Elektromotus Emus BMS documentation

Emus BMS Serial Protocol

Version 2.0.12

Version Notes:

Version	Author	Date	Description
1.0.8 B	MM	Jun 17, 2011	Initial version
1.8 A	MM	May 21, 2012	Changes to reflect the version 1.8.x software
1.8 B	MM	May 22, 2012	Added documentation of other commands
2.0.0	JB	Feb 21, 2013	Changes to reflect the version 2.0.0
2.0.1	JB	Apr 25, 2013	Re-introduced BF20 function
2.0.2	JB	Jun 27, 2013	Added CS4 and RS2 sentences. Expanded sixth data field of ST1 sentence to two bytes to reserve space for more protection flags in the future. Added eight field to ST1 sentence that contains pin statuses. Updated FN_FUNCTIONS_FLAGS_0 parameter description
2.0.3	JB	Nov 07, 2014	New document title. New template applied. Deprecated sentences removed. Parts of the document restructured and rewritten for more clarity. Changes to reflect the version 2.0.18_RC3 Emus BMS Control Unit firmware.
2.0.4	JB	Feb 19, 2015	Few mistakes corrected in “Data field encoding types” description. “LAST CHARGE ENERGY” and “LAST DISCHARGE ENERGY” fields added to DT1 sentence.
2.0.5	DP	Mar 16, 2015	BMS Status Sentence: updated Pin Status Flag description. Added Statistics field description and encoding.
2.0.6	JB	Dec 09, 2015	Added connection settings information. Added sentences related to cell temperature measurement support, which was introduced in Control Unit firmware version 2.0.19_RC9. Renamed some sentences and sentence field names in order to avoid confusion between cell temperatures and cell module temperatures. Update LG1, SS1 and ST1 sentence description accordingly. Updated some sentence examples. Updated „Parameter meaning by ID“ table.
2.0.7	JB	May 31, 2016	Corrected mistake in the example of ST1 sentence (wrong CRC value). Added descriptions of new configuration parameters and updated the DT1 sentence to reflect changes introduced in Control Unit firmware version 2.0.20_RC1.
2.0.8	JB	July 25, 2016	Updated the DT1 sentence to reflect changes introduced in Control Unit firmware version 2.0.20_RC4. Added “Climate Control Max Duration While Not Charging” parameter which was missing from the “Parameter meaning by ID” table.
2.0.9	JB	Mar 10, 2017	Updated PW1, PW2, and CS1 sentences, “Parameter meaning by ID” list, and removed CS2, CS3 and CS4 sentences to reflect the changes introduced in Control Unit firmware version 2.0.21.0
2.0.10	JB	Mar 24, 2017	Updated ST1 sentence according to the changes introduced in Control Unit firmware version 2.0.21.2.
2.0.11	JB	May 23, 2017	Added the previously implemented and forgotten “Charger Connected” protection flag in the description of ST1 sentence.
2.0.12	JB	Aug 26, 2017	Corrected reserved bit information in fields “PROTECTION FLAGS” and “POWER REDUCTION FLAGS” in ST1 sentence.

Table of Contents

Introduction

Emus BMS Control Unit is capable of communicating and interacting with other devices in the system over RS232 or USB interfaces by using a special serial communication protocol. This serial communication protocol is used to send Emus BMS operation status updates to other devices, receive configuration and control messages from other devices, and perform Control Unit firmware updates. This document describes the serial communication protocol to help integrate Emus BMS with other embedded systems.
In order to establish communication with Emus BMS Control Unit over the RS232 or USB interface, the external device must use the following connection settings:

Baud rate: 57.6kpbs;
Data Bits: 8 bits;
Parity: None;
Stop Bits: 1 bit;
Hardware Flow Control: None

General format

The general format of serial communication is based on text line sentences, separated by carriage return and/or line feed ASCII characters 0x0A or 0x0D, therefore each new text line is considered as a potentially valid sentence. A valid sentence must also satisfy several other rules:

- Sentence name and data fields in text string must be separated by ASCII comma characters as delimiters;
- Sentence name is the first text section until the delimiting comma character;
- The format of sentence name and its data fields must comply with the description in corresponding version of Emus BMS Control Unit firmware documentation;
- Each sentence ends with two characters, that denote the hexadecimal 8-bit value of CRC checksum, which was calculated from all preceding characters in the sentence;
- ASCII characters 0x0A and 0x0D are sentence delimiters, and are not calculated into CRC checksum.

General sentence format notation is:

<CR/LF>[Sentence Name],[Data field 1],[...],[Data field n],[CRC checksum]<CR/LF>

Below is an example of valid sentence text string:

```
ST1,00,00,0000,000128E3,07,0000,00,00040802,A2
```

'ST1' is the sentence name. The sentence contains eight data fields, '00' being the first one, and '00040802' being the last. The remaining field '93' is the CRC checksum, calculated from all the preceding characters, starting with 'S' to the final ','.
Emus BMS can send the sentences periodically and/or upon request from external device. Usually the request is denoted by '?' in data field of the sentence sent by external device to Emus BMS. Below is an example of request sentence that can be sent to Emus BMS:

```
VR1,?,D7
```

'VR1' is sentence name, '?' is the data request symbol, and 'D7' is CRC checksum.
Not all sentences support the '?' data request. The details of every specific sentence are described in chapters of this document, dedicated to individual sentences.
The CRC checksum is 8 bit value, calculated based on X^8+X^5+X^4+X^0 polynomial with initial value 0. The function example in C programming language that can be used to decode the CRC value is given below:

```
#define CRC8INIT      0x00
#define CRC8POLY      0x18              //0X18 = X^8+X^5+X^4+X^0
uint8_t crc8 ( uint8_t *data_in, uint16_t number_of_bytes_to_read )
{
        uint8_t        crc;
        uint16_t loop_count;
        uint8_t  bit_counter;
        uint8_t  data;
        uint8_t  feedback_bit;
        crc = CRC8INIT;
        for (loop_count = 0; loop_count != number_of_bytes_to_read; loop_count++)
        {
                data = data_in[loop_count];
                bit_counter = 8;
                do {
                        feedback_bit = (crc ^ data) & 0x01;
                        if ( feedback_bit == 0x01 ) {
                                crc = crc ^ CRC8POLY;
                        }
                        crc = (crc >> 1) & 0x7F;
                        if ( feedback_bit == 0x01 ) {
                                crc = crc | 0x80;
                        }
                        data = data >> 1;
                        bit_counter--;
                } while (bit_counter > 0);
        }
        return crc;
}
```

Data field encoding types

Data fields in the sentences may have several data coding formats to represent different types of data in simple concise format encoded in text string. Formats are designed for data to be easily encoded or decoded with little processing effort, at the same time requiring modest transmission rate.

Hexadecimal encoding

Most of the data values are transferred in hexadecimal format, using number characters from '0' to '9' and uppercase characters from 'A' to 'F'. Any data that utilizes this encoding is sent using big endian format, where most significant value comes first. The length of data field that contains hexadecimal value depends on size of value being transferred: 8-bit byte is transferred in 2 characters, 16-bit word is transferred in 4 characters, and 32-bit double word is transferred in 8 characters.
There are several types of data that are transferred in hexadecimal encoding, which are described below along with their abbreviations.

HexCode - Code of predefined meaning or text, encoded in hexadecimal. Example: if data field has predefined value meanings, such as 0 - Normal, 1 - Warning, 2 - Error, then value '02' in that field means that Emus BMS Control Unit is reporting an error.

HexDec - Fixed point decimal number encoded in hexadecimal. The value is decoded by converting the hexadecimal representation into signed or unsigned integer, adding an offset value, and then multiplying by multiplier (offset and multiplier are specified in this document for each data field where needed). For example, if hexadecimal number '8D' represents unsigned integer with offset of -100 and multiplier of 0.1, then the actual value is:

$$(141_{(\text{hexadecimal } 0x8D)} + (-100)) \times 0.1 = 4.1;$$

If the hexadecimal number is '5E', then the actual value would be:

$$(94_{(\text{hex } 0x5E)} + (-100)) \times 0.1 = -0.6;$$

Please note that even if the raw hexadecimal value is treated as unsigned, the decoded value could be still signed value if offset is a negative number.

HexDecByteArray – An array of bytes that represent fixed point decimal numbers, encoded in hexadecimal. Example: if data field is specified as HexDecByteArray with offset 200 and multiplier 0.01, then a string '9D9F9E' in that field encodes the following values:

$$(157_{(\text{hex } 0x9D)} + 200) \times 0.01 = 3.57;$$
$$(159_{(\text{hex } 0x9F)} + 200) \times 0.01 = 3.59;$$
$$(158_{(\text{hex } 0x9E)} + 200) \times 0.01 = 3.58.$$

HexBitBool – A set of logical (Boolean) values, where each bit of a byte represents a separate logical value, encoded in hexadecimal. For example, if data field description specifies that bit 0 represents “Under-voltage” flag, and bit 1 represents “Over-Voltage” flag, then value '02' in that data field means that “Over-voltage” flag is active.

Decimal encoding

In decimal encoding, a signed or unsigned integers are represented in their usual decimal format.

DecInt – Signed or unsigned integer.

String encoding

Str – Human readable information string.

Sentences

The sentences that can be sent by Emus BMS Control Unit are described in following chapters.
NOTE! The sentence content may change with newer Emus BMS Control Unit firmware versions. For application backwards-compatibility, it is advised leave the opportunity to receive more fields in the sentence when Emus BMS is integrated with an external device, as new fields are always added at the end of the sentence. It is important to check the CRC of the full sentence regardless of number of fields in it. Individual data field length may also change with never versions, therefore it is advised to rely on the comma delimiters when reading the data from a field.

BB1 – Battery Balancing Rate Summary Sentence

This sentence contains the summary of cell balancing rates of the battery pack. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
BB1,0050,00,00,00,,A0,B1
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.
If Emus BMS Control Unit cannot communicate to cell modules, the data fields are empty. Example:

```
BB1,,,,,,,21
```

Cell balancing rate shows the cell balancing current as a percentage from maximum possible balancing current, with values ranging from 0 to 255 (note that the multiplier converts the range of values to be from 0 to 100). The maximum possible balancing current depends on the cell voltage and the resistance of shunt resistor on the cell module, therefore the actual balancing current is calculated by the following formula:

Balancing Current [A] = (Cell Voltage [V] / Shunt Resistance [Ohm]) x (Balancing Rate / 100)

For example, the decoded value 13 on a cell with 3.6 V and shunt resistance 2.7 Ohm means that the balancing current is ~173 mA.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	NUMBER OF CELLS	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Number of cells that are detected through communication channel.

2	MIN CELL BALANCING RATE	HexDec unsigned offset: 0 multiplier: 100/255 result: unsigned unit: %	Lowest cell module balancing rate in the battery pack.
3	MAX CELL BALANCING RATE	HexDec unsigned offset: 0 multiplier: 100/255 result: unsigned unit: %	Highest cell module balancing rate in the battery pack.
4	AVERAGE CELL BALANCING RATE	HexDec unsigned offset: 0 multiplier: 100/255 result: unsigned unit: %	Average cell module balancing rate in the battery pack.
5	Empty field		An empty field for backward compatibility.
6	BALANCING VOLTAGE THRESHOLD	HexDec unsigned offset: 200 multiplier: 0.01 result: unsigned unit: V	Balancing voltage threshold: if cell voltage is above this threshold, cell module starts balancing.

BB2 – Battery Balancing Detail Sentence

This sentence contains individual cell balancing rates of a group of cells. Each group consists of 1 to 8 cells. The units of the cell balancing rate are the same as in BB1 sentence, and are described in detail in page 7. This sentence is sent only after Emus BMS Control Unit receives a request sentence from external device, where the only data field is '?' symbol. The normal response to BB2 request message, when battery pack is made up of two parallel cell strings:

```
BB2,00,0000,08,0000000000000000,45
BB2,00,0008,08,0000000000000000,99
BB2,00,0010,08,0000000000000000,D7
BB2,00,0018,08,0000000000000000,0B
BB2,00,0020,08,0000000000000000,78
BB2,01,0028,08,0000000000000000,42
BB2,01,0030,08,0000000000000000,0C
BB2,01,0038,08,0000000000000000,D0
BB2,01,0040,08,0000000000000000,D9
BB2,01,0048,08,0000000000000000,05
```

If Emus BMS Control Unit cannot communicate to cell modules, the data fields are empty. Example:

```
BB2,,,,,,,E4
```


Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	CELL STRING NUMBER	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Cell string number, to which the group of cells belong. This help identify the actual position of the group if the battery pack consists of several parallel cell strings. If only one string is used, this field is 0.
2	CELL NUMBER OF FIRST CELL IN GROUP	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Cell number of the first cell in the group. Cells are numbered from 0, and the numbering does not reset if several parallel strings are used: if battery pack consists of two parallel strings with 40 cells in each string, then the last cell in the first string is number 39, and the first cell in the second string is number 40.
3	SIZE OF GROUP	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Size of the group of cells.
4	INDIVIDUAL CELL MODULE BALANCING RATE	HexDecByteArray unsigned offset: 0 multiplier: 100/255 result: unsigned unit: %	An array containing cell module balancing rates of cells in the group.

BC1 – Battery Charge Sentence

This sentence contains the state of charge data of the battery pack. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
BC1,000456F0,00057E40,1EDC,3C
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	BATTERY CHARGE	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: C	The estimated charge of battery pack in Coulombs. One Ah is equal to 3600 Coulombs.
2	BATTERY CAPACITY	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: C	Capacity of battery pack in Coulombs. One Ah is equal to 3600 Coulombs.

3	STATE OF CHARGE	HexDec signed offset: 0 multiplier: 0.01 result: signed unit: %	Estimated state of charge.

BT1 – Battery Cell Module Temperature Summary Sentence

This sentence contains the summary of cell module temperature values of the battery pack. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
BT1,0050,78,7A,78,,1A
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.
If Emus BMS Control Unit cannot communicate to cell modules, the data fields are empty. Example:

```
BT1,,,,,,F9
```

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	NUMBER OF CELLS	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Number of cells that are detected through communication channel.
2	MIN CELL MODULE TEMPERATURE	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Lowest cell module temperature in the battery pack.
3	MAX CELL MODULE TEMPERATURE	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Highest cell module temperature in the battery pack.
4	AVERAGE CELL MODULE TEMPERATURE	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Average cell module temperature in the battery pack.
5	Empty field		An empty field for backward compatibility.

BT2 – Battery Cell Module Temperature Detail Sentence

This sentence contains individual cell module temperatures of a group of cells. Each group consists of 1 to 8 cells. This sentence is sent only after Control Unit receives a request sentence from external device, where the only data field is '?' symbol. The normal response to BT2 request message, when battery pack is made up of two parallel cell strings:

```
BT2,00,0000,08,7778787878787878,0C
BT2,00,0008,08,7878787878787878,5B
BT2,00,0010,08,7877787778787878,D6
BT2,00,0018,08,7878787778787777,35
BT2,00,0020,08,7878777877787877,32
BT2,01,0028,08,7778777878777777,C7
BT2,01,0030,08,7777787878787778,62
BT2,01,0038,08,7878787877787878,E8
BT2,01,0040,08,7778777878787878,FA
BT2,01,0048,08,7878787777787878,43
```

If Emus BMS Control Unit cannot communicate to cell modules, the data fields are empty. Example:

```
BT2,,,,,,,AD
```

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	CELL STRING NUMBER	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Cell string number, to which the group of cells belong. This help identify the actual position of the group if the battery pack consists of several parallel cell strings. If only one string is used, this field is 0.
2	CELL NUMBER OF FIRST CELL IN GROUP	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Cell number of the first cell in the group. Cells are numbered from 0, and the numbering does not reset if several parallel strings are used: if battery pack consists of two parallel strings with 40 cells in each string, then the last cell in the first string is number 39, and the first cell in the second string is number 40.
3	SIZE OF GROUP	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Size of the group of cells.
4	INDIVIDUAL CELL MODULE TEMPERATURES	HexDecByteArray unsigned offset: -100 multiplier: 1 result: signed unit: °C	An array containing cell module temperatures of cells in the group.

BT3 – Battery Cell Temperature Summary Sentence

This sentence contains the summary of cell temperature values of the battery pack. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
BT3,0008,7A,7B,7A,,EA
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.
If Emus BMS Control Unit cannot communicate to cell modules, or external temperature senors are not installed on any of the cell modules, the data fields are empty. Example:

```
BT3,,,,,,,EE
```

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	NUMBER OF CELLS	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Number of cells that are detected through communication channel.
2	MIN CELL TEMPERATURE	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Lowest cell temperature in the battery pack.
3	MAX CELL TEMPERATURE	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Highest cell temperature in the battery pack.
4	AVERAGE CELL TEMPERATURE	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Average cell temperature in the battery pack.
5	Empty field		An empty field for backward compatibility.

BT4 – Battery Cell Temperature Detail Sentence

This sentence contains individual cell temperatures of a group of cells. Each group consists of 1 to 8 cells. This sentence is sent only after Control Unit receives a request sentence from external device, where the only data field is '?' symbol. The normal response to BT2 request message, when battery pack is made up of two parallel cell strings:

```
BT4,00,0000,08,777A7878787A7878,CF
BT4,00,0008,08,7878787878787878,2F
BT4,00,0010,08,7877787778787878,A2
BT4,00,0018,08,78787A7778787777,52
BT4,00,0020,08,787877787A787877,60
BT4,01,0028,08,7778777878777777,B3
BT4,01,0030,08,777A787878787778,12
BT4,01,0038,08,7A78787877787878,2C
BT4,01,0040,08,77787778787A7878,80
BT4,01,0048,08,787A787777787878,8E
```

If Emus BMS Control Unit cannot communicate to cell modules, the data fields are empty. Example:

```
BT4,,,,,,,3E
```

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	CELL STRING NUMBER	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Cell string number, to which the group of cells belong. This help identify the actual position of the group if the battery pack consists of several parallel cell strings. If only one string is used, this field is 0.
2	CELL NUMBER OF FIRST CELL IN GROUP	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Cell number of the first cell in the group. Cells are numbered from 0, and the numbering does not reset if several parallel strings are used: if battery pack consists of two parallel strings with 40 cells in each string, then the last cell in the first string is number 39, and the first cell in the second string is number 40.
3	SIZE OF GROUP	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Size of the group of cells.
4	INDIVIDUAL CELL TEMPERATURES	HexDecByteArray unsigned offset: -100 multiplier: 1 result: signed unit: °C	An array containing temperatures of cells in the group.

BV1 – Battery Voltage Summary Sentence

This sentence contains the summary of cell voltage values of the battery pack. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
BV1,0050,4A,94,80,335B,,D3
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.
If Emus BMS Control Unit cannot communicate to cell modules, the data fields are empty. Example:

```
BV1,,,,,,,39
```

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	NUMBER OF CELLS	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Number of cells that are detected through communication channel.
2	MIN CELL VOLTAGE	HexDec unsigned offset: 200 multiplier: 0.01 result: unsigned unit: V	Lowest cell voltage in the battery pack.
3	MAX CELL VOLTAGE	HexDec unsigned unsigned offset: 200 multiplier: 0.01 result: unsigned unit: V	Highest cell voltage in the battery pack.
4	AVERAGE CELL VOLTAGE	HexDec unsigned offset: 200 multiplier: 0.01 result: unsigned unit: V	Average cell voltage in the battery pack.
5	TOTAL VOLTAGE	HexDec unsigned offset: 0 multiplier: 0.01 result: unsigned unit: V	Total voltage of all cells in the battery pack.
6	Empty field		An empty field for backward compatibility.

BV2 – Battery Voltage Detail Sentence

This sentence contains individual voltages of a group of cells. Each group consists of 1 to 8 cells. This sentence is sent only after Control Unit receives a request sentence from external device, where the only data field is '?' symbol. The normal response to BV2 request message, when battery pack is made up of two parallel cell strings:

```
BV2,00,0000,08,8B85858585868587,93
BV2,00,0008,08,878782807D7F7F7D,A8
BV2,00,0010,08,7F83848365717E6D,00
BV2,00,0018,08,8585838482828075,8E
BV2,00,0020,08,7B7E817F7B718B8A,53
BV2,01,0028,08,828C8B9392899188,71
BV2,01,0030,08,829394928E8E8E96,7B
BV2,01,0038,08,898C8A928A8A897E,40
BV2,01,0040,08,83848B8B818C818C,C6
BV2,01,0048,08,878686888F787A8E,9D
```

If Emus BMS Control Unit cannot communicate to cell modules, the data fields are empty. Example:

```
BV2,,,,,,,FC
```

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	CELL STRING NUMBER	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Cell string number, to which the group of cells belong. This help identify the actual position of the group if the battery pack consists of several parallel cell strings. If only one string is used, this field is 0.
2	CELL NUMBER OF FIRST CELL IN GROUP	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Cell number of the first cell in the group. Cells are numbered from 0, and the numbering does not reset if several parallel strings are used: if battery pack consists of two parallel strings with 40 cells in each string, then the last cell in the first string is number 39, and the first cell in the second string is number 40.
3	SIZE OF GROUP	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Size of the group of cells.
4	INDIVIDUAL CELL VOLTAGES	HexDecByteArray unsigned offset: 200 multiplier: 0.01 result: unsigned unit: V	An array containing voltages of cells in the group

CF2 – Parameter Configuration Sentence

This sentence is used to retrieve or to change values of the Emus BMS configuration parameters. To retrieve the value of a certain configuration parameter, a request sentence with parameter ID in the first data field, and character '?' in the second data field must be sent to Emus BMS Control Unit. Example:

```
CF2,0C0E,?,30
```

Emus BMS Control Unit replies with the value of specified parameter. Example:

```
CF2,0C0E,00,C0
```

When a sentence with parameter value in the second data field (as in the example above) is sent to Emus BMS Control unit, it writes the submitted parameter data into its memory and responds with an identical sentence as a confirmation of successfully changed parameter. Word and double word parameter values must follow big-endian format, with most significant byte coming first.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	PARAMETER ID	HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned	The ID of parameter. List of parameter IDs and description of corresponding parameters are given in the "Parameter meaning by ID" table at the end of this document.
2	PARAMETER DATA	HexDec	Parameter value. Multiplier, offset and sign depends on the parameter, and are specified for each parameter separately in "Parameter meaning by ID" table at the end of this document.

CG1 – Can Devices Status Sentence

This sentence contains the statuses of Emus internal CAN peripherals. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
CG1,00,00,01,28,01,28,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,
00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,0
0,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,89
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	CAN CURRENT SENSOR STATUS	HexCode	Value that indicates CAN Current Sensor status. Meanings: 0 – Not configured; 1 – OK; 2 – Error ; 3 – No Response.
2	0		Reserved for future use
3	CAN CELL GROUP MODULE 0 STATUS	HexCode	Value that indicates CAN Cell Group Module 0 status. Meanings: 0 – Not configured; 1 – OK; 2 – Error ; 3 – No Response.
4	CAN CELL GROUP MODULE 0 NUMBER OF CELLS	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Number of cells connected to CAN Cell Group Module 0.
5	CAN CELL GROUP MODULE 1 STATUS	HexCode	Value that indicates CAN Cell Group Module 1 status. Meanings: 0 – Not configured; 1 – OK; 2 – Error ; 3 – No Response.
6	CAN CELL GROUP MODULE 1 NUMBER OF CELLS	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Number of cells connected to CAN Cell Group Module 1.
...			
65	CAN CELL GROUP MODULE 31 STATUS	HexCode	Value that indicates CAN Cell Group Module 31 status. Meanings: 0 – Not configured; 1 – OK; 2 – Error ; 3 – No Response.
66	CAN CELL GROUP MODULE 31 NUMBER OF CELLS	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Number of cells connected to CAN Cell Group Module 31.

CN1 – Received CAN Message Sentence

This sentence reports the CAN messages received on CAN bus by Emus BMS Control Unit, if “Send to RS232/USB” function is enabled. Example:

```
CN1,18FF50E5,1,0,8,0B90006000000000,4C
```

Since RS232/USB interface is much slower than CAN interface, using this sentence Emus BMS Control Unit sends only charger-related CAN messages, CAN messages from Emus CAN protocol, and messages related to Emus internal CAN peripherals configuration. This limitation is needed to prevent flooding the RS232/USB interface with CAN data.
This sentence may also be used to instruct Emus BMS Control Unit to send any CAN message to the CAN bus – a request sentence with format identical to the example above needs to be sent to Emus BMS Control Unit via RS232/USB interface in such case.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	CAN IDENTIFIER	HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned	Four-byte-long identifier of CAN message. In case standard CAN identifier is used, only the lower 11 bits of this field represent the identifier.
2	IDENTIFIER EXTENSION FLAG	HexCode	Flag that indicates whether standard or extended identifier is used. Meanings: 0 – Standard CAN ID; 1 – Extended CAN ID.
3	REMOTE TRANSMISSION REQUEST FLAG	HexCode	Remote transmission request flag. Meanings: 0 – No remote transmission request; 1 – Remote transmission request.
4	DATA LENGTH	DecInt unsigned	Number of bytes in data field.
5	DATA	HexDecByteArray	Array of up to 8 bytes, containing CAN message data.

CN2 – Sent CAN Message Sentence

This sentence reports the CAN messages that Emus BMS Control Unit sends to CAN bus, if “Send to RS232/USB” function is enabled. Example:

```
CN2,1806E5F4,1,0,8,0B90006200000000,FC
```

Same exact limitation as in CN1 sentence applies to this sentence too: only charger-related CAN messages, CAN messages from Emus CAN protocol, and messages related to Emus internal CAN peripherals configuration are reported using this sentence.
The format of the data fields is exactly the same as in CN1 message.

CS1 – Charger Status Sentence

This sentence contains the parameters and status of the charger. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
CS1,01,00,0B90,0062,0B90,0060,64
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	NUMBER OF CONNECTED CHARGERS	HexCode	Number of parallel connected chargers currently communicating with the Control Unit.
2	CAN CHARGER STATUS	HexCode	CAN charger's status byte. For values meaning please consult charger's manual. For non-CAN chargers, this field is empty.
3	SET VOLTAGE	HexDec unsigned offset: 0 multiplier: 0.1 result: unsigned unit: V	Charging voltage that is determined by Emus BMS Control Unit, and sent to the CAN-based charger. For non-CAN chargers this field is empty.
4	SET CURRENT	HexDec unsigned offset: 0 multiplier: 0.1 result: unsigned unit: A	Charging current that is determined by Emus BMS Control Unit, and sent to the CAN-based charger. For non-CAN chargers this field is empty.
5	ACTUAL VOLTAGE	HexDec unsigned offset: 0 multiplier: 0.1 result: unsigned unit: V	Actual charging voltage reported by the charger to Emus BMS Control Unit. If charger type does not provide actual charging voltage information, or non-CAN charger is used, this field is empty.
6	ACTUAL CURRENT	HexDec unsigned offset: 0 multiplier: 0.1 result: unsigned unit: A	Actual charging current reported by the charger to Emus BMS Control Unit. If charger type does not provide actual charging current information, or non-CAN charger is used, this field is empty.

CV1 – "Current and Voltage" Sentence

This sentence contains the values of battery voltage and current, measured by Emus BMS. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
CV1,000015AD,0004,01FF,01FD,01FA,03FC,09DA,66CF,0000,0000,DE
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	TOTAL VOLTAGE	HexDec unsigned offset: 0 multiplier: 0.01 result: unsigned unit: V	Total voltage of the battery pack.
2	CURRENT	HexDec signed offset: 0 multiplier: 0.1 result: signed unit: A	Current which is flowing through the battery pack. Positive value indicates charge current, negative value – discharge current.
3 – 10	Reserved internal		Internal BMS operation parameters that are used for BMS current measurement diagnostics from generated customer log files. Subject to change in next firmware releases.

DT1 – Distance and Energy Status Sentence

This sentence contains distance and energy related values, estimated (or measured) by Emus BMS Control Unit. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
DT1,0078,000000DD,00000057,000045B4,00000003,00000001,79
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	SPEED	HexDec unsigned Offset: 0 Multiplier: 0.1 Result: unsigned	Momentary speed value measured by Emus BMS Control Unit.

2	DISTANCE SINCE CHARGE	HexDec unsigned Offset: 0 Multiplier: 0.01 Result: unsigned	Distance traveled since last charge.
3	MOMENTARY CONSUMPTION	HexDec unsigned Offset: 0 Multiplier: 0.1 Result: unsigned	Momentary energy consumption in 0.1 Wh per distance unit.
4	ESTIMATED DISTANCE LEFT	HexDec unsigned Offset: 0 Multiplier: 0.01 Result: unsigned	Distance remaining, estimated based on current state of charge of the battery and distance driven in the current trip.
5	LAST CHARGE ENERGY	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Energy accumulated during last charge, i.e. from the moment the charger was connected, to the moment the charger is disconnected, in Wh.
6	LAST DISCHARGE ENERGY	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Energy used during last discharge (or trip), i.e. from the moment the charger was disconnected, to the moment the charger is connected again, in Wh.
7	LAST TRIP AVERAGE CONSUMPTION	HexDec unsigned Offset: 0 Multiplier: 0.1 Result: unsigned	Average energy consumption, calculated from the distance driven and energy consumed during the last trip;
8	ESTIMATED DISTANCE LEFT BASED ON LAST TRIP	HexDec unsigned Offset: 0 Multiplier: 0.01 Result: unsigned	Distance remaining, estimated based on currently remaining energy in the battery and last trip average consumption.
9	AVERAGE DISCHARGE ENERGY	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Average of the energy used in the last 20 trips (or less if total number of trips is less than 20), in Wh.
10	MAX DISCHARGE ENERGY	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	Maximum energy used in a single trip during the last 20 trips (or less if total number of trips is less than 20), in Wh.
11	CURRENT TRIP AVERAGE CONSUMPTION	HexDec unsigned Offset: 0 Multiplier: 0.1 Result: unsigned	Average energy consumption, calculated from the distance driven and energy consumed during the current trip;
12	ESTIMATED DISTANCE LEFT BASED ON AVG. CONSUMPTION	HexDec unsigned Offset: 0 Multiplier: 0.01 Result: unsigned	Distance remaining, estimated based on currently remaining energy in the battery and current trip average consumption.

FD1 – “Factory Defaults” Sentence

This sentence is used to reset the configuration, statistics, and event log of Emus BMS to factory default values. It is sent by external device to BMS, leaving the parameters field empty. Example:

```
FD1,,E2
```

IN1 – Input Pins Status Sentence

This sentence contains the status of Emus BMS Control Unit’s input pins. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
IN1,50,00,00,00,B9
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is ‘?’ symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	Reserved	HexBitBool Bit: 0-3	Bits 0 to 3 are reserved.
	AC SENSE	HexBitBool Bit: 4	AC SENSE input pin digital status.
	IGN. IN.	HexBitBool Bit: 5	IGN IN input pin digital status.
	FAST CHG.	HexBitBool Bit: 6	FAST CHG input pin digital status.
2-4	Reserved		

LG1 – Events Log Sentence

This sentence is used to retrieve the events log from Emus BMS. The request is sent with ‘?’ symbol as parameter. To clear the events log, ‘c’ needs to be sent symbol as the sentence parameter. Examples:

```
LG1,?,ED
LG1,c,D7
```

The response is multiple LG1 sentences with one event in each sentence. Response examples:

```
LG1,03,01,FFFFFF,1BCAC4D3,FC
LG1,04,03,FFFFFF,1BCAC4C6,19
```


If the events log is empty, or erase command was sent, Emus BMS Control Unit responds with an empty sentence:

```
LG1,,D7
```

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	LOG EVENT SEQUENCE NUMBER	HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned	Sequence number of log event where lowest number shows most recent event.
2	LOG EVENT IDENTIFIER	HexCode	Identifier of log event. Meanings: 0 – No event; 1 – BMS Started; 2 – Lost communication to cells; 3 – Established communication to cells; 4 – Cells voltage critically low; 5 – Critical low voltage recovered; 6 – Cells voltage critically high; 7 – Critical high voltage recovered; 8 – Discharge current critically high; 9 – Discharge critical high current recovered; 10 – Charge current critically high; 11 – Charge critical high current recovered; 12 – Cell module temperature critically high; 13 – Critical high cell module temperature recovered; 14 – Leakage detected; 15 – Leakage recovered; 16 – Warning: Low voltage - reducing power; 17 – Power reduction due to low voltage recovered; 18 – Warning: High current - reducing power; 19 – Power reduction due to high current recovered; 20 – Warning: High cell module temperature - reducing power; 21 – Power reduction due to high cell module temperature recovered; 22 – Charger connected; 23 – Charger disconnected; 24 – Started pre-heating stage; 25 – Started pre-charging stage; 26 – Started main charging stage; 27 – Started balancing stage; 28 – Charging finished; 29 – Charging error occurred; 30 – Retrying charging; 31 – Restarting charging; 42 – Cell temperature critically high; 43 – Critically high cell temperature recovered; 44 – Warning: High cell temperature – reducing power; 45 – Power reduction due to high cell temperature recovered.

3	EVENT PARAMETER	Reserved	Reserved
4	TIMESTAMP	HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned	The timestamp of event occurrence coded in number of seconds since January 1, 2000 time 00:00.

OT1 – Output Pins Status Sentence

This sentence contains the status of Emus BMS Control Unit's output pins. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
OT1,80,00,80,00,14
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	CHARGER	HexBitBool Bit: 7	CHARGER output pin digital status
2	Reserved		
3	HEATER	HexBitBool Bit: 4	HEATER output pin digital status
	BAT. LOW	HexBitBool Bit: 5	BAT. LOW output pin digital status
	BUZZER	HexBitBool Bit: 6	BUZZER output pin digital status
	CHG. IND.	HexBitBool Bit: 7	CHG. IND. output pin digital status
4	Reserved		

PW1 – Password Submission and Authentication Query Sentence

This sentence is used to log in, log out, or to request authentication status, depending on the sentence parameter. Sending '?' symbol as a sentence parameter requests authentication status from Emus BMS Control Unit. To log into level 1 access from level 0 access or into level 2 access from level 1 access, a corresponding password string of up to 8 characters needs to be in the parameter field of the sentence. To log out of the current level of access, parameter field of the sentence needs to be left empty. Examples in a corresponding order:

```
PW1,?,B7
PW1,mypass12,27
PW1,,B2
```


In all three cases Emus BMS Control Unit will respond with authentication status. Example:

```
PW1,0,AF
```

Description of response sentence data field:

Field #	Value meaning	Format	Description
1	AUTHENTICATION STATUS	HexCode	Authentication status: Meanings: 0 – Logged out, access level 0; 1 – Logged in, access level 1; 2 – Logged in, access level 2; ? – Log in request. Emus BMS Control Unit may send this request if user atempts to execute an action that requires logging in.

PW2 – “Set New Password” Sentence

This sentence is used to set or clear Emus BMS Control passwords. The sentence parameter field should consist of 4 to 8 characters long string. Level 1 password is set if current access level is 1, and level 2 password is set if current access level is 2. Clearing a password can be done by sending an empty string while logged into corresponding access level. Examples in respective order:

```
PW2,mypass12,41
PW2,,56
```

Emus BMS Control Unit responds with a result status, that indicates whether setting password succeeded or failed. Example:

```
PW2,1,E3
```

Description of response sentence data field:

Field #	Value meaning	Format	Description
1	PASSWORD SET RESULT	HexCode	Result of the attempt to set a new password. Meanings: 0 – Setting password failed; 1 – Setting password succeeded

RC1 – “Reset Current to Zero” Sentence

This sentence is used to reset the current sensor’s reading to 0 A, after current sensor is initially installed in the user's application. This sentence is meant to be sent by an external device, leaving the parameter field empty. Example:

```
RC1,,07
```


RS1 – “Reset Control Unit” Sentence

This sentence is used to reset the Emus BMS Control Unit. It is meant to be sent by external device, leaving the parameters field empty. Example:

```
RS1,,3F
```

RS2 – Reset Source History Log Sentence

This sentence is used to retrieve the reset source history log. It is requested by Emus BMS Control Panel when Emus BMS Control Unit connects to it, to be written into the log file. Example:

```
RS2,1BCAB37C,40,1BCAB16F,04,1BCAB16D,05,1BCAB168,04,1BCAB167,05,DF
```

Additionally, the sentence can be explicitly requested by request sentence from external device where the only data field is ‘?’ symbol.
Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	TIMESTAMP FOR RECORD 1	HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned	The timestamp of reset occurrence in number of seconds since January 1, 2000 time 00:00.
2	RESET SOURCE FLAGS FOR RECORD 1	HexBitBool	Flags that indicate the reset source. Bit meanings: Bit 0: Power-on Reset Flag (occurs when power supply voltage to the control unit is rising after power up); Bit 1: External Reset Flag (occurs when reset pin of the control unit is pulled low); Bit 2: Brown-out Reset Flag (occurs when internal power supply voltage to the control unit main processor falls below 4.3V); Bit 3: Watchdog Reset Flag; Bit 4: JTAG Reset Flag; Bit 5: Stack Overflow Reset Flag (software reset); Bit 6: User Caused Reset Flag (occurs when user resets the control unit from control panel, updates firmware, changes CAN speed, performs master clear, etc.).
...			
9	TIMESTAMP FOR RECORD 5	HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned	The timestamp of reset occurrence in number of seconds since January 1, 2000 time 00:00.
10	RESET SOURCE FLAGS FOR RECORD 5	HexBitBool	Flags that indicate the reset source. Bit meanings are the same as for record 1.

SC1 – "Set State of Charge" Sentence

This sentence is used to set the current state of charge of the battery in %. It is meant to be sent by external device, specifying the new State of Charge value as the only sentence parameter. Valid parameter values range from 0 to 100. The parameter should be encoded HexDec format with 0 offset and multiplier of 1. Example:

`SC1,64,E5` (sets 100% SoC)

SS1 – Statistics Sentence

This sentence is used to retrieve the statistics from Emus BMS Control Unit. To request all statistics at once, '?' symbol needs to be used as sentence parameter. Any single statistic can be requested with statistic identifier as the sentence parameter. The unprotected statistics can be cleared with 'c' symbol as the sentence parameter. Examples in a corresponding order:

```
SS1,?,F1
SS1,01,90
SS1,c,CB
```

The response is one or multiple SS1 sentences with one statistic in each sentence. Examples:

```
SS1,00,00000003,,
SS1,01,00000005,,
SS1,0A,85,0000,1BCE6DCE
SS1,0B,86,0000,1BCE6DD3
```

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	STATISTIC IDENTIFIER	HexCode	Identifier of statistic. Meanings: 0 – Total discharge; 1 – Total charge; 2 – Total discharge energy; 3 – Total charge energy; 4 – Total discharge time; 5 – Total charge time; 6 – Total distance; 7 – Master clear count; 8 – Max Discharge Current; 9 – Max Charge Current; 10 – Min Cell Voltage; 11 – Max Cell Voltage; 12 – Max Cell Voltage Difference; 13 – Min Pack Voltage; 14 – Max Pack Voltage; 15 – Min Cell Module Temperature; 16 – Max Cell Module Temperature; 17 – Max Cell Module Temperature Difference;

			18 – BMS starts count; 19 – Under-voltage protection count; 20 – Over-voltage protection count; 21 – Discharge over-current protection count; 22 – Charge over-current protection count; 23 – Cell module overheat protection count; 24 – Leakage protection count; 25 – No cell comm. protection count; 26 – Low voltage power reduction count; 27 – High current power reduction count; 28 – High cell module temperature power reduction count; 29 – Charger connect count; 30 – Charger disconnect count; 31 – Pre-heat stage count; 32 – Pre-charge stage count; 33 – Main charge stage count; 34 – Balancing stage count; 35 – Charging finished count; 36 – Charging error occurred; 37 – Charging retry count; 38 – Trips count; 39 – Charge restarts count; 45 – Cell overheat protection count; 46 – High cell temperature power reduction count; 47 – Min Cell Temperature; 48 – Max Cell Temperature; 49 – Max Cell Temperature Difference.
2	STATISTIC VALUE	HexDec	Value of statistic. The length, coding and meaning depends on specific statistic.
3	STATISTIC VALUE ADDITIONAL INFO	HexDec	Additional accompanying information of the statistic value (if applicable). The length, coding and meaning depends on specific statistic.
4	TIMESTAMP	HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 (if applicable)

Description of each statistics values:

Identifier	Value format	Additional value format	Timestamp format
0 – Total discharge	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: Ah	-	-
1 – Total charge	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: Ah	-	-

2 – Total discharge energy	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: Wh	-	-
3 – Total charge energy	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: Wh	-	-
4 – Total discharge time	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: s	-	-
5 – Total charge time	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: s	-	-
6 – Total distance	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: pulses	-	-
7 – Master clear count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned	-
8 – Max Discharge Current	HexDec unsigned offset: 0 multiplier: 0.1 result: unsigned unit: A	-	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
9 – Max Charge Current	HexDec unsigned offset: 0 multiplier: 0.1 result: unsigned unit: A	-	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned

10 – Min Cell Voltage	HexDec unsigned offset: 200 multiplier: 0.01 result: unsigned unit: V	Cell ID HexDec unsigned offset: 0 multiplier: 1 result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
11 – Max Cell Voltage	HexDec unsigned offset: 200 multiplier: 0.01 result: unsigned unit: V	Cell ID HexDec unsigned offset: 0 multiplier: 1 result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
12 – Max Cell Voltage Difference	HexDec unsigned offset: 0 multiplier: 0.01 result: unsigned unit: V	LSB – Min cell voltage at the time max cell voltage difference was registered, with following format: HexDec unsigned offset: 200 multiplier: 0.01 result: unsigned unit: V 2nd byte - Max cell voltage at the time max cell voltage difference was registered, with following format: HexDec unsigned offset: 200 multiplier: 0.01 result: unsigned unit: V 3rd and 4th bytes (word) – ID of cell with min voltage at the time max cell voltage difference was registered, with following format: HexDec unsigned offset: 0 multiplier: 1 result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned

13 – Min Pack Voltage	HexDec unsigned offset: 0 multiplier: 0.01 result: unsigned unit: V	-	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
14 – Max Pack Voltage	HexDec unsigned offset: 0 multiplier: 0.01 result: unsigned unit: V	-	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
15 – Min Cell Module Temperature	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Cell ID HexDec unsigned offset: 0 multiplier: 1 result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
16 – Max Cell Module Temperature	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Cell ID HexDec unsigned offset: 0 multiplier: 1 result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned

17 – Max Cell Module Temperature Difference	HexDec unsigned offset: 0 multiplier: 1 result: signed unit: °C	LSB – Min cell module temperature at the time max temperature difference was registered, with following format: HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C 2nd byte - Max cell module temperature at the time max temperature difference was registered, with following format: HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C 3rd and 4th bytes (word) – ID of cell module with min temperature at the time max cell temperature difference was registered, with following format: HexDec unsigned offset: 0 multiplier: 1 result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
18 – BMS starts count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
19 – Under-voltage protection count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned

20 – Over-voltage protection count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
21 – Discharge over-current protection count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
22 – Charge over-current protection count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
23 – Cell module overheat protection count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
24 – Leakage protection count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned

25 – No cell comm. protection count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
26 – Low voltage power reduction count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
27 – High current power reduction count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
28 – High cell module temperature power reduction count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
29 – Charger connect count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-
30 – Charger disconnect count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-

31 – Pre-heat stage count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-
32 – Pre-charge stage count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-
33 – Main charge stage count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-
34 – Balancing stage count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-
35 – Charging finished count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-
36 – Charging error occurred	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-
37 – Charging retry count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-

38 – Trips count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-
39 – Charge restarts count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	-
45 – Cell overheat protection count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
46 – High cell temperature power reduction count	-	Count HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit:	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
47 – Min Cell Temperature	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Cell ID HexDec unsigned offset: 0 multiplier: 1 result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned
48 – Max Cell Temperature	HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C	Cell ID HexDec unsigned offset: 0 multiplier: 1 result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned

49 – Max Cell Temperature Difference	HexDec unsigned offset: 0 multiplier: 1 result: signed unit: °C	LSB – Min cell temperature at the time max temperature difference was registered, with following format: HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C 2nd byte - Max cell temperature at the time max temperature difference was registered, with following format: HexDec unsigned offset: -100 multiplier: 1 result: signed unit: °C 3rd and 4th bytes (word) – ID of cell with min temperature at the time max cell temperature difference was registered, with following format: HexDec unsigned offset: 0 multiplier: 1 result: unsigned	The timestamp of when the statistic was last updated, in number of seconds since January 1, 2000 time 00:00 HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned

ST1 – BMS Status Sentence

This sentence indicates overall status of the Emus BMS operation. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
ST1,00,00,0000,000128E3,07,0000,00,00040802,93
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	CHARGING STAGE	HexCode	The current charging stage. Value meanings: 0 – "Charger Disconnected" 1 – "Pre-Heating Stage" 2 – "Pre-Charging Stage" 3 – "Main Charging Stage" 4 – "Balancing Stage" 5 – "Charging Finished" 6 – "Charging Error"
2	LAST CHARGING ERROR	HexCode	Last registered charging error. Value meanings: 0 – No error; 1 – No cell communication at the start of charging or communication lost during Pre-charging (using CAN charger), cannot charge; 2 – No cell communication (using non-CAN charger), cannot charge; 3 – Maximum charging stage duration expired; 4 – Cell communication lost during Main Charging or Balancing stage (using CAN charger), cannot continue charging; 5 – Cannot set cell module balancing threshold; 6 – Cell or cell module temperature too high; 7 – Cell communication lost during Pre-heating stage (using CAN charger); 8 – Number of cells mismatch; 9 – Cell over-voltage; 10 – Cell protection event occurred.
3	LAST CHARGING ERROR PARAMETER	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	An additional diagnostic parameter, that usually indicates the charging stage before the error occurred. This parameter may have other meanings in the future.
4	STAGE DURATION	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: s	The duration of current charging stage in seconds.

5	BATTERY STATUS FLAGS	HexBitBool	Battery status and cell communication status flags. Bit meanings: Bit 0: Cell voltages validity (1 if valid, 0 if invalid); Bit 1; Cell module temperatures validity; Bit 2: Cell balancing rates validity; Bit 3: Number of live cells validity; Bit 4: Battery charging finished (1 if active, 0 if inactive). This flag is used only when using non-CAN charger. Bit 5: Cell temperatures validity; Bits 6-7 are reserved.
6	PROTECTION FLAGS	HexBitBool	Protection status flags. Bit meanings: Bit 0: Cell Under-voltage; Bit 1: Cell Over-voltage; Bit 2: Discharge Over-current; Bit 3: Charge Over-current; Bit 4: Cell Module Overheat; Bit 5: Leakage; Bit 6: No Cell Communication; Bit 10: Charger Connected; Bit 11: Cell Overheat; Bit 12: No Current Sensor; Bit 13: Pack Under-Voltage; Bits 7-9 and 14-15 are reserved.
7	POWER REDUCTION FLAGS	HexBitBool	Warning (power reduction) status flags. Bit meanings: Bit 0: Low voltage; Bit 1: High current; Bit 2: High cell module temperature; Bit 5: High cell temperature; Bits 3-4 and 6-7 are reserved.
8	PIN STATUS FLAGS	HexBitBool	Pin statuses for each pin function. If pin function is not mapped, pin status flag is 0. Bit meanings: Bit 0: No Function (unused); Bit 1: Speed Sensor Input (0 if speed is zero, otherwise 1); Bit 2: Fast Charge Switch Input; Bit 3: Charger Mains AC Sense Input; Bit 4: Ignition Key Input; Bit 5: Heater Enable Output; Bit 6: Reserved; Bit 7: Sound Buzzer Output; Bit 8: Battery Low Indication Output; Bit 9: Charging Indication Output; Bit 10: Charger Enable Output; Bit 11: State of Charge Output (0 if SoC is 0%, otherwise 1); Bit 12: Battery Contactor Output; Bit 13: Battery Fan Output; Bit 14: Current Sensor Input (channel 0, 0 if measured value equals 0, otherwise 1); Bit 15: Leakage Sensor Input; Bit 16: Power Reduction Output; Bit 17: Charging Interlock; Bit 18: Analog Charger Control Output (for analog

			signal controlled TC/Elcon charger); Bit 19: ZVU Boost Charge Output (for ZVU charger); Bit 20: ZVU Slow Charge Output (for ZVU charger); Bit 21: ZVU Buffer Mode Output (for ZVU charger); Bit 22: BMS Failure Output; Bit 23: Equalization Enable Output; Bit 24: DCDC Control Output; Bit 25: ESM Recitfier Current Limit (for Eltek SmartPack controller); Bit 26: Contactor Pre-charge Output; Bits 27-31 are reserved.

TD1 –Time and Date Sentence

This sentence contains the date and time value of Emus BMS Control Unit's internal clock. It is sent periodically with configurable time intervals for active and sleep states (Data Transmission to Display Period). Example:

```
TD1,2014,10,07,14,50,07,00,000003E5,60
```

Additionally, the sentence can be explicitly requested by request sentence from external device, where the only data field is '?' symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	YEAR	DecInt unsigned	Year.
2	MONTH	DecInt unsigned	Month (value range 01-12).
3	DAY	DecInt unsigned	Day of month (value range 01-31).
4	HOUR	DecInt unsigned	Hour (value range 00-23).
5	MINUTE	DecInt unsigned	Minute (value range 00-59).
6	SECOND	DecInt unsigned	Second (value range 00-59).
7	Reserved		This field is reserved for backwards-compatibility. The value is always 0.
8	UPTIME	HexDec unsigned offset: 0 multiplier: 1 result: unsigned unit: s	Number of seconds since last power on.

TC1 – "Cell Module internal temperature sensor calibration" Sentence

This sentence is used to set the reference temperature of cell modules, and is meant to be sent by an external device. The reference temperature value is equal to the ambient temperature of the room where the battery is stored, and should be measured using an external thermometer. The measured value should be used as the parameter of this sentence, applying HexDec unsigned format, with offset of -100, and multiplier of 1. Cell module temperature calibration should be done only once, after assembling the cell modules on the cells. Example:

`TC1,78,B0` (sets +20°C reference temperature to all cell modules)

TC2 – "Cell Module external temperature sensor calibration" Sentence

This sentence is used to calibrate the cell temperature measurement if cell modules with external temperature sensors are used. It is sent from the Emus BMS Control Panel when external temperature calibration procedure is executed, and it is not recommended to send it from any other external device unless the correct calibration values are know. Example:

TC2,0000,00,00,00,7B

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	CELL MODULE ID	HexDec unsigned offset: 0 multiplier: 1 result: unsigned	ID of the cell module to which the calibration values are to be sent. If this field is 0, calibration values are sent to all cell modules at once.
2	BETA COEFFICIENT	HexDec unsigned	Beta calibration coefficient derived from curve data during external temperature calibration procedure.
3	GAMMA COEFFICIENT	HexDec unsigned	Gamma calibration coefficient derived from curve data during external temperature calibration procedure.
4	DELTA COEFFICIENT	HexDec unsigned	Delta calibration coefficient derived from curve data during external temperature calibration procedure.

!NOTE: Beta, Gamma and Delta coefficients do not correspond to any values in the datasheet of the thermistors that is used from cell temperature measurement.

VR1 – Version Sentence

This sentence is used to retrieve the hardware type and firmware version of Emus BMS Control Unit. It is sent by BMS once when it is powered up. Example:

```
VR1,BMS1,00000382,2.0.18_RC1_ZVU,9D
```

Additionally the sentence can be explicitly requested by request sentence from external device where the only data field is '?' symbol.

Description of each field in the sentence:

Field #	Value meaning	Format	Description
1	HARDWARE TYPE	Str	Hardware type. For standard Emus BMS Control Unit, this field contains "BMS1".
2	SERIAL NUMBER	HexDec unsigned Offset: 0 Multiplier: 1 Result: unsigned	Serial number of Emus BMS Control Unit
3	FIRMWARE VERSION	Str	Firmware version string of Emus BMS Control Unit. If Control Unit is in boot mode, this field contains "boot".

Master Clear

Emus BMS configuration, statistics, events, and password (for example if it was forgotten) can be cleared using master clear procedure. The only setting that is not cleared, is the “Master clear count” statistic, which is incremented after each master clear procedure performed.
Master clear is performed by sending a sequence of five ‘x’ characters and a CR or LF character to the Control Unit through the serial interface (RS232/USB). This must be done within 10 seconds after BMS startup (reset by sending RS1 sentence or a power-on reset). No other character should be sent to BMS before this sequence.

Firmware upgrade

BMS software is upgraded through serial interface (RS232/USB) using the special transfer procedure:

1. Reset the Emus BMS Control Unit using RS1 sentence command or via power-on reset;
2. When the upgrading device receives ‘#’ character from the Control Unit after reset, it should send the ‘#’ character back to the Control Unit within 1 second to make it enter bootloader mode;
3. Once in bootloader mode, Control Unit sends VR1 sentence, where the version of firmware is indicated as ‘boot’.
4. The upgrading device reads the new firmware data from a firmware file, and sends it to the Control Unit divided into separate frames. After each frame the BMS responds with byte 0x11 indicating successful frame reception or 0x22 indicating CRC error.
5. Upgrading device continues sending frames until all frames from firmware file are sent. If some frame was not accepted, indicating CRC error, then this frame must be retransmitted by upgrading device.
6. Upon successful reception of the last frame the Control Unit restarts and boots up with newly upgraded firmware.

The firmware upgrade file (supplied by JSC “Elektromotus”) is a text file, where each byte is encoded by 2 symbols from 0 to 9 and from A to F, that denote the hexadecimal value of the byte. For example, ‘0004424D’ denotes hexadecimal values of 4 bytes - 0x00, 0x04, 0x42 and 0x4D.
The bytes in the file are organized in frames, where two first bytes indicate the length of the subsequent data before next frame starts. The length field bytes are in big endian order (the most significant byte goes first). For example, the first two bytes of the frame ‘0004424D5331’ denote that the data length is 4 bytes, and the data bytes are 0x42, 0x4D 0x53, and 0x31. Please note that some frames can have zero length, meaning that the frame is empty, and data length bytes of subsequent frame goes immediately after ‘0000’.
The upgrading device should skip the first 3 frames in the firmware file, which contain information about hardware, firmware version and serial number. All subsequent frames should be sent to the Control Unit one at a time, waiting for 0x11 or 0x22 reply before sending the next frame.

Parameter meaning by ID

0100	uint16_t	Number of Overall Cells	Configure the number of cells that you have in your battery pack. This setting allows BMS to verify if it has detected correct number of cells and if the communication with cells is OK.
0102	uint16_t	Capacity	The capacity of the cell for BMS to calculate the total capacity of the pack. If you are using sever parallel strings of cells, multiply the cell capacity by the number of parallel strings for correct state of charge calculation. Coded in 0.1 Ah.
0004	uint8_t	Cell Under-Voltage protection “Activate at:” threshold	Minimum allowed voltage at which, if enabled, contactor is disconnected. Coded in 0.01 V with offset of 200.
0005	uint8_t	Cell Over-Voltage protection “Activate at:” threshold	Maximum Allowed Voltage at which, if enabled, contactor will be disconnected. Coded in 0.01 V with offset of 200.
0006	uint8_t	Cell Module Over-Heat protection “Activate At” threshold	The maximum allowed temperature in degrees of Celsius of cell modules. If this temperature is reached on some cell module then BMS switches of the charging and indicates an error. Coded in 1 Celsius units with offset of -100.
0007	uint8_t	Maximum Balancing Current	The maximum balancing current of cell modules. If cell modules are heating too much during balancing cycle, reduce this parameter. 0 - no balancing, 255 max balancing current.
0008	uint8_t	Low Cell Voltage “Activate at” threshold	The low voltage threshold reaching which causes Low Voltage indicator warning. Blinking low voltage shows that some cell has reached this low voltage threshold. When Low Voltage is constantly on then cells average voltage decreased beyond this setting. Coded in 0.01V with offset of 200.
0009	uint8_t	Minimum Charging Temperature	Minimum cell temperature at cells can be safely charged. If any of the cells temperature if below this threshold, BMS will go to pre-heating stage. Coded in 1 Celsius units with offset of -100.
000A	uint8_t	DC/DC Control Voltage Threshold In Active State	Cell voltage below which DC/DC Control Output pin is deactivated in active state (charger connected or ignition inputs reads active signal). It is activated again if minimum cell voltages goes 0.1V above this threshold of at least 10 seconds. Coded in 0.01V with offset of 200.
000B	uint8_t	Fully Charged Voltage	Voltage to which charging proceeds. When this voltage is reached charging goes into constant voltage phase. Coded in 0.01V with offset of 200.
000C	uint8_t	Allowed Disbalance	Allowed voltage difference between cells when charging is finished. Coded in 0.01V.

000D	uint8_t	Pre-charge Voltage	Voltage threshold below which a cell is considered deeply discharged. Below this threshold battery will be charged with pre-charge current, if CAN charger is used. Coded in 0.01V with offset of 200.
000E	uint8_t	Early Balancing Threshold	Voltage at which early balancing starts to reduce the balancing stage duration. Coded in 0.01V with offset of 200.
0010	uint8_t	Data Transmission to Display Period In Active State	Display update period which defines the frequency of broadcasting the parameters via RS232/USB interface and/or CAN bus. Active state is when either charger is connected or ignition key on IGN input PF5 is in switched on. Coded in 0.1s.
0111	uint16_t	Data Transmission to Display Period In Sleep State	Display update period which defines the frequency of broadcasting the parameters via RS232/USB interface and/or CAN bus. Sleep state is when charger is deactivated and on IGN input is in switched off. Coded in 0.1s.
0013	uint8_t	Number of Cell Strings	Number of parallel cell strings
0014	uint8_t	Fan On Temperature	Cell or cell module temperature (whichever is higher) threshold, above which BMS enables Battery Fan Output. Coded in 1 Celsius units with offset of -100.
0015	uint8_t	High Cell Module Temperature power reduction “Activate at” threshold	Sets the cell module temperature threshold above which BMS indicates warning and activates power reduction (if BF9 function is enabled and pin PF16 is assigned). During charging balancing current is gradually reduced if it starts exceeding this temperature threshold. Coded in 1 Celsius units with offset of -100.
0016	uint8_t	Climate Control Normal Temperature	Battery climate control temperature when not charging. Coded in 1 Celsius units with offset of -100.
0017	uint8_t	Climate Control Charging Temperature	Battery climate control temperature when charging. Coded in 1 Celsius units with offset of -100.
0118	int16_t	Climate Control Minimum SOC	Minimum value of SOC, below which battery climate is no longer controlled to prevent deep discharge. Coded in 0.01 %.
001A	uint8_t	Charge Restart Voltage	Voltage value at which charging is restarted if charger remains connected after previous charging session is finished. Coded in 0.01V with offset of 200.
0022	uint8_t	SOC at Low Volt.Warn.	SOC will be set equal to this value when minimum cell voltage reaches "Low Voltage Warning" threshold.
0025	uint8_t	Cell Under-Voltage Protection Activation Delay	Duration for which the cell under-voltage condition must persist before protection is activated. Coded in 0.1s.
0026	uint8_t	Cell Under-Voltage Protection Deactivation Delay	Duration for which the cell under-voltage condition must no longer persist before protection is deactivated. Coded in 1s.

0027	uint8_t	Cell Over-Voltage Protection Activation Delay	Duration for which the cell over-voltage condition must persist before protection is activated. Coded in 0.1s.
0028	uint8_t	Cell Over-Voltage Protection Deactivation Delay	Duration for which the cell over-voltage condition must no longer persist before protection is deactivated. Coded in 1s.
0029	uint8_t	Cell Module Over-Heat Protection Activation Delay	Duration for which the cell module over-heat condition must persist before protection is activated. Coded in 0.1s.
002A	uint8_t	Cell Module Over-Heat Protection Deactivation Delay	Duration for which the cell module over-heat condition must no longer persist before protection is deactivated. Coded in 1s.
002B	uint8_t	Discharge Over-current Protection Activation Delay	Duration for which the discharge over-current condition must persist before protection is activated. Coded in 0.1s.
002C	uint8_t	Discharge Over-current Protection Deactivation Delay	Duration for which the discharge over-current condition must no longer persist before protection is deactivated. Coded in 1s.
002D	uint8_t	Charge Over-current Protection Activation Delay	Duration for which the charge over-current condition must persist before protection is activated. Coded in 0.1s.
002E	uint8_t	Charge Over-current Protection Deactivation Delay	Duration for which the charge over-current condition must no longer persist before protection is deactivated. Coded in 1s.
002F	uint8_t	No Cell Communication Protection Activation Delay	Duration for which “no cell communication” condition must persist before protection is activated. Coded in 0.1s.
0030	uint8_t	No Cell Communication Protection Deactivation Delay	Duration for which “no cell communication” condition must no longer persist before protection is deactivated. Coded in 1s.
0031	uint8_t	Cell Under-Voltage Protection “Deactivate at” threshold	Cell voltage threshold at which cell under-voltage protection is deactivated. Coded in 0.01V with offset of 200.
0032	uint8_t	Cell Over-Voltage Protection “Deactivate at” threshold	Cell voltage threshold at which cell over-voltage protection is deactivated. Coded in 0.01V with offset of 200.
0033	uint8_t	Cell Module Over-Heat Protection “Deactivate at” threshold	Cell module temperature threshold at which cell module over-heat protection is deactivated. Coded in 1 Celsius units with offset of -100.
0034	uint8_t	Low Cell Voltage Reduction Activation Delay	Duration for which the low cell voltage condition must persist before reduction is activated. Coded in 0.1s.
0035	uint8_t	Low Cell Voltage Reduction Deactivation Delay	Duration for which the low cell voltage condition must no longer persist before reduction is deactivated. Coded in 1s.
0036	uint8_t	High Cell Module Temperature Reduction Activation Delay	Duration for which the high cell module temperature condition must persist before reduction is activated. Coded in 0.1s.

0037	uint8_t	High Cell Module Temperature Reduction Deactivation Delay	Duration for which the high cell module temperature condition must no longer persist before reduction is deactivated. Coded in 1s.
0038	uint8_t	High Discharge Current Reduction Activation Delay	Duration for which the high discharge current condition must persist before reduction is activated. Coded in 0.1s.
0039	uint8_t	High Discharge Current Reduction Deactivation Delay	Duration for which the high discharge current condition must no longer persist before reduction is deactivated. Coded in 1s.
003A	uint8_t	Low Cell Voltage Reduction “Deactivate at” threshold	Cell voltage threshold at which low cell voltage reduction is deactivated. Coded in 0.01V with offset of 200.
003B	uint8_t	High Cell Module Temperature Reduction “Deactivate at” threshold	Cell module temperature threshold at which high cell module temperature reduction is deactivated. Coded in 1 Celsius units with offset of -100.
003C	uint8_t	Contactor Pre-charge Duration	Duration for which the Contactor Pre-charge Output pin is held active before activation of Battery Contactor Output pin. Coded in 1s.
0048	uint8_t	Climate Control Max Duration While Not Charging	The duration after which the battery climate is no longer controlled when not charging. Coded in 1h.
0049	uint8_t	Insulation Fault Protection Activation Delay	Duration for which the insulation fault condition must persist before protection is activated. Coded in 0.1s.
004A	uint8_t	Insulation Fault Protection Deactivation Delay	Duration for which the insulation fault condition must no longer persist before protection is deactivated. Coded in 1s.
004B	uint8_t	Cell Over-Heat Protection “Activate at” threshold	Cell temperature threshold at which cell over-heat protection is activated. Coded in 1 Celsius units with offset of -100.
004C	uint8_t	Cell Over-Heat Protection “Deactivate at” threshold	Cell temperature threshold at which cell over-heat protection is deactivated. Coded in 1 Celsius units with offset of -100.
004D	uint8_t	Cell Over-Heat Protection Activation Delay	Duration for which the cell over-heat condition must persist before protection is activated. Coded in 0.1s.
004E	uint8_t	Cell Over-Heat Protection Deactivation Delay	Duration for which the cell over-heat condition must no longer persist before protection is deactivated. Coded in 1s.
004F	uint8_t	High Cell Temperature Reduction “Activate at” threshold	Cell temperature threshold at which high cell temperature reduction is activated. Coded in 1 Celsius units with offset of -100.
0050	uint8_t	High Cell Temperature Reduction “Deactivate at” threshold	Cell temperature threshold at which high cell temperature reduction is deactivated. Coded in 1 Celsius units with offset of -100.
0051	uint8_t	High Cell Temperature Reduction Activation Delay	Duration for which the high cell temperature condition must persist before reduction is activated. Coded in 0.1s.

0052	uint8_t	High Cell Temperature Reduction Deactivation Delay	Duration for which the high cell temperature reduction must no longer persist before reduction is deactivated. Coded in 1s.
0060	uint8_t	DC/DC Control Voltage Threshold In Passive State	Cell voltage below which DC/DC Control Output pin is deactivated in passive state (charger not connected or ignition inputs reads no active signal). It is activated again if minimum cell voltages goes 0.1V above this threshold of at least 10 seconds. Coded in 0.01V with offset of 200.
0061	uint8_t	No Current Sensor Protection Activation Delay	Duration for which the no current sensor condition must persist before protection is activated. Coded in 0.1s.
0062	uint8_t	No Current Sensor Protection Deactivation Delay	Duration for which the no current sensor condition must no longer persist before protection is deactivated. Coded in 1s.
0063	uint8_t	Cell Comm Restore Duration	Duration for which the charging is attempted before a charging error is registered in case there is no cell communication and “Cell Comm Restore” feature is enabled.
0400	uint8_t	Distance Estimate Safety Margin	Left distance estimate safety margin in % of total range of fully charged pack. This value is subtracted from estimated left distance.
0607	uint32_t	Pulses per Distance Unit	Pulses per distance unit for distance and speed calculations.
0503	uint16_t	Distance Unit Name	The name of distance units for information purposes. Maximum two characters. It does not affect any calculations.
0405	uint8_t	Min Soc Output	Output PWM signal range corresponding to 0% SOC value
0406	uint8_t	Max SoC Output	Output PWM signal range corresponding to 100% SOC value.
0800	uint8_t	Pin 0 function	Mapped function of the pin. The default function is ADC0.
0801	uint8_t	Pin 1 function	Mapped function of the pin. The default function is ADC0.
0802	uint8_t	Pin 2 function	Mapped function of the pin. The default function is ADC0.
0803	uint8_t	Pin 3 function	Mapped function of the pin. The default function is ADC0.
0804	uint8_t	Pin 4 function	Mapped function of the pin. The default function is MAINS_SENSE0.
0805	uint8_t	Pin 5 function	Mapped function of the pin. The default function is IGNITION_BTN0.
0806	uint8_t	Pin 6 function	Mapped function of the pin. The default function is FAST_CHARGE_BTN0.
0807	uint8_t	Pin 7 function	Mapped function of the pin. The default function is CHARGER_EN0.
0809	uint8_t	Pin 9 function	Mapped function of the pin. The default function is on top of the list. Default function is HEATER0.

080A	uint8_t	Pin 10 function	Mapped function of the pin. The default function is LOW_VOLT_IND0.
080B	uint8_t	Pin 11 function	Mapped function of the pin. The default function is BUZZER0.
080C	uint8_t	Pin 12 function	Mapped function of the pin. The default function is CHARGING_IND0.
080D	uint8_t	Pin 13 function	Mapped function of the pin. The default function is SPEED0.
080E	uint8_t	Pin 14 function	Mapped function of the pin. The default function is SOC0.
0D00	uint16_t	CAN ID Base	CAN ID Base address. For extended 29 bit ID it represents upper 13 bits of ID. For basic 11 bit ID it this a base address number.
0C02	uint8_t	CAN Speed	Bit rate of CAN interface. Indexes according to CiA 301,305.
0D03	uint16_t	Device CAN ID base	CAN Identifier base, allocated for communication with Emus BMS internal peripherals. For extended 29 bit ID it represents upper 13 bits of ID. For basic 11 bit ID it this a base address number.
0C05	uint8_t	CAN Cell Group Module Count	Number of configured CAN cell group modules. It is advised not to configure this parameter from an external application.
0C07	uint8_t	CAN Cell Group Module #0 Number of Cells	Number of cells connected to CAN Cell Group Module 0. It is not advised to configure this parameter from an external application.
0C08	uint8_t	CAN Cell Group Module #1 Number of Cells	Number of cells connected to CAN Cell Group Module 1. It is not advised to configure this parameter from an external application.
0C09	uint8_t	CAN Cell Group Module #2 Number of Cells	Number of cells connected to CAN Cell Group Module 2. It is not advised to configure this parameter from an external application.
0C0A	uint8_t	CAN Cell Group Module #3 Number of Cells	Number of cells connected to CAN Cell Group Module 3. It is not advised to configure this parameter from an external application.
0C0B	uint8_t	CAN Cell Group Module #4 Number of Cells	Number of cells connected to CAN Cell Group Module 4. It is not advised to configure this parameter from an external application.
0C0C	uint8_t	CAN Cell Group Module #5 Number of Cells	Number of cells connected to CAN Cell Group Module 5. It is not advised to configure this parameter from an external application.
0C0D	uint8_t	CAN Cell Group Module #6 Number of Cells	Number of cells connected to CAN Cell Group Module 6. It is not advised to configure this parameter from an external application.
0C0E	uint8_t	CAN Cell Group Module #7 Number of Cells	Number of cells connected to CAN Cell Group Module 7. It is not advised to configure this parameter from an external application.
0C0F	uint8_t	CAN Cell Group Module #8 Number of Cells	Number of cells connected to CAN Cell Group Module 8. It is not advised to configure this parameter from an external application.
0C10	uint8_t	CAN Cell Group Module #9 Number of Cells	Number of cells connected to CAN Cell Group Module 9. It is not advised to configure this parameter from an external application.

0C11	uint8_t	CAN Cell Group Module #10 Number of Cells	Number of cells connected to CAN Cell Group Module 10. It is not advised to configure this parameter from an external application.
0C12	uint8_t	CAN Cell Group Module #11 Number of Cells	Number of cells connected to CAN Cell Group Module 11. It is not advised to configure this parameter from an external application.
0C13	uint8_t	CAN Cell Group Module #12 Number of Cells	Number of cells connected to CAN Cell Group Module 12. It is not advised to configure this parameter from an external application.
0C14	uint8_t	CAN Cell Group Module #13 Number of Cells	Number of cells connected to CAN Cell Group Module 13. It is not advised to configure this parameter from an external application.
0C15	uint8_t	CAN Cell Group Module #14 Number of Cells	Number of cells connected to CAN Cell Group Module 14. It is not advised to configure this parameter from an external application.
0C16	uint8_t	CAN Cell Group Module #15 Number of Cells	Number of cells connected to CAN Cell Group Module 15. It is not advised to configure this parameter from an external application.
0C17	uint8_t	CAN Cell Group Module #16 Number of Cells	Number of cells connected to CAN Cell Group Module 16. It is not advised to configure this parameter from an external application.
0C18	uint8_t	CAN Cell Group Module #17 Number of Cells	Number of cells connected to CAN Cell Group Module 17. It is not advised to configure this parameter from an external application.
0C19	uint8_t	CAN Cell Group Module #18 Number of Cells	Number of cells connected to CAN Cell Group Module 18. It is not advised to configure this parameter from an external application.
0C1A	uint8_t	CAN Cell Group Module #19 Number of Cells	Number of cells connected to CAN Cell Group Module 19. It is not advised to configure this parameter from an external application.
0C1B	uint8_t	CAN Cell Group Module #20 Number of Cells	Number of cells connected to CAN Cell Group Module 20. It is not advised to configure this parameter from an external application.
0C1C	uint8_t	CAN Cell Group Module #21 Number of Cells	Number of cells connected to CAN Cell Group Module 21. It is not advised to configure this parameter from an external application.
0C1D	uint8_t	CAN Cell Group Module #22 Number of Cells	Number of cells connected to CAN Cell Group Module 22. It is not advised to configure this parameter from an external application.
0C1E	uint8_t	CAN Cell Group Module #23 Number of Cells	Number of cells connected to CAN Cell Group Module 23. It is not advised to configure this parameter from an external application.
0C1F	uint8_t	CAN Cell Group Module #24 Number of Cells	Number of cells connected to CAN Cell Group Module 24. It is not advised to configure this parameter from an external application.
0C20	uint8_t	CAN Cell Group Module #25 Number of Cells	Number of cells connected to CAN Cell Group Module 25. It is not advised to configure this parameter from an external application.
0C21	uint8_t	CAN Cell Group Module #26 Number of Cells	Number of cells connected to CAN Cell Group Module 26. It is not advised to configure this parameter from an external application.
0C22	uint8_t	CAN Cell Group Module #27 Number of Cells	Number of cells connected to CAN Cell Group Module 27. It is not advised to configure this parameter from an external application.

0C23	uint8_t	CAN Cell Group Module #28 Number of Cells	Number of cells connected to CAN Cell Group Module 28. It is not advised to configure this parameter from an external application.
0C24	uint8_t	CAN Cell Group Module #29 Number of Cells	Number of cells connected to CAN Cell Group Module 29. It is not advised to configure this parameter from an external application.
0C25	uint8_t	CAN Cell Group Module #30 Number of Cells	Number of cells connected to CAN Cell Group Module 30. It is not advised to configure this parameter from an external application.
0C26	uint8_t	CAN Cell Group Module #31 Number of Cells	Number of cells connected to CAN Cell Group Module 31. It is not advised to configure this parameter from an external application.
0D27	uint16_t	CAN Cell Group Module #0 Serial Number	Serial number of CAN Cell Group Module 0. It is not advised to configure this parameter from an external application.
0D29	uint16_t	CAN Cell Group Module #1 Serial Number	Serial number of CAN Cell Group Module 1. It is not advised to configure this parameter from an external application.
0D2B	uint16_t	CAN Cell Group Module #2 Serial Number	Serial number of CAN Cell Group Module 2. It is not advised to configure this parameter from an external application.
0D2D	uint16_t	CAN Cell Group Module #3 Serial Number	Serial number of CAN Cell Group Module 3. It is not advised to configure this parameter from an external application.
0D2F	uint16_t	CAN Cell Group Module #4 Serial Number	Serial number of CAN Cell Group Module 4. It is not advised to configure this parameter from an external application.
0D31	uint16_t	CAN Cell Group Module #5 Serial Number	Serial number of CAN Cell Group Module 5. It is not advised to configure this parameter from an external application.
0D33	uint16_t	CAN Cell Group Module #6 Serial Number	Serial number of CAN Cell Group Module 6. It is not advised to configure this parameter from an external application.
0D35	uint16_t	CAN Cell Group Module #7 Serial Number	Serial number of CAN Cell Group Module 7. It is not advised to configure this parameter from an external application.
0D37	uint16_t	CAN Cell Group Module #8 Serial Number	Serial number of CAN Cell Group Module 8. It is not advised to configure this parameter from an external application.
0D39	uint16_t	CAN Cell Group Module #9 Serial Number	Serial number of CAN Cell Group Module 9. It is not advised to configure this parameter from an external application.
0D3B	uint16_t	CAN Cell Group Module #10 Serial Number	Serial number of CAN Cell Group Module 10. It is not advised to configure this parameter from an external application.
0D3D	uint16_t	CAN Cell Group Module #11 Serial Number	Serial number of CAN Cell Group Module 11. It is not advised to configure this parameter from an external application.
0D3F	uint16_t	CAN Cell Group Module #12 Serial Number	Serial number of CAN Cell Group Module 12. It is not advised to configure this parameter from an external application.
0D41	uint16_t	CAN Cell Group Module #13 Serial Number	Serial number of CAN Cell Group Module 13. It is not advised to configure this parameter from an external application.

0D43	uint16_t	CAN Cell Group Module #14 Serial Number	Serial number of CAN Cell Group Module 14. It is not advised to configure this parameter from an external application.
0D45	uint16_t	CAN Cell Group Module #15 Serial Number	Serial number of CAN Cell Group Module 15. It is not advised to configure this parameter from an external application.
0D47	uint16_t	CAN Cell Group Module #16 Serial Number	Serial number of CAN Cell Group Module 16. It is not advised to configure this parameter from an external application.
0D49	uint16_t	CAN Cell Group Module #17 Serial Number	Serial number of CAN Cell Group Module 17. It is not advised to configure this parameter from an external application.
0D4B	uint16_t	CAN Cell Group Module #18 Serial Number	Serial number of CAN Cell Group Module 18. It is not advised to configure this parameter from an external application.
0D4D	uint16_t	CAN Cell Group Module #19 Serial Number	Serial number of CAN Cell Group Module 19. It is not advised to configure this parameter from an external application.
0D4F	uint16_t	CAN Cell Group Module #20 Serial Number	Serial number of CAN Cell Group Module 20. It is not advised to configure this parameter from an external application.
0D51	uint16_t	CAN Cell Group Module #21 Serial Number	Serial number of CAN Cell Group Module 21. It is not advised to configure this parameter from an external application.
0D53	uint16_t	CAN Cell Group Module #22 Serial Number	Serial number of CAN Cell Group Module 22. It is not advised to configure this parameter from an external application.
0D55	uint16_t	CAN Cell Group Module #23 Serial Number	Serial number of CAN Cell Group Module 23. It is not advised to configure this parameter from an external application.
0D57	uint16_t	CAN Cell Group Module #24 Serial Number	Serial number of CAN Cell Group Module 24. It is not advised to configure this parameter from an external application.
0D59	uint16_t	CAN Cell Group Module #25 Serial Number	Serial number of CAN Cell Group Module 25. It is not advised to configure this parameter from an external application.
0D5B	uint16_t	CAN Cell Group Module #26 Serial Number	Serial number of CAN Cell Group Module 26. It is not advised to configure this parameter from an external application.
0D5D	uint16_t	CAN Cell Group Module #27 Serial Number	Serial number of CAN Cell Group Module 27. It is not advised to configure this parameter from an external application.
0D5F	uint16_t	CAN Cell Group Module #28 Serial Number	Serial number of CAN Cell Group Module 28. It is not advised to configure this parameter from an external application.
0D61	uint16_t	CAN Cell Group Module #29 Serial Number	Serial number of CAN Cell Group Module 29. It is not advised to configure this parameter from an external application.
0D63	uint16_t	CAN Cell Group Module #30 Serial Number	Serial number of CAN Cell Group Module 30. It is not advised to configure this parameter from an external application.
0D65	uint16_t	CAN Cell Group Module #31 Serial Number	Serial number of CAN Cell Group Module 31. It is not advised to configure this parameter from an external application.

0C67	uint8_t	CAN Cell Group Module #0 String Number	Parallel string number of cells connected to CAN Cell Group Module 0. It is not advised to configure this parameter from an external application.
0C68	uint8_t	CAN Cell Group Module #1 String Number	Parallel string number of cells connected to CAN Cell Group Module 1. It is not advised to configure this parameter from an external application.
0C69	uint8_t	CAN Cell Group Module #2 String Number	Parallel string number of cells connected to CAN Cell Group Module 2. It is not advised to configure this parameter from an external application.
0C6A	uint8_t	CAN Cell Group Module #3 String Number	Parallel string number of cells connected to CAN Cell Group Module 3. It is not advised to configure this parameter from an external application.
0C6B	uint8_t	CAN Cell Group Module #4 String Number	Parallel string number of cells connected to CAN Cell Group Module 4. It is not advised to configure this parameter from an external application.
0C6C	uint8_t	CAN Cell Group Module #5 String Number	Parallel string number of cells connected to CAN Cell Group Module 5. It is not advised to configure this parameter from an external application.
0C6D	uint8_t	CAN Cell Group Module #6 String Number	Parallel string number of cells connected to CAN Cell Group Module 6. It is not advised to configure this parameter from an external application.
0C6E	uint8_t	CAN Cell Group Module #7 String Number	Parallel string number of cells connected to CAN Cell Group Module 7. It is not advised to configure this parameter from an external application.
0C6F	uint8_t	CAN Cell Group Module #8 String Number	Parallel string number of cells connected to CAN Cell Group Module 8. It is not advised to configure this parameter from an external application.
0C70	uint8_t	CAN Cell Group Module #9 String Number	Parallel string number of cells connected to CAN Cell Group Module 9. It is not advised to configure this parameter from an external application.
0C71	uint8_t	CAN Cell Group Module #10 String Number	Parallel string number of cells connected to CAN Cell Group Module 10. It is not advised to configure this parameter from an external application.
0C72	uint8_t	CAN Cell Group Module #11 String Number	Parallel string number of cells connected to CAN Cell Group Module 11. It is not advised to configure this parameter from an external application.
0C73	uint8_t	CAN Cell Group Module #12 String Number	Parallel string number of cells connected to CAN Cell Group Module 12. It is not advised to configure this parameter from an external application.

0C74	uint8_t	CAN Cell Group Module #13 String Number	Parallel string number of cells connected to CAN Cell Group Module 13. It is not advised to configure this parameter from an external application.
0C75	uint8_t	CAN Cell Group Module #14 String Number	Parallel string number of cells connected to CAN Cell Group Module 14. It is not advised to configure this parameter from an external application.
0C76	uint8_t	CAN Cell Group Module #15 String Number	Parallel string number of cells connected to CAN Cell Group Module 15. It is not advised to configure this parameter from an external application.
0C77	uint8_t	CAN Cell Group Module #16 String Number	Parallel string number of cells connected to CAN Cell Group Module 16. It is not advised to configure this parameter from an external application.
0C78	uint8_t	CAN Cell Group Module #17 String Number	Parallel string number of cells connected to CAN Cell Group Module 17. This parameter should not be configured from an external device.
0C79	uint8_t	CAN Cell Group Module #18 String Number	Parallel string number of cells connected to CAN Cell Group Module 18. It is not advised to configure this parameter from an external application.
0C7A	uint8_t	CAN Cell Group Module #19 String Number	Parallel string number of cells connected to CAN Cell Group Module 19. It is not advised to configure this parameter from an external application.
0C7B	uint8_t	CAN Cell Group Module #20 String Number	Parallel string number of cells connected to CAN Cell Group Module 20. It is not advised to configure this parameter from an external application.
0C7C	uint8_t	CAN Cell Group Module #21 String Number	Parallel string number of cells connected to CAN Cell Group Module 21. It is not advised to configure this parameter from an external application.
0C7D	uint8_t	CAN Cell Group Module #22 String Number	Parallel string number of cells connected to CAN Cell Group Module 22. It is not advised to configure this parameter from an external application.
0C7E	uint8_t	CAN Cell Group Module #23 String Number	Parallel string number of cells connected to CAN Cell Group Module 23. It is not advised to configure this parameter from an external application.
0C7F	uint8_t	CAN Cell Group Module #24 String Number	Parallel string number of cells connected to CAN Cell Group Module 24. It is not advised to configure this parameter from an external application.
0C80	uint8_t	CAN Cell Group Module #25 String Number	Parallel string number of cells connected to CAN Cell Group Module 25. It is not advised to configure this parameter from an external application.

0C81	uint8_t	CAN Cell Group Module #26 String Number	Parallel string number of cells connected to CAN Cell Group Module 26. It is not advised to configure this parameter from an external application.
0C82	uint8_t	CAN Cell Group Module #27 String Number	Parallel string number of cells connected to CAN Cell Group Module 27. It is not advised to configure this parameter from an external application.
0C83	uint8_t	CAN Cell Group Module #28 String Number	Parallel string number of cells connected to CAN Cell Group Module 28. It is not advised to configure this parameter from an external application.
0C84	uint8_t	CAN Cell Group Module #29 String Number	Parallel string number of cells connected to CAN Cell Group Module 29. It is not advised to configure this parameter from an external application.
0C85	uint8_t	CAN Cell Group Module #30 String Number	Parallel string number of cells connected to CAN Cell Group Module 30. It is not advised to configure this parameter from an external application.
0C86	uint8_t	CAN Cell Group Module #31 String Number	Parallel string number of cells connected to CAN Cell Group Module 31. It is not advised to configure this parameter from an external application.
1100	uint16_t	Current Sensor L Calibration Value	L calibrations value of current sensor. This value is written on back of current sensor.
1002	uint8_t	Current Senor L Reference Value	Reference value for low current sensor. This value is set when current measurement is reset to zero.
1103	uint16_t	Current Sensor H Calibration Value	H calibrations value of current sensor. This value is written on back of current sensor.
1105	int16_t	Current Senor H Reference Value	Reference value for high current sensor. This value is set when current measurement is reset to zero.
1007	uint8_t	Current Sensor Reverse Direction	Reverses the direction of current sensor. Use this setting to ensure that positive current value is when charging and negative current value is when discharging.
1008	uint8_t	Current Sensor Deadzone	Dead zone of the sensor reading to improve 0 value stability. Use small values in range up to ~10.
1009	uint8_t	Current Sensor Type	Type of current sensor used. Should be equal to 0 if Emus BMS Gen1 Dual Range Current Sensor is used, and 1 if Emus BMS Gen2 Dual Range Current Sensor is used.

1600	uint32_t	Function Flags 0	Emus BMS function set 0. Individual bits enables/disables the following functions (bit value 1 – enabled): Bit 0: Over-Voltage Cutoff; Bit 1: Under-Voltage Cutoff; Bit 2: Over-Current Cutoff; Bit 3: Cell Module Overheat Cutoff; Bit 4: Leakage Cutoff; Bit 5: Cutoff override (by rapidly toggling Ignition input pin); Bit 6: Low Voltage Reduction; Bit 7: High Current Reduction; Bit 8: High Cell Module Temperature Reduction; Bit 9: CAN interface (interface can be turned off if not used to reduce power consumption); Bit 10: Periodic Data Broadcast (on CAN); Bit 11: Use Extended 29bit ID (for CAN communication); Bit 12: Broadcast (data) on RS232/USB; Bit 13: No Cells Communication Cutoff; Bit 14: Send (CAN messages) to RS232/USB; Bit 15: Charge Over-Current Cutoff; Bit 16: Use Serial Cells Communication; Bit 17: Use Analog Current Sensor (deprecated function); Bit 19: Broadcast Each Cell Value (on CAN); Bit 20: Battery Climate Control; Bit 22: Cell Comm Restore; Bit 27: External Contactor Deactivation; Bit 30: Reduce SOC at Under-Voltage. Bits not defined here are reserved for future use
1604	uint32_t	Function Flags 1	Emus BMS function set 1. Individual bits enables/disables the following functions (bit value 1 – enabled): Bit 4: Charger Connecter Cutoff; Bit 5: Contactor Pre-charge; Bit 6: Reset External Contactor Deactivation On Protection; Bit 7: Cell Overheat Cutoff; Bit 8: High Cell Temperature Reduction; Bit 9: No Current Sensor Cutoff; Bit 10: Broadcast TM4 Neuro CAN messages; Bits not defined here are reserved for future use
1901	uint16_t	Fast Charging Current	Current value during constant current charging phase, using a controlled charger, for fast charging. Coded in 0.1A.
1903	uint16_t	Slow Charging Current	Current value during constant current charging phase, using a controlled charger, for slow charging. Coded in 0.1A.
1805	uint8_t	Pre-charge Current	Low current value for pre-charging (used when cell voltage is very low), as percent of nominal battery capacity. This parameter applies only when using a CAN based or analog signal controlled charger. Coded in 0.1%.

1806	uint16_t	Charge Finished Current	Current value, at which charging is considered finished, as a percent of nominal battery capacity. This parameter applies only when using a CAN based or analog signal controlled charger. Coded in 0.1%.
1907	uint16_t	Maximum Pre-charge Stage Duration	Maximum allowed duration of pre-charging stage exceeding which triggers charging error and stops the charging process. Coded in 1 minute units.
1909	uint16_t	Maximum Main Charge Stage Duration	Maximum allowed duration of main charging stage exceeding which triggers charging error and stops the charging process. Coded in 1 minute units.
190B	uint16_t	Maximum Balancing Stage Duration	Maximum allowed duration of balancing stage exceeding which triggers charging error and stops the charging process. Coded in 1 minute units.
190D	uint16_t	Charger Over-Current Protection “Activate at” threshold	Critical charge current above which BMS engages protection function by disconnecting the contactor relay. Coded in 0.1A.
190F	uint16_t	High Discharge Current Reduction “Activate at” threshold	Warning discharge current above which BMS enables buzzer warning and power reduction function pin (if enabled). Coded in 0.1A.
1911	uint16_t	Discharge Over-Current Protection “Activate at” threshold	Critical discharge current above which BMS engages protection function by disconnecting the contactor relay. Coded in 0.1A.
1815	uint8_t	Number of Chargers	Eltek Valere EV Charger specific parameter. Sets the number of chargers if multiple chargers are controlled by BMS.
1916	uint16_t	Charger CAN ID Base	Sets the Base ID for communication with chargers that have configurable CAN ID (such as Eltek Valere EV Charger).
191A	uint16_t	Max PWM Output	Maximum value of the PWM signal that is used for analog signal controlled charger current control. Coded in 0.01V.
191C	uint16_t	Min PWM Output	Minimum value of the PWM signal that is used for analog signal controlled charger current control. Coded in 0.01V.