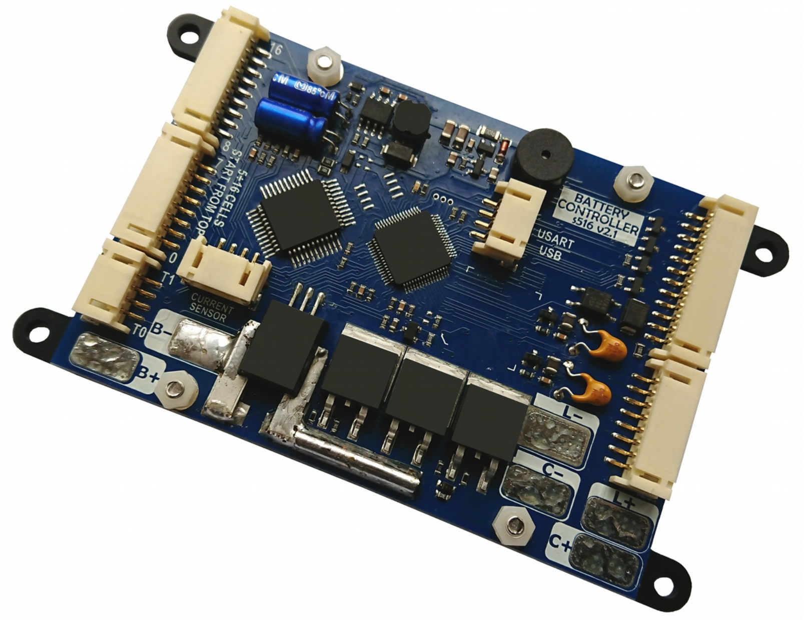
Energus Power Solutions Ltd.

Communication Protocols

Tiny BMS s516 – 30A / 150A / 750A



Revision B, 2018-12-11

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Chapter 1: *Tiny BMS UART* communication protocol

1. Introduction

Tiny BMS device includes a single multi-purpose *UART* interface. In combination with various converters, the interface is compatible with *USB*, *bluetoot*h and *CAN* interfaces. Various proprietary commands are available for fast communication, also *MODBUS* commands *03* and *16* are supported for rapid integration to existing industrial systems. An internal *Tiny BMS* device register map is given in *Chapter 3*. The register map values can be read and modified using *MODBUS* and proprietary commands. This chapter in detail covers all available commands implemented to communicate with *Tiny BMS* device. Every command request and response contains *16* bit *CRC* checksum. How to calculate *CRC* value refer to C*hapter 1.2.*

Note: *UART* configuration: baudrate *115200 bit/s*, *8* data bits, *1* stop bit, no parity, no flow control. *UART* configuration is not allowed to be changed by the user.

1.1. *UART* communication commands list

1.1.1. *Tiny BMS* acknowledgement

Response from *BMS* [NACK]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	CMD	ERROR	CRC:LSB	CRC:MSB
			0x00 – CMD ERROR		
			0x01 – CRC ERROR		

Response from *BMS* [ACK]				
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0xAA	0x01	CMD	CRC:LSB	CRC:MSB

CMD – Command code
ERROR – Error code

1.1.2. Read *Tiny BMS* registers block

Request to *BMS*						
Byte1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0xAA	0x07	RL	ADDR:LSB	ADDR:MSB	CRC:LSB	CRC:MSB
			[UINT_16]			

Response from *BMS* [OK]										
Byte1	Byte 2	Byte 3	Byte 4	Byte 5	**...**	Byte n*2+2	Byte n*2+3	Byte n*2+4	Byte n*2+5
0xAA	0x07	PL	DATA1:LSB	DATA1:MSB	**...**	DATAn:LSB	DATAn:MSB	CRC:LSB	CRC:MSB
			[UINT_16]			[UINT_16]			

RL – Registers to read
ADDR – First registers block address
DATA – Registers block values

PL – Payload length byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Payload size in bytes (last packet)					
1	Reserved	Current packet ID					

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x07	ERROR	CRC:LSB	CRC:MSB

1.1.3. Read *Tiny BMS* individual registers

Request to *BMS*									
Byte1	Byte 2	Byte 3	Byte 4	Byte 5	**...**	Byte n*2+2	Byte n*2+3	Byte n*2+4	Byte n*2+5
0xAA	0x09	PL	ADDR1:LSB	ADDR1:MSB	**...**	ADDRn:LSB	ADDRn:MSB	CRC:LSB	CRC:MSB
			[UINT_16]			[UINT_16]			

PL – Payload length in bytes

Response from *BMS* [OK]									
Byte1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	**...**	Byte n*4	Byte n*4+1
0xAA	0x09	PL	ADDR1:LSB	ADDR1:MSB	DATA1:LSB	DATA1:MSB	**...**	ADDRn:LSB	ADDRn:MSB
			[UINT_16]		[UINT_16]			[UINT_16]	

Byte n*4+2	Byte n*4+3	Byte n*4+4	Byte n*4+5
DATAn:LSB	DATAn:MSB	CRC:LSB	CRC:MSB
[UINT_16]			

ADDR – Individual registers addresses
DATA – Registers values

PL – Payload length byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Payload size in bytes (last packet)					
1	Reserved	Current packet ID					

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x09	ERROR	CRC:LSB	CRC:MSB

1.1.4. Write *Tiny BMS* registers block

Request to *BMS*									
Byte1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	**...**	Byte n*2+4	Byte n*2+5
0xAA	0x0B	PL	ADDR:LSB	ADDR:MSB	DATA1:LSB	DATA1:MSB	**...**	DATAn:LSB	DATAn:MSB
			[UINT_16]		[UINT_16]			[UINT_16]	

Byte n*2+6	Byte n*2+7
CRC:LSB	CRC:MSB

ADDR – First registers block address (valid addresses to write *0x012C* to *0x018F*)
DATA – Registers block values to write

PL – Payload length byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Payload size in bytes (last packet)					
1	Reserved	Current packet ID					

Response from *BMS* [ACK]				
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0xAA	0x01	0x0B	CRC:LSB	CRC:MSB

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x0B	ERROR	CRC:LSB	CRC:MSB

1.1.5. Write *Tiny BMS* individual registers

Request to *BMS*									
Byte1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	**...**	Byte n*4	Byte n*4+1
0xAA	0x0D	PL	ADDR1:LSB	ADDR1:MSB	DATA1:LSB	DATA1:MSB	**...**	ADDRn:LSB	ADDRn:MSB
			[UINT_16]		[UINT_16]			[UINT_16]	

Byte n*4+2	Byte n*4+3	Byte n*4+4	Byte n*4+5
DATAn:LSB	DATAn:MSB	CRC:LSB	CRC:MSB
[UINT_16]			

ADDR – Individual registers addresses (valid addresses to write *0x012C* to *0x018F*)
DATA – Individual registers values to write

PL – Payload length byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Payload size in bytes (last packet)					
1	Reserved	Current packet ID					

Response from *BMS* [ACK]				
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0xAA	0x01	0x0D	CRC:LSB	CRC:MSB

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x0D	ERROR	CRC:LSB	CRC:MSB

1.1.6. Read *Tiny BMS* registers block (*MODBUS* compatible)

Request to *BMS*							
Byte1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xAA	0x03	ADDR1:MSB	ADDR1:LSB	0x00	RL	CRC:LSB	CRC:MSB
		[UINT_16]					

ADDR – First registers block address
RL – Registers to read. Max. *127* registers (*0x7F*)

Response from *BMS* [OK]									
Byte1	Byte 2	Byte 3	Byte 4	Byte 5	...	Byte n*2+2	Byte n*2+3	Byte n*2+4	Byte n*2+5
0xAA	0x03	PL	DATA1:MSB	DATA1:LSB	...	DATAn:MSB	DATAn:LSB	CRC:LSB	CRC:MSB
			[UINT_16]			[UINT_16]			

PL – Payload length in bytes

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x03	ERROR	CRC:LSB	CRC:MSB

1.1.7. Write *Tiny BMS* registers block (*MODBUS* compatible)

Request to *BMS*									
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte8	Byte 9	**...**
0xAA	0x10	ADDR:MSB	ADDR:LSB	0x00	RL	PL	DATA1:MSB	DATA1:LSB	**...**
		[UINT_16]					[UINT_16]		

Byte n*2+6	Byte n*2+7	Byte n*2+8	Byte n*2+9
DATAn:MSB	DATAn:LSB	CRC:LSB	CRC:MSB
[UINT_16]			

Response from *BMS* [OK]							
Byte1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xAA	0x10	ADDR:MSB	ADDR:LSB	0x00	RL	CRC:LSB	CRC:MSB
		[UINT_16]					

ADDR – First registers block address
RL – Registers to write. Max. *100* registers (*0x64*)
PL – Payload length in bytes
DATA – Registers block values to write

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x10	ERROR	CRC:LSB	CRC:MSB

1.1.8. Reset *Tiny BMS*, clear *Events* and *Statistics*

Request to *BMS*				
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0xAA	0x02	OPTION	CRC:LSB	CRC:MSB
		0x01 – Clear *Events*		
		0x02 – Clear *Statistics*		
		0x05 – Reset *BMS*		

Response from *BMS* [ACK]				
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0xAA	0x01	0x02	CRC:LSB	CRC:MSB

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x02	ERROR	CRC:LSB	CRC:MSB

1.1.9. Read *Tiny BMS* newest *Events*

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x11	CRC:LSB	CRC:MSB

Response from *BMS* [OK]											
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11	**...**
0xAA	0x11	PL	BTSP:LSB	BTSP	BTSP	BTSP:MSB	TSP1:LSB	TSP1	TSP1:MSB	EVENT1	**...**
			[UINT32]				[UINT24]			[UINT_8]	

Byte n*4+4	Byte n*4+5	Byte n*4+6	Byte n*4+7	Byte n*4+8	Byte n*4+9
TSPn:LSB	TSPn	TSPn:MSB	EVENTn	CRC:LSB	CRC:MSB
[UINT_24]			[UINT_8]		

PL – Payload length in bytes
PTSP – *BMS* timestamp in seconds
TSP – Event timestamp in seconds
EVENT – *BMS* Event ID

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x11	ERROR	CRC:LSB	CRC:MSB

1.1.10. Read *Tiny BMS* all *Events*

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x12	CRC:LSB	CRC:MSB

Response from *BMS* [OK]											
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11	**...**
0xAA	0x12	PL	BTSP:LSB	BTSP	BTSP	BTSP:MSB	TSP1:LSB	TSP1	TSP1:MSB	EVENT1	**...**
			[UINT_32]				[UINT_24]			[UINT_8]	

Byte n*4+4	Byte n*4+5	Byte n*4+6	Byte n*4+7	Byte n*4+8	Byte n*4+9
TSPn:LSB	TSPn	TSPn:MSB	EVENTn	CRC:LSB	CRC:MSB
[UINT_24]			[UINT_8]		

PL – Payload length in bytes
PTSP – *BMS* timestamp in seconds
TSP – *Event* timestamp in seconds
EVENT – *BMS Event* ID

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x12	ERROR	CRC:LSB	CRC:MSB

1.1.11. Read battery pack voltage (*Reg:36*)

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x14	CRC:LSB	CRC:MSB

Response from *BMS* [OK]							
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xAA	0x14	DATA:LSB	DATA	DATA	DATA:MSB	CRC:LSB	CRC:MSB
		[FLOAT]					

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x14	ERROR	CRC:LSB	CRC:MSB

1.1.12. Read battery pack current (*Reg:38*)

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x15	CRC:LSB	CRC:MSB

Response from *BMS* [OK]							
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xAA	0x15	DATA:LSB	DATA	DATA	DATA:MSB	CRC:LSB	CRC:MSB
		[FLOAT]					

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x15	ERROR	CRC:LSB	CRC:MSB

1.1.13. Read battery pack max. cell voltage (*Reg:41*)

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x16	CRC:LSB	CRC:MSB

Response from *BMS* [OK]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x16	DATA:LSB	DATA:MSB	CRC:LSB	CRC:MSB
		[UINT_16]			

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x16	ERROR	CRC:LSB	CRC:MSB

1.1.14. Read battery pack min. cell voltage (*Reg:40*)

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x17	CRC:LSB	CRC:MSB

Response from *BMS* [OK]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x17	DATA:LSB	DATA:MSB	CRC:LSB	CRC:MSB
		[UINT_16]			

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x17	ERROR	CRC:LSB	CRC:MSB

1.1.15. Read *Tiny BMS* online status (*Reg:50*)

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x18	CRC:LSB	CRC:MSB

Response from *BMS* [OK]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x18	DATA:LSB	DATA:MSB	CRC:LSB	CRC:MSB
		0x91 – Charging [INFO]			
		0x92 – Fully Charged [INFO]			
		0x93 – Discharging [INFO]			
		0x96 – Regeneration [INFO]			
		0x97 – Idle [INFO]			
		0x9B – Fault [ERROR]			

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x18	ERROR	CRC:LSB	CRC:MSB

1.1.16. Read *Tiny BMS* lifetime counter (*Reg:32*)

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x19	CRC:LSB	CRC:MSB

Response from *BMS* [OK]							
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xAA	0x19	DATA:LSB	DATA	DATA	DATA:MSB	CRC:LSB	CRC:MSB
		[UINT_32]					

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x19	ERROR	CRC:LSB	CRC:MSB

1.1.17. Read *Tiny BMS* estimated *SOC* value (*Reg:46*)

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x1A	CRC:LSB	CRC:MSB

Response from *BMS* [OK]							
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xAA	0x1A	DATA:LSB	DATA	DATA	DATA:MSB	CRC:LSB	CRC:MSB
		[UINT_32]					

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x1A	ERROR	CRC:LSB	CRC:MSB

1.1.18. Read *Tiny BMS* device temperatures (*Reg:48*, *Reg:42*, *Reg:43*)

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x1B	CRC:LSB	CRC:MSB

Response from *BMS* [OK]										
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
0xAA	0x1B	PL	DATA1:LSB	DATA1:MSB	DATA2:LSB	DATA2:MSB	DATA3:LSB	DATA3:MSB	CRC:LSB	CRC:MSB
			[INT_16]		[INT_16]		[INT_16]			

PL – Payload length in bytes
DATA1 – *Tiny BMS* internal temperature
DATA2 – External temperature sensor *#1* temperature value (value of *-32768* if not connected)
DATA3 – External temperature sensor *#2* temperature value (value of *-32768* if not connected)

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x1B	ERROR	CRC:LSB	CRC:MSB

1.1.19. Read battery pack cells voltages

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x1C	CRC:LSB	CRC:MSB

Response from *BMS* [OK]									
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	**...**	Byte n*2+2	Byte n*2+3	Byte n*2+4	Byte n*2+5
0xAA	0x1C	PL	DATA1:LSB	DATA1:MSB	**...**	DATAn:LSB	DATAn:MSB	CRC:LSB	CRC:MSB
			[UINT_16]			[UINT_16]			

PL – Payload length in bytes

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x1C	ERROR	CRC:LSB	CRC:MSB

1.1.20. Read *Tiny BMS* settings values (min, max, default, current)

Request to *BMS*						
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0xAA	0x1D	OPTION	0x00	RL	CRC:LSB	CRC:MSB
		0x01 – Min. settings				
		0x02 – Max. settings				
		0x03 – Default settings				
		0x04 – Current settings				

RL – Registers to read. Max. *100* (*0x64*) registers

Response from *BMS* [OK]									
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	**...**	Byte n*2+2	Byte n*2+3	Byte n*2+4	Byte n*2+5
0xAA	0x1D	PL	DATA1:LSB	DATA1:MSB	**...**	DATAn:LSB	DATAn:MSB	CRC:LSB	CRC:MSB
			[UINT_16]			[UINT_16]			

PL – Payload length in bytes

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x1D	ERROR	CRC:LSB	CRC:MSB

1.1.21. Read *Tiny BMS* version

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x1E	CRC:LSB	CRC:MSB

Response from *BMS* [OK]									
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
0xAA	0x1E	PL	DATA1	DATA2	DATA3	DATA4:LSB	DATA4:MSB	CRC:LSB	CRC:MSB
			[UINT_8]	[UINT_8]	[UINT_8]	[UINT_16]			

PL – Payload length in bytes
DATA1 – Hardware version
DATA2 – Hardware changes version
DATA3 – Firmware public version
DATA4 – Firmware internal version

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x1E	ERROR	CRC:LSB	CRC:MSB

1.1.22. Read *Tiny BMS* extended version

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x1F	CRC:LSB	CRC:MSB

Response from *BMS* [OK]											
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11	Byte 12
0xAA	0x1F	PL	DATA1	DATA2	DATA3	DATA4:LSB	DATA4:MSB	DATA5	DATA6	CRC:LSB	CRC:MSB
			[UINT_8]	[UINT_8]	[UINT_8]	[UINT_16]		[UINT_8]	[UINT_8]		

PL – Payload length in bytes
DATA1 – Hardware version
DATA2 – Hardware changes version
DATA3 – Firmware public version
DATA4 – Firmware internal version
DATA5 – Bootloader version
DATA6 – Register map version

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x1F	ERROR	CRC:LSB	CRC:MSB

1.1.23. Read *Tiny BMS* calculated speed, left distance and estimated time values

Request to *BMS*			
Byte 1	Byte 2	Byte 3	Byte 4
0xAA	0x20	CRC:LSB	CRC:MSB

Response from *BMS* [OK]															
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
0xAA	0x20	DATA1:LSB	DATA1	DATA1	DATA1:MSB	DATA2:LSB	DATA2	DATA2	DATA2:MSB	DATA3:LSB	DATA3	DATA3	DATA3:MSB	CRC:LSB	CRC:MSB
		[FLOAT]				[UINT_32]				[UINT_32]					

DATA1 – Speed (*km/h*)
DATA2 – Left distance to empty battery (*km*)
DATA3 – Estimated time left to empty battery (*seconds*)

Response from *BMS* [ERROR]					
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0xAA	0x00	0x20	ERROR	CRC:LSB	CRC:MSB

1.2. *CRC* checksum calculation

CRC stands for *Cyclic Redundancy Check*. It is two bytes added to the end of every command message for error detection. Every byte in the message is used to calculate the *CRC* value. The receiving device also must calculate the *CRC* and compare it to the *CRC* from sending device. If even one bit in the message is received incorrectly, the *CRC* values will be different and will result in an error. In the *Tiny BMS UART* communication protocol the *CRC* checksum is *16* bit value, calculated based on standard *MODBUS CRC* polynomial $x^{16}+x^{15}+x^{2}+1$ (*0x8005* in *HEX* format). Below is the function example in *C* programming language that can be used as a reference to calculate the *16* bit *CRC* value:

```
const static uint16_t crcTable[256]={
   0x0000, 0xC0C1, 0xC181, 0x0140, 0xC301, 0x03C0, 0x0280, 0xC241,
   0xC601, 0x06C0, 0x0780, 0xC741, 0x0500, 0xC5C1, 0xC481, 0x0440,
   0xCC01, 0x0CC0, 0x0D80, 0xCD41, 0x0F00, 0xCFC1, 0xCE81, 0x0E40,
   0x0A00, 0xCAC1, 0xCB81, 0x0B40, 0xC901, 0x09C0, 0x0880, 0xC841,
   0xD801, 0x18C0, 0x1980, 0xD941, 0x1B00, 0xDBC1, 0xDA81, 0x1A40,
   0x1E00, 0xDEC1, 0xDF81, 0x1F40, 0xDD01, 0x1DC0, 0x1C80, 0xDC41,
   0x1400, 0xD4C1, 0xD581, 0x1540, 0xD701, 0x17C0, 0x1680, 0xD641,
   0xD201, 0x12C0, 0x1380, 0xD341, 0x1100, 0xD1C1, 0xD081, 0x1040,
   0xF001, 0x30C0, 0x3180, 0xF141, 0x3300, 0xF3C1, 0xF281, 0x3240,
   0x3600, 0xF6C1, 0xF781, 0x3740, 0xF501, 0x35C0, 0x3480, 0xF441,
   0x3C00, 0xFCC1, 0xFD81, 0x3D40, 0xFF01, 0x3FC0, 0x3E80, 0xFE41,
   0xFA01, 0x3AC0, 0x3B80, 0xFB41, 0x3900, 0xF9C1, 0xF881, 0x3840,
   0x2800, 0xE8C1, 0xE981, 0x2940, 0xEB01, 0x2BC0, 0x2A80, 0xEA41,
   0xEE01, 0x2EC0, 0x2F80, 0xEF41, 0x2D00, 0xEDC1, 0xEC81, 0x2C40,
   0xE401, 0x24C0, 0x2580, 0xE541, 0x2700, 0xE7C1, 0xE681, 0x2640,
   0x2200, 0xE2C1, 0xE381, 0x2340, 0xE101, 0x21C0, 0x2080, 0xE041,
   0xA001, 0x60C0, 0x6180, 0xA141, 0x6300, 0xA3C1, 0xA281, 0x6240,
   0x6600, 0xA6C1, 0xA781, 0x6740, 0xA501, 0x65C0, 0x6480, 0xA441,
   0x6C00, 0xACC1, 0xAD81, 0x6D40, 0xAF01, 0x6FC0, 0x6E80, 0xAE41,
   0xAA01, 0x6AC0, 0x6B80, 0xAB41, 0x6900, 0xA9C1, 0xA881, 0x6840,
   0x7800, 0xB8C1, 0xB981, 0x7940, 0xBB01, 0x7BC0, 0x7A80, 0xBA41,
   0xBE01, 0x7EC0, 0x7F80, 0xBF41, 0x7D00, 0xBDC1, 0xBC81, 0x7C40,
   0xB401, 0x74C0, 0x7580, 0xB541, 0x7700, 0xB7C1, 0xB681, 0x7640,
   0x7200, 0xB2C1, 0xB381, 0x7340, 0xB101, 0x71C0, 0x7080, 0xB041,
   0x5000, 0x90C1, 0x9181, 0x5140, 0x9301, 0x53C0, 0x5280, 0x9241,
   0x9601, 0x56C0, 0x5780, 0x9741, 0x5500, 0x95C1, 0x9481, 0x5440,
   0x9C01, 0x5CC0, 0x5D80, 0x9D41, 0x5F00, 0x9FC1, 0x9E81, 0x5E40,
   0x5A00, 0x9AC1, 0x9B81, 0x5B40, 0x9901, 0x59C0, 0x5880, 0x9841,
   0x8801, 0x48C0, 0x4980, 0x8941, 0x4B00, 0x8BC1, 0x8A81, 0x4A40,
   0x4E00, 0x8EC1, 0x8F81, 0x4F40, 0x8D01, 0x4DC0, 0x4C80, 0x8C41,
   0x4400, 0x84C1, 0x8581, 0x4540, 0x8701, 0x47C0, 0x4680, 0x8641,
   0x8201, 0x42C0, 0x4380, 0x8341, 0x4100, 0x81C1, 0x8081, 0x4040
};

uint16_t CRC16 (const uint8_t* data, uint16_t length)
{
   uint8_t tmp;
   uint16_t crcWord = 0xFFFF;

   while (length--)
   {
      tmp = *data++ ^ crcWord;
      crcWord >>= 8;
      crcWord ^= crcTable[tmp];
   }
   return crcWord;
}
```

1.3. *UART* communication examples

Note: If *Tiny BMS* device is in sleep mode, the first command must be send twice. After received the first command *BMS* wakes up from sleep mode, but the response to the command will be sent when it receives the command a second time. *Tiny BMS* does not enter sleep mode again while communication is ongoing.

1.3.1. *MODBUS* write registers example

Below is an example, how to configure *Over-Voltage Cutoff* threshold to *4.2 V* value and *Under-Voltage Cutoff* threshold to *2.5 V* value using *MODBUS* write command:

Over-Voltage Cutoff register address is *315* (*0x013B*)
Under-Voltage Cutoff register address is *316* (*0x013C*)
According to *1.1.7* chapter:
ADDR = *0x013B* (according to *Tiny BMS* registers map);
RL=*0x02* (write two registers);
PL=*0x04* (all *Tiny BMS* registers contains two bytes);
DATA: *4.2 V=4200 mV* (*0x1068*), *2.5 V=2500 mV* (*0x09C4*);

CRC = *0x6119*.
Command request bytes sequence to send to *BMS* according to *1.1.7* chapter:
0xAA 0x10 0x01 0x3B 0x00 0x02 0x04 0x10 0x68 0x09 0xC4 0x19 0x61.

If command was sended successfully, *BMS* responds with data:
0xAA 0x10 0x01 0x3B 0x00 0x02 0x28 0x22
Configured registers block address – *0x013B*;
Configurred two registers – *0x0002*;
CRC – 0x2228.

1.3.2. *MODBUS* read registers example

Below is an example, how to read five cells voltages (cell *5* to cell *9*) using *MODBUS* read command:

According to *1.1.6* chapter:
ADDR = *0x0005* (cell *5* address according to *Tiny BMS* registers map);
RL=*0x05* (read five registers);
CRC = *0x138C*.
Command request bytes sequence to send to *BMS* according to *1.1.6* chapter:
0xAA 0x03 0x00 0x05 0x00 0x05 0x8C 0x13.

If command was sent successfully, *BMS* responds with data:
0xAA 0x03 0x0A 0x97 0x40 0x97 0x40 0x97 0x2C 0x97 0x2C 0x97 0x2C 0x3E 0xC7
Payload length – *0x0A* (*10* bytes);
Cell *5* voltage – *0x9740* (*38720* decimal or *3.872 V* according to *Tiny BMS* registers map)
Cell *6* voltage – *0x9740* (*38720* decimal or *3.872 V* according to *Tiny BMS* registers map)
Cell *7* voltage – *0x972C* (*38700* decimal or *3.870 V* according to *Tiny BMS* registers map)
Cell *8* voltage – *0x972C* (*38700* decimal or *3.870 V* according to *Tiny BMS* registers map)
Cell *9* voltage – *0x972C* (*38700* decimal or *3.870 V* according to *Tiny BMS* registers map)
CRC – 0xC73E.

1.3.3. *Tiny BMS* read temperatures example

Below is provided an example, how to read temperature values using *read Tiny BMS* device temperatures command:

Command request bytes sequence to send to *BMS* according to *1.1.18* chapter:
0xAA 0x1B 0x3F 0x1B
CRC = *0x1B3F*.

If command was sent successfully, *BMS* responds with data:
0xAA 0x1B 0x06 0x16 0x01 0x14 0x01 0x16 0x01 0x0E 0x4E
Payload length – *0x06* (*6* bytes);
Tiny BMS internal temperature – *0x0116* (*278* decimal or *27.8 °C* according to *Tiny BMS* registers map)
Tiny BMS external *#1* temperature – *0x0114* (*276* decimal or *27.6 °C* according to *Tiny BMS* registers map)
Tiny BMS external *#2* temperature – *0x0116* (*278* decimal or *27.8 °C* according to *Tiny BMS* registers map)
CRC – 0x4E0E.

Chapter 2: *Tiny BMS CAN* bus communication protocol

2. Introduction

Tiny BMS device used along with *Energus PS CAN-UART* converter module gives an instant *CAN* bus connectivity with the user side *CAN* controller or other industrial equipment. Various proprietary commands are available for fast *CAN* bus communication. This chapter in detail covers all available commands implemented to communicate with *Tiny BMS* device. An internal *Tiny BMS* registers map is given in *Chapter 3.*

Note: *CAN* bitrate is *500 kbit/s* (not allowed to change by the user). Default node *ID* after firmware update is *0x01*. When multi-slave *CAN* bus topology is used, node *ID* can be assigned with *19 Tiny BMS CAN* command. Automatic node *ID* assignment is not available.

Note: *Tiny BMS CAN-UART* converter works and *CAN* bus communication is available only when *BMS* device is in active state (charging, discharging or *Ignition* enabled).

2.1. *CAN* bus communication commands list

2.1.1. Reset *Tiny BMS*, clear *Events* and *Statistics*

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x02	OPTION	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01							0x01 – Clear *Events*						
												0x02 – Clear *Statistics*						
												0x05 – Reset *BMS*						

***** - Last command bytes with zeros can be ignored

Response from *BMS* [OK]												
CAN identifier 11 bits											2 data bytes	
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x02
					Default node ID - 0x01							

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x02	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.2. Read *Tiny BMS* registers block

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x03	ADDR:MSB	ADDR:LSB	0x00	RL	0x00	0x00	0x00
					Default node ID - 0x01							[UINT_16]						

***** - Last command bytes with zeros can be ignored
ADDR – Registers block start addresses
RL – Registers to read. Max. *127* (*0x7F*) registers

The number of *CAN* messages responded from *BMS* is equal to the count of registers requested to read. First *CAN* message returns first register value and each other *CAN* message returns next registers values respectively.

Response from *BMS* [OK] – MSG 1

CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x03	PL	DATA1:MSB	DATA1:LSB	0x00
					Default node ID - 0x01									[UINT_16]		

Response from *BMS* [OK] – MSG n

CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x03	PL	DATAn:MSB	DATAn:LSB	n-1
					Default node ID - 0x01									[UINT_16]		

PL – Payload (DATA) length in bytes
DATA – Registers data

Response from *BMS* [ERROR]

CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x03	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.3. Write *Tiny BMS* registers block

The number of *CAN* messages sent to *BMS* is equal to the count of registers requested to write. First *CAN* message contains start address, register length and first register value and each other *CAN* message contains next registers values respectively.

Request to *BMS* – MSG 1

CAN identifier 11 bits											8 data bytes							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	0	Node ID (0x01...0x3F)						0x10	ADDR:MSB	ADDR:LSB	0x00	RL	DATA1:MSB	DATA1:LSB	0x00
					Default node ID - 0x01							[UINT_16]				[UINT_16]		

Request to *BMS* – MSG n

CAN identifier 11 bits											8 data bytes							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	0	Node ID (0x01...0x3F)						0x10	ADDR:MSB	ADDR:LSB	0x00	RL	DATAn:MSB	DATAn:LSB	n-1
					Default node ID - 0x01							[UINT_16]				[UINT_16]		

ADDR - Registers block start addresses. Start address can be in range *0x12C* to *0x18F*
RL – Registers to write. Max. *100* (*0x64*) registers
DATA – Registers data to write

Response from *BMS* [OK]

CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x10	ADDR:MSB	ADDR:LSB	0x00	RL
					Default node ID - 0x01								[UINT_16]			

ADDR – Configured registers blosck start address
RL – Configured registers

Response from *BMS* [ERROR]

CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x10	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.4. Read *Tiny BMS* newest *Events*

Request to *BMS*

CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x11	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

The number of *CAN* messages responded from *BMS* is equal to the count of events requested. First *CAN* message returns current *BMS* timestamp and each other *CAN* message returns new event *ID* and timestamp respectively.

Response from *BMS* [OK] – MSG 1																		
CAN identifier 11 bits											8 data bytes							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x11	PL	BTSP:LSB	BTSP	BTSP	BTSP:MSB	0x00
					Default node ID - 0x01									[UINT_32]				

Response from *BMS* [OK] – MSG n																		
CAN identifier 11 bits											8 data bytes							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x11	PL	TSPn:LSB	TSPn	TSPn:MSB	IDn	n-1
					Default node ID - 0x01									[UINT_24]			[UINT_8]	

PL – Payload (DATA) length in bytes
BTSP – Tiny *BMS* timestamp in seconds
TSP – Newest *Event* timestamp in seconds
ID – *Event* ID

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x11	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.5. Read *Tiny BMS* all *Events*

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x12	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

The number of *CAN* messages responded from *BMS* is equal to the count of events requested. First *CAN* message returns current *BMS* timestamp and each other *CAN* message returns event *ID* and timestamp respectively.

Response from *BMS* [OK] – MSG 1																		
CAN identifier 11 bits											8 data bytes							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x12	PL	BTSP:LSB	BTSP	BTSP	BTSP:MSB	0x00
					Default node ID - 0x01									[UINT_32]				

Response from *BMS* [OK] – MSG n																		
CAN identifier 11 bits											8 data bytes							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x12	PL	TSPn:LSB	TSPn	TSPn:MSB	IDn	n-1
					Default node ID - 0x01									[UINT_24]			[UINT_8]	

PL – Payload (DATA) length in bytes
BTSP – Tiny *BMS* timestamp in seconds
TSP – Newest *Event* timestamp in seconds
ID – *Event* ID

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x12	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.6. Read battery pack voltage (*Reg:36*)

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x14	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

Response from *BMS* [OK]																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x14	DATA:LSB	DATA	DATA	DATA:MSB
					Default node ID - 0x01								[FLOAT]			

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x14	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.7. Read battery pack current (*Reg:38*)

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x15	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

Response from *BMS* [OK]																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x15	DATA:LSB	DATA	DATA	DATA:MSB
					Default node ID - 0x01								[FLOAT]			

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x15	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.8. Read battery pack max. cell voltage (*Reg:41*)

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x16	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

Response from *BMS* [OK]														
CAN identifier 11 bits											4 data bytes			
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x16	DATA:LSB	DATA:MSB
					Default node ID - 0x01								[UINT_16]	

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x16	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.9. Read battery pack min. cell voltage (*Reg:40*)

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x17	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

Response from *BMS* [OK]														
CAN identifier 11 bits											4 data bytes			
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x17	DATA:LSB	DATA:MSB
					Default node ID - 0x01								[UINT_16]	

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x17	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.10. Read *Tiny BMS* online status (*Reg:50*)

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x18	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

Response from *BMS* [OK]														
CAN identifier 11 bits											4 data bytes			
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x18	DATA:LSB	DATA:MSB
					Default node ID - 0x01								0x91 – Charging [INFO]	
													0x92 – Fully charged [INFO]	
													0x93 – Discharging [INFO]	
													0x96 – Regeneration [INFO]	
													0x97 – Idle [INFO]	
													0x9B – Fault [ERROR]	

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x18	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.11. Read *Tiny BMS* lifetime counter (*Reg:32*)

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x19	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

* - Last command bytes with zeros can be ignored

Response from *BMS* [OK]																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x19	DATA:LSB	DATA	DATA	DATA:MSB
					Default node ID - 0x01								[UINT32]			

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x19	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.12. Read *Tiny BMS* estimated *SOC* value (*Reg:46*)

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x1A	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

* - Last command bytes with zeros can be ignored

Response from *BMS* [OK]																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x1A	DATA:LSB	DATA	DATA	DATA:MSB
					Default node ID - 0x01								[UINT32]			

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x1A	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.13. Read *Tiny BMS* device temperatures (*Reg:48*, *Reg:42*, *Reg:43*)

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x1B	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

* - Last command bytes with zeros can be ignored

Response from *BMS* [OK] – MSG 1																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x1B	PL	DATA1:LSB	DATA1:MSB	0x00
					Default node ID - 0x01									[INT_16]		

Response from *BMS* [OK] – MSG 2																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x1B	PL	DATA2:LSB	DATA2:MSB	0x01
					Default node ID - 0x01									[INT_16]		

Response from *BMS* [OK] – MSG 3																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x1B	PL	DATA3:LSB	DATA3:MSB	0x02
					Default node ID - 0x01									[INT_16]		

PL – Payload (DATA) length in bytes
DATA1 – *Tiny BMS* internal temperature
DATA2 – External temperature sensor *#1* temperature value (value of *-32768* if not connected)
DATA3 – External temperature sensor *#2* temperature value (value of *-32768* if not connected)

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x1B	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.14. Read battery pack cells voltages

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x1C	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

BMS response returned *CAN* messages are equal to battery cells count. First *CAN* message returns first cell voltage and each other *CAN* message returns next cells voltages respectively.

Response from *BMS* [OK] – MSG 1																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x1C	PL	DATA1:LSB	DATA1:MSB	0x00
					Default node ID - 0x01									[UINT_16]		

Response from *BMS* [OK] – MSG n																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x1C	PL	DATAn:LSB	DATAn:MSB	n-1
					Default node ID - 0x01									[UINT_16]		

PL – Payload (DATA) length in bytes

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x1C	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.15. Read *Tiny BMS* settings values (min, max, default, current)

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x1D	OPTION	0x00	RL	0x00	0x00	0x00	0x00
					Default node ID - 0x01							0x01 – Min. settings						
												0x02 – Max. settings						
												0x03 – Default settings						
												0x04 – Current settings						

***** - Last command bytes with zeros can be ignored
RL – Registers to read. Max. *100* (*0x64*) registers

The number of *CAN* messages responded from *BMS* is equal to the count of settings registers requested. First *CAN* message returns first register and each other *CAN* message returns next registers respectively.

Response from *BMS* [OK] – MSG 1																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x1D	PL	DATA1:LSB	DATA1:MSB	0x00
					Default node ID - 0x01									[UINT_16]		

Response from *BMS* [OK] – MSG n																
CAN identifier 11 bits											6 data bytes					
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x1D	PL	DATAn:LSB	DATAn:MSB	n-1
					Default node ID - 0x01									[UINT_16]		

PL – Payload (DATA) length in bytes

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x1D	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.16. Read *Tiny BMS* version

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x1E	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

Response from *BMS* [OK]																		
CAN identifier 11 bits											8 data bytes							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x1E	PL	DATA1	DATA2	DATA3	DATA4:LSB	DATA4:MSB
					Default node ID - 0x01									[UINT_8]	[UINT_8]	[UINT_8]	[UINT_16]	

PL – Payload (DATA) length in bytes
DATA1 – Hardware version
DATA2 – Hardware changes version
DATA3 – Firmware public version
DATA4 – Firmware internal version

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x1E	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.17. Read *Tiny BMS* calculated speed, left distance and estimated time values

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Node ID (0x01...0x3F)						0x20	0x00	0x00	0x00	0x00	0x00	0x00	0x00
					Default node ID - 0x01													

***** - Last command bytes with zeros can be ignored

Response from *BMS* [OK] – MSG 1																		
CAN identifier 11 bits											8 data bytes							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x20	PL	DATA1:LSB	DATA1	DATA1	DATA1:MSB	0x00
					Default node ID - 0x01									[FLOAT]				

Response from *BMS* [OK] – MSG 2																		
CAN identifier 11 bits											8 data bytes							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x20	PL	DATA2:LSB	DATA2	DATA2	DATA2:MSB	0x01
					Default node ID - 0x01									[UINT_32]				

Response from *BMS* [OK] – MSG 3																			
CAN identifier 11 bits											8 data bytes								
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x20	PL	DATA3:LSB	DATA3	DATA3	DATA3:MSB	0x02
					Default node ID - 0x01									[UINT_32]				

PL – Payload length in bytes
DATA1 – Speed (*km/h*)
DATA2 – Left distance to empty battery (*km*)
DATA3 – Estimated time left to empty battery (*seconds*)

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x20	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.18. Read *CAN* node *ID*

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2*	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	0	0	0	0	0	0	0x28	0x00	0x00	0x00	0x00	0x00	0x00	0x00

***** - Last command bytes with zeros can be ignored

Response from *BMS* [OK]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x01	0x28	DATA
					Default node ID - 0x01								

DATA – *CAN-UART* converter *CAN* node *ID* (*0x01* to *0x3F*)

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	Node ID (0x01...0x3F)						0x00	0x28	ERROR
					Default node ID - 0x01								

ERROR – Response error code

2.1.19. Write *CAN* node *ID*

Request to *BMS*																		
CAN identifier 11 bits											8 data bytes*							
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3*	Byte 4*	Byte 5*	Byte 6*	Byte 7*	Byte 8*
0	1	0	0	0	Old ID (0x01...0x3F)						0x29	DATA	0x00	0x00	0x00	0x00	0x00	0x00

***** - Last command bytes with zeros can be ignored
DATA - *CAN-UART* converter *CAN* node new *ID* (*0x01* to *0x3F*)

Response from *BMS* [OK]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	New ID (0x01...0x3F)						0x01	0x29	DATA

DATA – *CAN-UART* converter *CAN* node new *ID* (*0x01* to *0x3F*)

Response from *BMS* [ERROR]													
CAN identifier 11 bits											3 data bytes		
10	9	8	7	6	5	4	3	2	1	0	Byte 1	Byte 2	Byte 3
0	1	0	0	1	New ID (0x01...0x3F)						0x00	0x28	ERROR

ERROR – Response error code

Chapter 3: *Tiny BMS* registers map

3. Introduction

This chapter in detail covers all an internal *Tiny BMS* registers map.

3.1. *Tiny BMS Live* data

<table>
<tr><th>Reg. Nr.</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>Action</th></tr>
<tr><td>0</td><td colspan="16">Cell 1 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>1</td><td colspan="16">Cell 2 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>2</td><td colspan="16">Cell 3 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>3</td><td colspan="16">Cell 4 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>4</td><td colspan="16">Cell 5 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>5</td><td colspan="16">Cell 6 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>6</td><td colspan="16">Cell 7 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>7</td><td colspan="16">Cell 8 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>8</td><td colspan="16">Cell 9 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>9</td><td colspan="16">Cell 10 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>10</td><td colspan="16">Cell 11 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>11</td><td colspan="16">Cell 12 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>12</td><td colspan="16">Cell 13 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>13</td><td colspan="16">Cell 14 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>14</td><td colspan="16">Cell 15 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>15</td><td colspan="16">Cell 16 Voltage [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>16-31</td><td colspan="16">Reserved</td><td>R</td></tr>
<tr><td>32</td><td colspan="16" rowspan="2">BMS Lifetime Counter [UINT_32] / Resolution 1 s</td><td rowspan="2">R</td></tr>
<tr><td>33</td></tr>
<tr><td>34</td><td colspan="16" rowspan="2">Estimated Time Left [UINT_32] / Resolution 1 s</td><td rowspan="2">R</td></tr>
<tr><td>35</td></tr>
<tr><td>36</td><td colspan="16" rowspan="2">Battery Pack Voltage [FLOAT] / Resolution 1 V</td><td rowspan="2">R</td></tr>
<tr><td>37</td></tr>
<tr><td>38</td><td colspan="16" rowspan="2">Battery Pack Current [FLOAT] / Resolution 1 A</td><td rowspan="2">R</td></tr>
<tr><td>39</td></tr>
<tr><td>40</td><td colspan="16">Minimal Cell Voltage [UINT_16] / Resolution 1 mV</td><td>R</td></tr>
<tr><td>41</td><td colspan="16">Maximal Cell Voltage [UINT_16] / Resolution 1 mV</td><td>R</td></tr>
<tr><td>42</td><td colspan="16">External Temp. Sensor #1 Temperature [INT_16] / Resolution 0.1 °C</td><td>R</td></tr>
<tr><td>43</td><td colspan="16">External Temp. Sensor #2 Temperature [INT_16] / Resolution 0.1 °C</td><td>R</td></tr>
<tr><td>44</td><td colspan="16">Distance Left To Empty Battery [UINT_16] / Resolution 1 km</td><td>R</td></tr>
<tr><td>45</td><td colspan="16">Reserved</td><td>R</td></tr>
<tr><td>46</td><td colspan="16" rowspan="2">State Of Charge [UINT_32] / Resolution 0.000001 %</td><td rowspan="2">R</td></tr>
<tr><td>47</td></tr>
<tr><td>48</td><td colspan="16">BMS Internal Temperature [INT_16] / Resolution 0.1 °C</td><td>R</td></tr>
<tr><td>49</td><td colspan="16">Reserved</td><td>R</td></tr>
<tr><td>50</td><td colspan="16">BMS Online Status [UINT_16] / 0x91-Charging, 0x92-Fully Charged,
0x93-Discharging, 0x96-Regenertion, 0x97-Idle, 0x9B-Fault</td><td>R</td></tr>
<tr><td>51</td><td colspan="16">Balancing Decision Bits [UINT_16] / First Cell - LSB Bit of LSB Byte: 1 - need balancing, 0 - cell no need balance</td><td>R</td></tr>
<tr><td>52</td><td colspan="16">Real Balancing Bits [UINT_16] / First Cell - LSB Bit of LSB Byte: 1 - balancing, 0 – not balancing</td><td>R</td></tr>
<tr><td>53</td><td colspan="16">Number Of Detected Cells [UINT_16]</td><td>R</td></tr>
<tr><td>54</td><td colspan="16" rowspan="2">Speed [FLOAT] km/h</td><td>R</td></tr>
<tr><td>55</td><td>R</td></tr>
<tr><td>56-99</td><td colspan="16">Reserved</td><td>R</td></tr>
</table>

3.2. *Tiny BMS Statistics* data

<table>
<tr><th>Reg. Nr.</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>Action</th></tr>
<tr><td>100</td><td colspan="16" rowspan="2">Total Distance [UINT_32] / Resolution 0.01 km</td><td rowspan="2">R</td></tr>
<tr><td>101</td></tr>
<tr><td>102</td><td colspan="16">Maximal Discharge Current [UINT_16] / Resolution 100 mA</td><td>R</td></tr>
<tr><td>103</td><td colspan="16">Maximal Charge Current [UINT_16] / Resolution 100 mA</td><td>R</td></tr>
<tr><td>104</td><td colspan="16">Maximal Cell Voltage Difference [UINT_16] / Resolution 0.1 mV</td><td>R</td></tr>
<tr><td>105</td><td colspan="16">Under-Voltage Protection Count [UINT_16] / Resolution 1 count</td><td>R</td></tr>
<tr><td>106</td><td colspan="16">Over-Voltage Protection Count [UINT_16] / Resolution 1 count</td><td>R</td></tr>
</table>

107	Discharge Over-Current Protection Count [UINT_16] / Resolution 1 count		R
108	Charge Over-Curent Protection Count [UINT_16] / Resolution 1 count		R
109	Over-Heat Protection Count [UINT_16] / Resolution 1 count		R
110	Reserved		R
111	Charging Count [UINT_16] / Resolution 1 count		R
112	Full Charge Count [UINT_16] / Resolution 1 count		R
113	Min. Pack Temperature [INT_8] / Resolution 1 °C	Max. Pack Temperature [INT_8] / Resolution 1 °C	R
114	Last BMS Reset Event [UINT_8] / 0x00-Unknown, 0x01-Low power reset, 0x02-Window watchdog reset, 0x03-Independent watchdog reset, 0x04-Software reset, 0x05-POR/PDR reset, 0x06-PIN reset, 0x07-Options bytes loading reset	Last Wakeup From BMS Sleep Mode Event [UINT_8] / 0x00-Charger connected, 0x01-Ignition, 0x02-Discharging detected, 0x03-UART communication detected	R
115	Reserved		R
116	Statistics Last Cleared On Tmestamp [UINT_32] / Resolution 1s		R
117			
118-199	Reserved		R

3.3. *Tiny BMS Events* data

Reg. Nr.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Action
200	Event_0 Timestamp [UINT_24 LSB] / Resolution 1 s																R
201	Event_0 Timestamp [UINT_24 MSB] / Resolution 1 s								Event_0 Message ID* [UINT_8]								R
202	Event_1 Timestamp [UINT_24 LSB] / Resolution 1 s																R
203	Event_1 Timestamp [UINT_24 MSB] / Resolution 1 s								Event_1 Message ID* [UINT_8]								R
204	Event_2 Timestamp [UINT_24 LSB] / Resolution 1 s																R
205	Event_2 Timestamp [UINT_24 MSB] / Resolution 1 s								Event_2 Message ID* [UINT_8]								R
206	Event_3 Timestamp [UINT_24 LSB] / Resolution 1 s																R
207	Event_3 Timestamp [UINT_24 MSB] / Resolution 1 s								Event_3 Message ID* [UINT_8]								R
...	...																...
...	...								...								...
296	Event_48 Timestamp [UINT_24 LSB] / Resolution 1 s																R
297	Event_48 Timestamp [UINT_24 MSB] / Resolution 1 s								Event_48 Message ID* [UINT_8]								R
298	Reserved																R
299	Reserved																R

* - *Events* messages *ID* list is attached in the *Chapter 4*.

3.4. *Tiny BMS* settings

Reg. Nr.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Action
300	Fully Charged Voltage [UINT_16] [1200 to 4500] / Resolution 1 mV																R/W
301	Fully Discharged Voltage [UINT_16] [1000 to 3500] / Resolution 1 mV																R/W
302	Reserved																R/W
303	Early Balancing Threshold [UINT_16] [1000 to 4500] / Resolution 1 mV																R/W
304	Charge Finished Current [UINT_16] [100 to 5000]* / Resolution 1 mA																R/W
305	Reserved																R/W
306	Battery Capacity [UINT_16] [10 to 65500] / Resolution 0.01 Ah																R/W
307	Number Of Series Cells [UINT_16] [4 to 16] / Resolution 1 cell count																R/W
308	Allowed Disbalance [UINT_16] [15 to 100] / Resolution 1 mV																R/W
309	Reserved																R/W
310	Reserved																R/W
311	Reserved																R/W
312	Pulses Per Unit [UINT_32] [1 to 100000] / Resolution 1 pulse per unit																R/W
313																	
314	Distance Unit Name [UINT_16] / 0x01-Meter, 0x02-Kilometer, 0x03-Feet, 0x04-Mile, 0x05-Yard																R/W
315	Over-Voltage Cutoff [UINT_16] [1200 to 4500] / Resolution 1 mV																R/W
316	Under-Voltage Cutoff [UINT_16] [800 to 3500] / Resolution 1 mV																R/W
317	Discharge Over-Current Cutoff [UINT_16] [1 to 750]* / Resolution 1 A																R/W
318	Charge Over-Current Cutoff [UINT_16] [1 to 750]* / Resolution 1 A																R/W
319	Over-Heat Cutoff [INT_16] [+20 to +90] / Resolution 1 °C																R/W
320	Low Temperature Charger Cutoff [INT_16] [-40 to +10] / Resolution 1 °C																R/W
321	Reserved																R/W
322	Reserved																R/W
323	Reserved																R/W
324	Reserved																R/W
325	Reserved																R/W

326	Reserved		R/W
327	Reserved		R/W
328	State Of Charge [UINT_16] [0 to 50000] / Resolution 0.002 %		R/W
329	Reserved		R/W
330	Charger Type [8 bits LSB] / 0x00-Variable (Reserved), 0x01-CC/CV, 0x02-CAN (Reserved)	Reserved	R/W
331	Load Switch Type [8 bits LSB] / 0x00-FET, 0x01-AIDO1, 0x02-AIDO2, 0x03-DIDO1, 0x04-DIDO2, 0x05-AIHO1 Active Low, 0x06-AIHO1 Active High, 0x07-AIHO2 Active Low, 0x08-AIHO2 Active High	Reserved	R/W
332	Automatic Recovery [8 bits LSB] [1 to 30] / Resolution 1 s	Reserved	R/W
333	Charger Switch Type [8 bits LSB] / 0x01-Charge FET, 0x02-AIDO1, 0x03-AIDO2, 0x04-DIDO1, 0x05-DIDO2, 0x06-AIHO1 Active Low, 0x07-AIHO1 Active High, 0x08-AIHO2 Active Low, 0x09-AIHO2 Active High	Reserved	R/W
334	Ignition [8 bits LSB] / 0x00-Disabled, 0x01-AID01, 0x02-AIDO2, 0x03-DIDO1, 0x04-DIDO2, 0x05-AIHO1, 0x06-AIHO2	Reserved	R/W
335	Charger Detection [8 bits LSB] / 0x01-Internal, 0x02-AIDO1, 0x03-AIDO2, 0x04-DIDO1, 0x05-DIDO2, 0x06-AIHO1, 0x07-AIHO2	Reserved	R/W
336	Speed Sensor Input [8 bits LSB] / 0x00-Disabled, 0x01-DIDO1, 0x02-DIDO2	Reserved	R/W
337	Precharge Pin [8 bits LSB] / 0x00-Disabed, 0x02-Discharge FET, 0x03-AIDO1, 0x04-AIDO2, 0x05-DIDO1, 0x06-DIDO2, 0x07-AIHO1 Active low, 0x08-AIHO1 Active high, 0x09-AIHO2 Active low, 0x10-AIHO2 Active high	Reserved	R/W
338	Precharge Duration [8 bits LSB] / 0x00-0.1 sec., 0x01-0.2 sec., 0x02-0.5 sec., 0x03-1 sec., 0x04-2 sec., 0x05-3 sec., 0x06-4 sec., 0x07-5 sec.	Reserved	R/W
339	Temperature Sensor Type [8 bits LSB] / 0x00-Dual 10K NTC, 0x01-Multipoint Active Sensor	Reserved	R/W
340	BMS Operation Mode [8 bits LSB] / 0x00-Dual Port Operation, 0x01-Single Port Operation	Reserved	R/W
341	Single Port Switch Type [8 bits LSB] / 0x00-FET, 0x01-AIDO1, 0x02-AIDO2, 0x03-DIDO1, 0x04-DIDO2, 0x05-AIHO1 Active Low, 0x06-AIHO1 Active High, 0x07-AIHO2 Active Low, 0x08-AIHO2 Active High	Reserved	R/W
342	Broadcast Time [8 bits LSB] / 0x00-Disabled, 0x01-0.1 sec., 0x02-0.2 sec., 0x03-0.5 sec., 0x04-1 sec., 0x05-2 sec., 0x06-5 sec., 0x07-10 sec.	Reserved	R/W
343	Protocol [8 bits LSB] / 0x00-CA V3, 0x01-ASCII, 0x02-SOC BAR	Reserved	R/W
344-399	Reserved		R/W

* *Tiny BMS* device internally changes these settings min. and max. values according to current sensor used.

3.5. *Tiny BMS* version data

Reg. Nr.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Action
500	Hardware Version [8 bits LSB]								Hardware Changes Version [8 bits MSB]								R
501	Public Release Firmware Version [8 bits LSB]								BPT (1 bit)*	BCS (2 bits)**		Reserved					R
502	Internal Firmware Version [UINT_16]																R
503	Bootloader Version [8 bits LSB]								Profile Version [8 bits MSB]								R
504	Product Serial Number [96 bits]																R
505																	
506																	
507																	
508																	
509																	
510-599	Reserved																R

* **BPT** – *BMS* Power Type / 0x00-Low Power, 0x01-High Power
** **BCS** – *BMS* Current Sensor Used / 0x00-Internal Resistor, 0x01-Internal HALL, 0x02-External

Chapter 4: *Tiny BMS Events* messages list

4. Introduction

This chapter in detail covers all the *Tiny BMS Events* messages and its *IDs*.

4.1. *Tiny BMS Fault* messages list

Fault ID (0x01 to 0x30)	Fault message
0x02	Under-Voltage Cutoff Occurred
0x03	Over-Voltage Cutoff Occurred
0x04	Over-Temperature Cutoff Occurred
0x05	Discharging Over-Current Cutoff Occurred
0x06	Charging Over-Current Cutoff Occurred
0x07	Regeneration Over-Current Cutoff Occurred
0x0A	Low Temperature Cutoff Occurred
0x0B	Charger Switch Error Detected
0x0C	Load Switch Error Detected
0x0D	Single Port Switch Error Detected
0x0E	External Current Sensor Disconnected (BMS restart required)
0x0F	External Current Sensor Connected (BMS restart required)

4.2. *Tiny BMS Warning* messages list

Warning ID (0x31 to 0x60)	Warning message
0x31	Fully Discharged Cutoff Occurred
0x37	Low Temperature Charging Cutoff Occurred
0x38	Charging Done (Charger voltage too high)
0x39	Charging Done (Charger voltage too low)

4.3. *Tiny BMS Information* messages list

Info ID (0x61 to 0x90)	Info message
0x61	System Started
0x62	Charging Started
0x63	Charging Done
0x64	Charger Connected
0x65	Charger Disconnected
0x66	Dual Port Operation Mode Activated
0x67	Single Port Operation Mode Activated
0x73	Recovered From Over-Temperature Fault Condition
0x74	Recovered From Low Temperature Warning Condition
0x75	Recovered From Low Temperature Fault Condition
0x76	Recovered From Charging Over-Current Fault Condition
0x77	Recovered From Discharging Over-Current Fault Condition
0x78	Recovered From Regeneration Over-Current Fault Condition
0x79	Recovered From Over-Voltage Fault Condition
0x7A	Recovered From Fully Discharged Voltage Warning Condition
0x7B	Recovered From Under-Voltage Fault Condition
0x7C	External Current Sensor Connected
0x7D	External Current Sensor Disconnected

Document revision history

Revision	Date	Description
A	2018-07-30	Initial release.
B	2018-12-11	Fixed *UART* command: *1.1.23 Read Tiny BMS calculated speed, left distance and estimated time values*