 Distribution of addresses

When the control module has only one lithium battery BMS in the system, the actual address of the lithium battery BMS can be ignored and 0x00 can be directly used for communication.

Table 1 Address Distribution Range of Each Device

Device	Address
Lithium battery BMS	Address range: 0x00 - 0xEF, 0xFF is used as a broadcast address, and 0x00 is used as an arbitrary address.
Control module	Address range: 0xF0 - 0xFE

4.2 Protocol data unit (PDU)

Each CAN data frame contains a single protocol data unit (PDU), as shown in Table 2. The protocol data unit consists of seven parts, namely priority (P), reserved bit (R), data page (DP), PDU format (PF), PDU specificity (PS), source address (SA) and data field.

Table 2 Protocol Data Unit (PDU)

	R	DP				...	
P			PF	PS	SA	DATA	
3	1	1	8	8	8	0 ～ 64	

Description: (data format requirements)

1. P is the priority: set from the highest 0 to the lowest 7.

2. R is reserved bit: for future development and use, this standard is set to 0.

3. DP is data page: the auxiliary page used to select the description of parameter group, and this standard is set to 0.

4. PF is PDU format: used to determine the format of PDU and the number of parameter group corresponding to data field.

5. PS is PDU specific format: in this standard, PS value is the target address.

6. SA is the source address: the source address for sending this message.

7. DATA is the data field: if the data length of a given parameter group is ≤8 bytes, it will be transmitted according to 8 bytes, with the default value of 00H. If the data length of a given parameter group is 9 ~ 1785, data transmission needs multiple CAN data frames, and communication is performed through the protocol transmission function. See 4.3 for details.

8. The third row of this table indicates the number of bits.

4.3 Transmission Protocol

Data frames larger than 8 bytes in this section shall be transmitted by the following multi-frame transmission protocol.

After receiving multi-frame protocol data, check the data. If the check fails, abandon the transmitted data.

Multi-frame messages cannot be nested and sent.

For multi-frame messages, the message period is the transmission period of the whole data packet, and the interval between single-frame messages is not less than 10ms.

Table 3 Multi-frame Data Transmission Protocol Format

Frame serial number	Data1	Data2	Data3	Data4	Data5	Data6	Data7	Data8
1	Serial number of current passage	Number of total message frames	Low byte of valid data length of the message	High byte of valid data length of the message	Valid data 01	Valid data 02	Valid data 03	Valid data 04
2	Serial number of current passage	Valid data 05	Valid data 06	Valid data 07	Valid data 08	...		
... ...								

	Serial number of current passage	Valid data N	Low byte of check code	High byte of check code	00H	00H	00H	00H

Description: (data format requirements)

1. The valid data length refers to the number of bytes from "valid data 01" to "valid data N".

2. The check code refers to the cumulative sum from "total frame number of messages" to "valid data n" (excluding "serial number of current passage" in each frame message).

3. The serial number of current passage ranges from 1 to 255.

When the last frame is less than 8 bytes, it is transmitted according to 8 bytes, and the unused part is set to 00H.

5 Classification of messages

5.1 General provisions

This part of message is divided into command frame, data frame and heartbeat frame according to types.

The message length is 8 bytes. If the actual data is less than 8 bytes, it will be sent as 8 bytes, and the unused part will be set to 00H.

5.2 Command frame

Table 4 Classification of Command Frame

Message description	PF	Priority	Data length (Byte)	Data type	Message period (ms)	Source address -- destination address
Fixed value inquiry	0x80	6	8	BIN	Non-periodic message	Control module - lithium battery BMS
Fixed value inquiry response	0x81	6	8	BIN	Non-periodic message	Lithium battery BMS - control module
Cell temperature inquiry	0x82	6	8	BIN	Non-periodic message	Control module - lithium battery BMS
Cell temperature inquiry response	0x83	6	8	BIN	Non-periodic message	Lithium battery BMS - control module
Monomer voltage inquiry	0x84	6	8	BIN	Non-periodic message	Control module - lithium battery BMS
Monomer voltage inquiry response	0x85	6	8	BIN	Non-periodic message	Lithium battery BMS - control module
Circulation times inquiry	0x86	6	8	BIN	Non-periodic message	Control module - lithium battery BMS

Message description	PF	Priority	Data length	Data type	Message period	Source address -- destination address
Circulation times inquiry response	0x87	6	8	BIN	Non-periodic message	Lithium battery BMS - control module
Other SOP inquiry	0x88	6	8	BIN	Non-periodic message	Control module - lithium battery BMS
Other SOP inquiry response	0x89	6	8	BIN	Non-periodic message	Lithium battery BMS - control module

5.3 Data frame

Table 5 Classification of Data Frame

Message description	PF	Priority	Data length (Byte)	Data type	Message period (ms)	Source address -- destination address
Charging request information	0x22	6	8	BIN	1000	Lithium battery BMS - control module
Battery alarm information	0x24	6	8	BIN	1000	Lithium battery BMS - control module
Battery operation information	0x26	6	8	BIN	1000	Lithium battery BMS - control module

5.4 Heartbeat frame

Table 6 Classification of Heartbeat Frame

Message description	PGN	Priority	Data length (Byte)	Data type	Message period (ms)	Source address -- destination address
Heartbeat frame	0x43	6	8	BIN	2000	Control module - lithium battery BMS

5.5 Program online updating frame

Table 7 Classification of Program Online Updating Frame

Message description	PGN	Priority	Data length (Byte)	Data type	Message period (ms)	Source address -- destination address
Updating heartbeat frame	0x70	4	8	BIN	1000	Control module - lithium battery BMS
Updating heartbeat response frame	0x71	4	8	BIN	1000	Lithium battery BMS - power control module

Start download command frame	0x72	4	8	BIN	500	Control module - lithium battery BMS
Start download response frame	0x73	4	8	BIN	500	Lithium battery BMS - power control module
Request interval command frame	0x74	4	Indetermi nate	BIN	500	Control module - lithium battery BMS
Request interval response frame 1	0x75	4	8	BIN	500	Lithium battery BMS - power control module
Request interval response frame 2	0x76	4	8	BIN	500	Lithium battery BMS - control module
Start group package command frame	0x77	4	8	BIN	500	Control module - lithium battery BMS
Start group package response frame	0x78	4	8	BIN	500	Lithium battery BMS - control module
Data send frame	0x79	4	8	BIN	10	Control module - lithium battery BMS
Complete group package command frame	0x7A	4	8	BIN	500	Control module - lithium battery BMS
Complete group package response frame	0x7B	4	8	BIN	500	Lithium battery BMS - control module
Program check data frame	0x7C	4	8	BIN	500	Control module - lithium battery BMS
Program check response frame	0x7D	4	8	BIN	500	Lithium battery BMS - control module
Immediate resetting command frame	0x7E	4	8	BIN	500	Control module - lithium battery BMS
Immediate resetting response frame	0x7F	4	8	BIN	500	Lithium battery BMS - control module

6 **Message Format and Content**

6.1 **Fixed value inquiry**

PF:80 Fixed value inquiry

Control module

Lithium battery

PF:81 Fixed value inquiry response
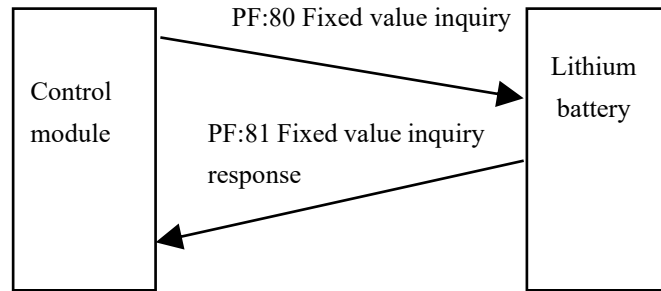
Table 8 Fixed Value Inquiry Command Frame

Start byte or bit	Parameter name	Data format	Field length	Remark
1	Series number of fixed value	BIN	2Byte	Unit: no Resolution ratio: 1/bit Scope: 1 - 200 Offset: 0

Table 9 Fixed Value Inquiry Response Frame

Start byte or bit	Parameter name	Data format	Field length	Remark
1	Series number of fixed value	BIN	2Byte	Unit: no Resolution ratio: 1/bit Scope: 1 - 200 Offset: 0
3	Operation return	BIN	1Byte	Bit7:　　　Successful identification 　　　　　0x00 --- Failed　0x01 --- Successful Bit6 ~ Bit4: Reserved Bit3 ~ Bit0: Failure reason 　　　　　0x00 --- Successful 　　　　　0x01 --- No fixed value 　　　　　0x02 --- Not allowed to read 　　　　　0x03 --- Read failure
4	Blank leaving	BIN	1Byte	Fixed as 0
5	Fixed value information	/	/	Refer to Table A.1 in the Appendix

6.2　Cell temperature inquiry

When the number of cell temperatures exceeds 8, multi-frame transmission is required.

PF:82 Cell temperature inquiry

PF:83 Cell temperature inquiry response

Control module

Lithium battery
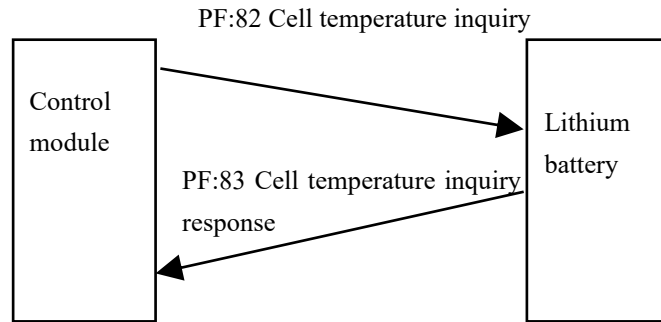
Table 10 Cell Temperature Inquiry Command Frame

Start byte or bit	Parameter name	Data format	Field length	Remark

Table 11 Cell Temperature Inquiry Response Frame

Start byte or bit	Parameter name	Data format	Field length	Remark
1	Cell temperature 1	BIN	1Byte	Unit: °C Resolution ratio: 1°C/bit Scope: 0-160°C Offset: 40
2	Cell temperature 2	BIN	1Byte	Unit: °C Resolution ratio: 1°C/bit Scope: 0-160°C Offset: 40
3	Cell temperature 3	BIN	1Byte	Unit: °C Resolution ratio: 1°C/bit Scope: 0-160°C Offset: 40
··· ···				
n	Cell temperature n	BIN	1Byte	Unit: °C Resolution ratio: 1°C/bit Scope: 0-160°C Offset: 40

6.3 Monomer voltage inquiry

When the number of cells exceeds 4, multi-frame transmission is required.

PF:84 Monomer voltage inquiry
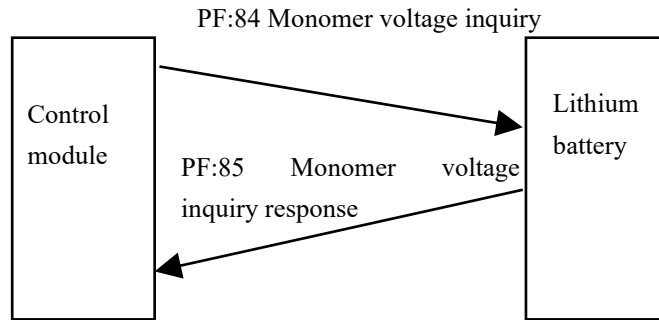
Table 12 Monomer Voltage Inquiry Command Frame

Start byte or bit	Parameter name	Data format	Field length	Remark

Table 13 Monomer Voltage Inquiry Response Frame

Start byte or bit	Parameter name	Data format	Field length	Remark
1	Cell voltage 1	BIN	2Byte	Unit: V Resolution ratio: 0.001V/bit Scope: 0-5V Offset: 0
3	Cell voltage 2	BIN	2Byte	Unit: V Resolution ratio: 0.001V/bit Scope: 0-5V Offset: 0
5	Cell voltage 3	BIN	2Byte	Unit: V Resolution ratio: 0.001V/bit Scope: 0-5V Offset: 0
••• •••				
n	Cell voltage n	BIN	2Byte	Unit: V Resolution ratio: 0.001V/bit Scope: 0-5V Offset: 0

6.4　Circulation times inquiry

PF:86 Circulation times inquiry

Control module → Lithium battery

PF:87 Circulation times inquiry response
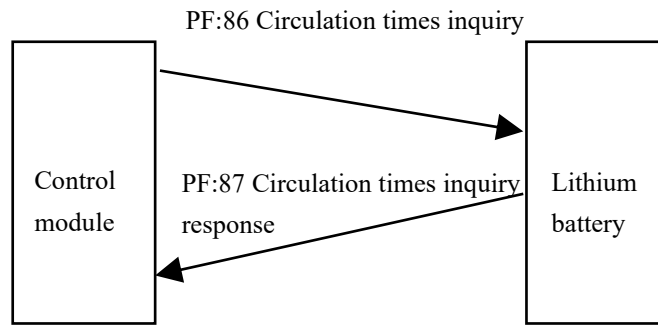
Table 14 Circulation Times Inquiry Command Frame

Start byte or bit	Parameter name	Data format	Field length	Remark

Table 15 Circulation Times Inquiry Response Frame

Start byte or bit	Parameter name	Data format	Field length	Remark
1	Circulation times	BIN	2Byte	Unit: time Resolution ratio: 1 time/bit Scope: 0-65535 Offset: 0

6.5 Other SOP inquiry

PF:88 Other SOP inquiry

Control module → Lithium battery

PF:89 Other SOP inquiry response
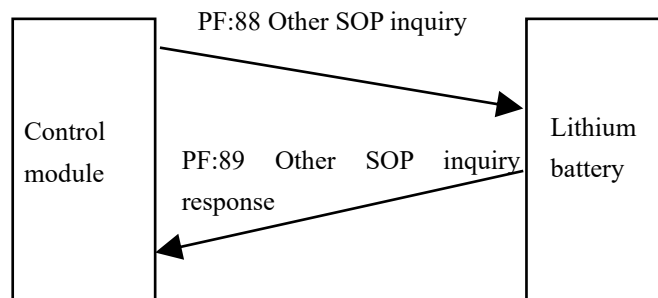
Table 16 Other SOP Inquiry Command Frame

Start byte or bit	Parameter name	Data format	Field length	Remark

Table 17 Other SOP Inquiry Response Frame

Start byte or bit	Parameter name	Data format	Field length	Remark
1	0.5s SOP	BIN	2Byte	Unit: W Resolution ratio: 10W/bit Scope: 0-60kW Offset: 0
3	3s SOP	BIN	2Byte	Unit: W Resolution ratio: 10W/bit Scope: 0-60kW Offset: 0

6.6 Charging request information

The charging request information is the information actively reported by the lithium battery BMS, and the main control module is not required to respond.
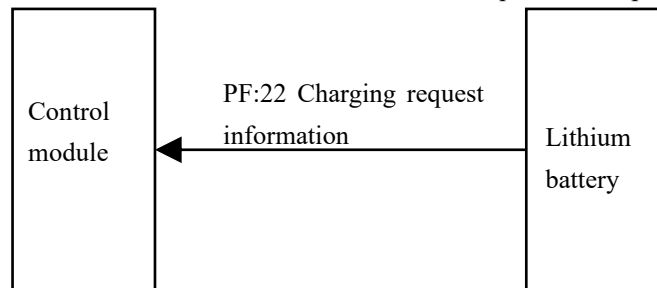
Table 18 Charging Request Information

Start byte or bit	Parameter name	Data format	Field length	Remark
1	Request voltage	BIN	2Byte	Unit: V Resolution ratio: 0.01V/bit Scope: 0-100V Offset: 0
3	Request current	BIN	2Byte	Unit: V Resolution ratio: 0.01V/bit Scope: 0-600V Offset: 0
5	Cell monomer highest voltage	BIN	2Byte	Unit: V Resolution ratio: 0.001V/bit Scope: 0-5V Offset: 0
7	Charging state	BIN	2Byte	B15: Temperature limit charging current occurs B14: The circulation times are limited to the charging current B13: Long-term standing limit charging current occurs B12： B11：

				B10：
				B9：
				B8：
				B7：
				B6：
				B5：
				B4：
				B3：
				B2：
				B1: Pre-charging is required
				B0: Charging is prohibited

6.7 Battery alarm information

The battery alarm information is the information actively reported by the lithium battery BMS, and the main control module is not required to respond.


Table 19 Battery Alarm Information

Start byte or bit	Parameter name	Data format	Field length	Remark
1	Alarm	BIN	2Byte	B15: Discharge overcurrent B14: Battery damage B13: B12: Battery low temperature (charging/discharging) B11: Battery high temperature (charging/discharging) B10: Battery (monomer) undervoltage B9: Battery (monomer) overvoltage B8： B7： B6： B5： B4： B3： B2： B1： B0: Charging overcurrent

Start byte or bit	Parameter name	Data format	Field length	Remark
3	Warning	BIN	2Byte	B15: Discharge overcurrent B14: B13: B12: Battery low temperature (charging/discharging) B11: Battery high temperature (charging/discharging) B10: Battery (monomer) undervoltage B9: Battery (monomer) overvoltage B8： B7： B6： B5： B4： B3： B2： B1： B0: Charging overcurrent

6.8 **Battery operation information**

The battery operation information is the information actively reported by the lithium battery BMS, and the main control module is not required to respond.
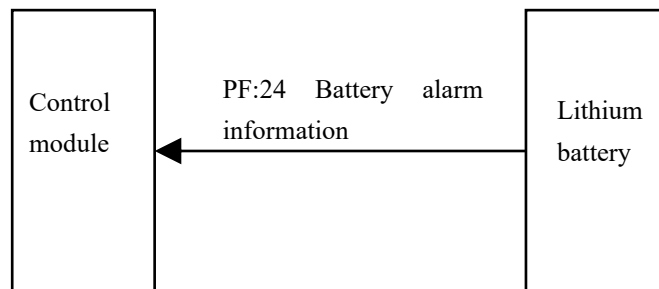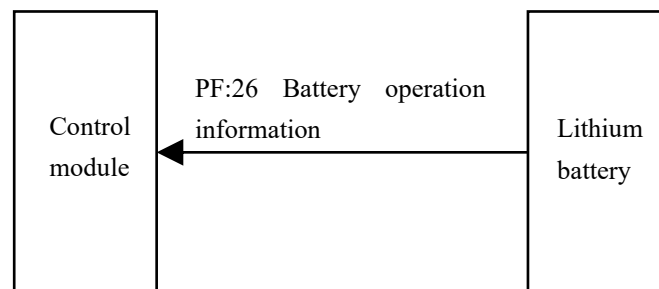
Table 20 Battery Operation Information

Start byte or bit	Parameter name	Data format	Field length	Remark
1	Total battery voltage	BIN	2Byte	Unit: V Resolution ratio: 0.01V/bit Scope: 0-100V Offset: 0
3	Battery current	BIN	2byte	Unit: A Resolution ratio: 0.01A/bit Scope: -300A-300A Offset: 0
5	SOC	BIN	1byte	Unit: % Resolution ratio: 1%/bit Scope: 0-100%

				Offset: 0
6	SOH	BIN	1byte	Unit: % Resolution ratio: 1%/bit Scope: 0-100% Offset: 0
7	15s SOP	BIN	2Byte	Unit: W Resolution ratio: 10W/bit Scope: 0-60kW Offset: 0

6.9 **Heartbeat frame**

After the heartbeat frame is powered on in the main control module, it needs to be sent to the lithium battery BMS periodically, and the lithium battery BMS does not need to respond.
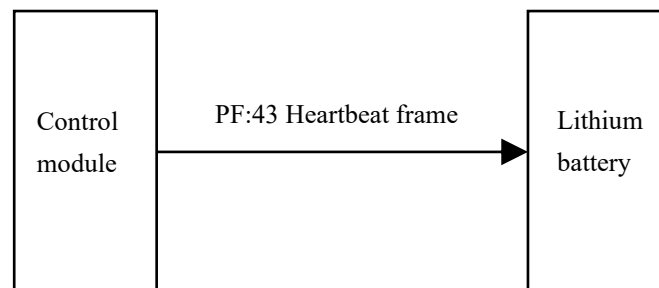
Table 21 Heartbeat Frame

Start byte or bit	Parameter name	Data format	Field length	Remark
1	CAN equipment pre-registration information	BIN	4Byte	Fixed as 0x00000001 currently
5	CAN equipment registration information	BIN	4byte	Fixed as 0x00000001 currently

7 **Program online updating**

To be updated

Appendix A
(Normative Appendix)
Table on Fixed Value Information of Lithium Battery BMS

Refer to Table A.1 for fixed value information of lithium battery BMS.

Table A.1 Fixed Value Information of Lithium Battery BMS

Serial number of fixed value	Parameter name	Data format	Field length	Remark
1	Equipment model	ASCII code	32Byte	For read only
2	Reservation	BIN	2Byte	
3	Equipment serial number	ASCII code	32Byte	For read only
4	Hardware version of equipment controller	BIN	2Byte	For read only Hardware version number consists of major version number and minor version number. Example: The hardware version number is V1.00, the major version number is 01H, and the minor version number is 00H; message byte sending sequence is 01H 00H.
5	Software version of equipment controller	BIN	2Byte	For read only Software version number consists of major version number and minor version number. Example: The software version number is V1.00, the major version number is 01H, and the minor version number is 00H; message byte sending sequence is 01H 00H.
6	Software date of equipment controller	BIN	4Byte	For read only Data1: year Data2: month Data3: date Data4: hour Example: The date of the software is 18: 00 on April 8, 2021, which is expressed as 21H 04H 08H 18H, and the message byte sending sequence is 21H 04H 08H 18H.
7	CAN protocol version	BIN	2Byte	For read only CAN protocol version number consists of major version number and minor version number. Example: The CAN protocol version number is V1.00, the major version number is 01H, and the minor version number is 00H; message byte sending sequence is 01H 00H.

8	Cell quantity	BIN	1Byte	Unit: PCS Resolution ratio: 1PCS/bit Scope: 0-16PCS Offset: 0
9	Cell type	BIN	1Byte	0: Iron phosphate lithium 1: Cobalt acid lithium 2: Other ternary polymer lithium batteries 3: Solid-state lithium battery
10	Quantity of cell temperature sensor	BIN	1Byte	Unit: PCS Resolution ratio: 1PCS/bit Scope: 0-255PCS Offset: 0
11	Quantity of environment temperature sensor	BIN	1Byte	Unit: PCS Resolution ratio: 1PCS/bit Scope: 0-255PCS Offset: 0
12	Quantity of other temperature sensors	BIN	1Byte	Unit: PCS Resolution ratio: 1PCS/bit Scope: 0-255PCS Offset: 0
13	Reservation	BIN	2Byte	
14	PACK rated voltage	BIN	2Byte	Unit: V Resolution ratio: 0.01V/bit Scope: 0-100V Offset: 0
15	PACK rated capacity	BIN	2Byte	Unit: AH Resolution ratio: 0.01AH/bit Scope: 0-300AH Offset: 0
16	Maximum discharge current	BIN	2Byte	Unit: A Resolution ratio: 0.01A/bit Scope: 0-600A Offset: 0
17	Maximum discharging current	BIN	2Byte	Unit: A Resolution ratio: 0.01A/bit Scope: 0-600A Offset: 0
18	FOV voltage			
19	OVP voltage			
20	Platform			

	voltage			
21	Reservation			