BMS Main 2.x

Modbus protocol

Revision 5 (24-October-2023)

Contents

1 General information

The BMS Main 2.x board provides the information about the battery system using Modbus protocol. The BMS is a Modbus-server and it responds to the Modbus-client's commands.

Interaction with the board is performed over the RS-485 bus (Modbus RTU) or the Ethernet network (Modbus TCP).

RS-485 bus connection parameters:

- baud rate, bps — 600, 1200, 2400, 4800, 9600 (by default), 19200, 38400, 57600, 115200;
- word length, bits — 8;
- parity — none;
- board address (by default) — 32.

Ethernet connection parameters:

- port — 502.

There is a description of the Input и Holding registers below. Column "Type" contains method of parameters coding:

U8 — unsigned 8-bit integer number;

U16 — unsigned 16-bit integer number;

S16 — signed 16-bit integer number;

U32 — unsigned 32-bit integer number;

REAL32 — single precision floating point number (IEEE 754 standard);

U8[x] — array of unsigned 8-bit integer numbers having a length of x;

U16[x] — array of unsigned 16-bit integer numbers having a length of x;

REAL32[x] — array of single precision floating point numbers having a length of x.

The ordering of bytes of a word — **little endian**.

2 Input registers

Register address	Number of registers	Content	Type
0x0000	1	Hardware version: byte 0 — minor; byte 1 — major.	U8[2]
0x0001-0x0002	2	Firmware version: byte 0 — patch; byte 1 — minor; byte 2 — major; byte 3 — not used (set to 0).	U8[4]
0x0003-0x0004	2	Bootloader version: byte 0 — patch; byte 1 — minor; byte 2 — major; byte 3 — not used (set to 0).	U8[4]
0x1000-0x1003	3	Current time on the board clock: byte 0 — day (BCD); byte 1 — month (BCD); byte 2 — year (BCD); byte 3 — hours (BCD); byte 4 — minutes (BCD); byte 5 — seconds (BCD).	U8[6]

0x2000	1	Discrete input signals (bitfield): bit 0 — signal "Battery cover opened"; bit 1 — signal "Charger connected"; bit 2 — signal "Power down request"; bit 3 — signal "Inhibit charging"; bit 4 — signal "Inhibit discharging"; bit 5 — signal “Charging contactor feedback”; bit 6 — signal “Discharging contactor feedback”; bit 7 — signal “Insulation status”.	U16
0x2001-0x2002	2	Current, A	REAL32
0x2003-0x2004	2	External temperature, °C	REAL32
0x2005-0x2006	2	Humidity, RH%	REAL32
0x2007-0x2008	2	Errors 1 (bitfield): bit 0 — error "Overcurrent"; bit 1 — error "Undervoltage"; bit 2 — error "Overvoltage"; bit 3 — error "Low DCH temperature"; bit 4 — error "High DCH temperature"; bit 5 — error "Battery cover"; bit 6 — error "High humidity"; bit 7 — error "Water";	U32

		bit 8 — error "Logic high temperature"; bit 9 — error "Logic offline"; bit 10 — "Critical error"; bit 11 — error "Crown truck offline"; bit 12 — "Cell count error"; bit 13 — error "HYG truck offline"; bit 14 — need to acknowledge errors; bit 15 — error "Combilift truck offline"; bit 16 — error "Short circuit"; bit 17 — error "Contactor high temperature"; bit 18 — "Logic count error"; bit 19 — "ADC error"; bit 20 — open or short circuit in the current sensor circuitry; bit 21 — large number of switching of the charging contactor; bit 22 — large number of switching of the discharging contactor; bit 23 — error "BMS Current Sensor offline"; bit 24 — internal error of the BMS Current Sensor; bit 25 — wrong checksum of the board settings; bit 26 — board is reset by the WDT; bit 27 — error "No temperature sensors"; bit 28 — error "Temperature sensor shorted"; bit 29 — error “Spirit offline”;	

		bits 30-31 – not used.	
0x2009-0x200A	2	Battery system state (bitfield): bit 0 — signal "Low SOC"; bit 1 — signal "High charging current"; bit 2 — charge contactor state (0 – opened, 1 – closed); bit 3 — signal "Allow charging"; bit 4 — signal "Charging current present"; bit 5 — discharge contactor state (0 – opened, 1 – closed); bit 6 — signal "Discharging current present"; bit 7 — signal "High voltage" (EV); bit 8 — signal "Heater" (0 – off, 1 – on); bit 9 — signal "Cooler" (0 – off, 1 – on); bit 10 — shutdown request from the HYG truck; bit 11 — initialization of the board (current sensor is calibrating, or BMS Logic boards are scanning); bit 12 — precharge contactor state (0 – opened, 1 – closed); bit 13 — shutdown request from Combilift truck; bit 14 — signal "Cell analysis"; bit 15 — balancing of the cell series #1; bit 16 — balancing of the cell series #2; bit 17 — auxiliary discharge contactor state (0 – opened, 1 – closed);	U32

		bit 18 — shutdown acknowledge; bit 19 — EWS signal from the Crown truck; bit 20 — main contactor state (0 – opened, 1 - closed); bit 21 – signal to reset the BMS (service reset); bit 22 - state of the charging/discharging contactor (0 – opened, 1 – closed); bit 23 – signal “Ready to charge”; bit 24 – signal “Ready to discharge”; bit 25 – signal “Power up”; bits 26-31 – not used.	
0x200B	1	Discrete output signals (bitfield): bit 0 — state of the output #1; bit 1 — state of the output #2; bit 2 — state of the output #3; bit 3 — state of the output #4; bits 4-15 — not used.	U16
0x200C	1	Relay states (bitfield): bit 0 — state of the relay #1; bit 1 — state of the relay #2; bit 2 — state of the relay #3; bit 3 — state of the relay #4; bits 4-15 — not used.	U16
0x200E	2	Errors 2 (bitfield):	U32

		bit 0 — error "Low CH temperature"; bit 1 — error “High CH temperature”; bit 2 — SD card mounting error; bit 3 — SD card filesystem error; bit 4 — error “Unallowable charging”; bit 5 — error “Stuck contactor”; bit 6 — “CH contactor feedback error”; bit 7 — “DCH contactor feedback error”; bit 8 – “Insulation fault”; bit 9 – “PCH contactor feedback error”; bit 10 – “CH/DCH contactor feedback error”; bit 11 – “Main contactor feedback error”; bits 12-31 — not used.	
0x2010	1	Address or the BMS Logic board whose parameters are in registers 0x2011-0x20C9	U16
0x2011	1	BMS Logic board state (bitfield): bit 0 — board is present; bit 1 — board is online; bit 2 — board is ready; bit 3 — data from the board is actual; bit 4 — temperature sensor #1 is present; bit 5 — temperature sensor #2 is present; bit 6 — temperature sensor #1 is shorted; bit 7 — temperature sensor #2 is shorted;	U16

		bits 8-15 — not used.	
0x2012-0x2013	2	Board temperature, °C	REAL32
0x2014-0x2015	2	Cell balancing flags (bitfield): bit i — balancing resistor is connected to the ith cell.	U32
0x2016-0x2029	20	Array of cells states. Each element of the array corresponds to a cell and is a bitfield: bit 0 — cell is present; bit 1 — temperature sensor is present; bit 2 — need to connect a balancing resistor to the cell; bit 3 — balancing resistor is connected to the cell; bit 4 — temperature sensor is shorted; bit 5 — wires are connected to the cell; bits 6-15 — not used.	U16[20]
0x202A-0x2051	40	Array of cells voltages (V)	REAL32[20]
0x2052-0x2079	40	Array of cells temperatures (°C)	REAL32[20]
0x207A-0x20A1	40	Array of cells SOCs (%)	REAL32[20]
0x20A2-0x20C9	40	Array of cells resistances (Ohm)	REAL32[20]
0x2100-0x2101	2	Battery state of charge (SOC), %	REAL32

0x2102	1	Number of BMS Logic boards	U16
0x2103	1	Number of cells	U16
0x2104-0x2105	2	Battery voltage, V	REAL32
0x2106-0x2107	2	Battery resistance, Ohm	REAL32
0x2108-0x2109	2	Effective capacity, A×h	REAL32
0x210A-0x210B	2	Balancing effectivity, %	REAL32
0x210C-0x210D	2	State of health, %	REAL32
0x210E-0x210F	2	Depth of discharge, A×h	REAL32
0x2110-0x2111	2	Minimum BMS Logic temperature	REAL32
0x2112	1	Address of the BMS Logic board whose temperature is minimal	U16
0x2113-0x2114	2	Maximum BMS Logic temperature	REAL32
0x2115	1	Address of the BMS Logic board whose temperature is maximal	U16
0x2116-0x2117	2	BMS Logic polling rate, commands pre second	REAL32
0x2118-0x2119	2	Minimum cell temperature	REAL32

0x211A	1	Address of the BMS Logic board which is connected to the cell whose temperature is minimal	U16
0x211B	1	Position of the cell whose temperature is minimal	U16
0x211C-0x211D	2	Maximum cell temperature	REAL32
0x211E	1	Address of the BMS Logic board which is connected to the cell whose temperature is maximal	U16
0x211F	1	Position of the cell whose temperature is maximal	U16
0x2120-0x2121	2	Minimum cell voltage	REAL32
0x2122	1	Address of the BMS Logic board which is connected to the cell whose voltage is minimal	U16
0x2123	1	Position of the cell whose voltage is minimal	U16
0x2124-0x2125	2	Maximum cell voltage	REAL32
0x2126	1	Address of the BMS Logic board which is connected to the cell whose voltage is maximal	U16
0x2127	1	Position of the cell whose voltage is maximal	U16
0x2128	1	Error flag: 0 — no errors; 1 — there are some errors.	U16
0x2129	1	J1939 charge voltage, 0,1V/bit	U16
0x212A	1	J1939 charge current, 0,1A/bit	U16

0x212B	1	J1939 charger state (bitfield): bit 0 — hardware fault; bit 1 — high temperature; bit 2 — invalid input voltage; bit 3 — invalid battery voltage; bit 4 — offline; bits 5-15 — not used.	U16
0x2130-0x2131	2	Energy received from the charger, W×h	REAL32
0x2132-0x2133	2	Energy consumed by the load, W×h	REAL32
0x2134-0x2135	2	Energy dissipated by the balancing resistors, W×h	REAL32
0x2140	1	SD-card mounting flag: 0 — not mounted; 1 — mounted.	U16
0x2141	1	Reserved	U16
0x2142	1	Reserved	U16
0x2150	1	Eltek charger state: 1 — no charging; 2 — charging; 3 — recoverable error; 4 — nonrecoverable error.	U16
0x2151	1	Eltek input current, 0,1A/bit	U16

0x2152	1	Eltek output current, 0,1A/bit	U16
0x2153	1	Eltek input voltage, 1V/bit	U16
0x2154	1	Eltek output voltage, 0,1V/bit	U16
0x2155	1	Eltek input frequency, 1Hz/bit	U16
0x2156	1	Eltek primary temperature, 1°C/bit	S16
0x2157	1	Eltek secondary temperature, 1°C/bit	S16
0x2158	1	Eltek available power, 0,5%/bit	U16
0x2159	1	Eltek maximum power, 1W/bit	U16
0x215A-0x215B	2	Eltek errors (bitfield): bit 0 — overvoltage (recoverable error); bit 1 — not used; bit 2 — internal communication error (nonrecoverable error); bit 3 — high mains (recoverable error); bit 4 — low mains (recoverable error); bit 5 — high temperature (recoverable error bit 6 — low temperature (recoverable error); bit 7 — current limited (recoverable error); bit 8 — not used; bit 9 — transformer error (nonrecoverable error); bits 10-15 — not used; bit 16 — undervoltage (recoverable error); bit 17 — control timeout (recoverable error);	U32

		bits 18-31 — not used.	
0x2160	1	Sunny Island discharge voltage, 0,1V/bit	U16
0x2161	1	Sunny Island current, 0,1A/bit	S16
0x2162	1	Sunny Island temperature, 0,1°C/bit	S16
0x2163	1	Sunny Island SOC, 0,01%/bit	U16
0x2164	1	Sunny Island SOH, 0,01%/bit	U16
0x2165	1	Sunny Island mode	U16
0x2166	1	Sunny Island state	U16
0x2167	1	Sunny Island errors	U16
0x2168	1	Sunny Island charge voltage, 0,01V/bit	U16
0x2170	1	Wi-Fi connection status: 0 — no connection; 1 — connection is established.	U16
0x2171-0x2172	2	IP-address in the Wi-Fi network	U8[4]
0x2173-0x2175	3	MAC-address of the Wi-Fi module	U8[6]
0x2176	1	BMS Crown communication status: 0 — offline; 1 — online.	U16
0x2177	1	Voltage on the A2 line of the BMS Crown, 0,1V/bit	U16
0x2178	1	Voltage on the A1 line of the BMS Crown, 0,1V/bit	U16
0x2179-	2	Instant effective capacity, A×h	REAL32

0x217A			
0x217B-0x217C	2	Coulomb received from the charger, A×h	REAL32
0x217D-0x217E	2	Coulomb consumed by the load, A×h	REAL32
0x217F-0x2180	2	Ethernet IP-address	U8[4]
0x2181-0x2182	2	Ethernet netmask	U8[4]
0x2183-0x2184	2	Ethernet gateway	U8[4]
0x2185-0x2186	2	Current zero level, V	REAL32
0x2187	1	HYG truck feedback	U16
0x2188	1	HYG truck communication state: 0 — offline; 1 — online.	U16
0x2189	1	BMS Indication interaction state: 0 — no actions; 1 — reading settings of the BMS Indication; 2 — settings are read; 3 — writing settings to the BMS Indication; 4 — settings are written.	U16
0x218A	1	Part of parameters which have been read or written from/to the BMS Indication, %	U16

0x218B	1	Combilift truck feedback	U16
0x218C	1	Combilift truck communication state: 0 — offline; 1 — online.	U16
0x218D	1	UPS Parus communication state: 0 — offline; 1 — online.	U16
0x218E	2	Instant voltage from the current sensor, V	REAL32
0x2190	2	Instant zero level from the current sensor, V	REAL32
0x2192	2	Instant voltage from the auxiliary current sensor, V	REAL32
0x2194	2	Instant zero level from the auxiliary current sensor, V	REAL32
0x2196	1	BMS Indication firmware update status: 0 — no actions; 1 — starting bootloader; 2 — bootloader is started; 3 — bootloader is not started; 1000-1006 — codes returned by the bootloader.	U16
0x2197	2	Instant value of current received from the BMS Current Sensor, 1mA/bit	S32
0x2199	2	Average value of current received from the BMS Current Sensor, 1mA/bit	S32
0x219B	1	BMS Current Sensor communication state: 0 — offline;	U16

		1 — online.	
0x219C	1	Spirit AGV truck communication state: 0 – offline; 1 – online.	U16
0x219D	1	BKM charger communication state: 0 – offline; 1 – online.	U16
0x219E	1	BKM trolleybus communication state: 0 – offline; 1 – online.	U16
0x219F	2	Charge current limit, A	REAL32
0x21A1	2	Discharge current limit, A	REAL32
0x21A3	1	MicroPower charger communication state: 0 – offline; 1 – online.	U16
0x21A4	1	S.P.E. charger communication state: 0 – offline; 1 – online.	U16
0x21A5	1	S.P.E. charger voltage, V	U16
0x21A6	1	S.P.E. charger current, A	U16
0x2200-0x2203	4	Record #1 from the errors journal. First 32-bit word contains a timestamp, second 32-bit word contains errors 1 flags (see 0x2007-0x2008).	U32[2]

		Timestamp format: bits 0-5 — year; bits 6-9 — month; bits 10-14 — day; bits 15-19 — hours; bits 20-25 — minutes; bits 26-31 — seconds.	
0x2204-0x2207	4	Record #2 from the errors journal	U32[2]
0x2208-0x227B		Records #3-31 from the errors journal	
0x227C-0x227F	4	Record #32 from the errors journal	U32[2]
0x2300	1	Number of the last record from the errors journal (1..32)	U16
0x2380	4	Record data #1 from the errors journal. First 32-bit word contains errors 2 flags (see 0x200E-0x200F).	U32[2]
0x2384-0x2387	4	Record data #2 from the errors journal	U32[2]
0x2388-0x23FB		Records data #3-31 from the errors journal	
0x23FC-0x23FF	4	Record data #32 from the errors journal	U32[2]
0x2400	2	Current measured by the auxiliary current sensor, A	REAL32

0x2402	2	Final battery current, A Note — It is the sum of the values measured by the main and auxiliary current sensors	REAL32
0x2410	1	Battery state: 0 – Unknown; 1 – Charging ON; 2 – Charging OFF; 3 – Relaxed (after charging); 4 – Discharging ON; 5 – Discharging OFF; 6 – Relaxed (after discharging).	U16
0x2411	2	Duration of the battery state (0x2410), seconds	U32

3 Holding registers

Register address	Number of registers	Content	Type
0x4000	1	Address of the BMS Logic board whose parameters should be in the input registers 0x2011-0x20C9	U16
0x4100	2	Command to acknowledge errors in the errors journal (bitfield). Each ith bit corresponds to (i+1) record. Notes: 1 – After the errors are acknowledged, the register value will be set to 0. 2 – To acknowledge all errors, set 0xFFFFFFFF.	U32
0x5100	1	Software control of the "Battery cover" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Battery cover".	U16
0x5101	1	Software control of the "Charger connected" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Charger connected".	U16
0x5102	1	Software control of the "Power down request" signal. Allowable values: 0 – clear the signal;	U16

		1 – set the signal; 2-65535 – use the physical input "Power down request".	
0x5103	1	Software control of the "Inhibit charging" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Inhibit charging".	U16
0x5104	1	Software control of the "Inhibit discharging" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Inhibit discharging".	U16
0x5105	1	Software control of the "Charging contactor feedback" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Charging contactor feedback".	U16
0x5106	1	Software control of the "Discharging contactor feedback" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Discharging contactor feedback".	U16

0x5107	1	Software control of the "Insulation status" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Insulation status".	U16
0x5108	1	Software control of the "Charge request" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Charge request".	U16
0x5109	1	Software control of the "Precharge request" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Precharge request".	U16
0x510A	1	Software control of the "Discharge request" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Discharge request".	U16
0x510B	1	Software control of the "PCH contactor feedback" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "PCH contactor	U16

		feedback".	
0x510C	1	Software control of the "CH/DCH contactor feedback" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "CH/DCH contactor feedback".	U16
0x510D	1	Software control of the "Main contactor feedback" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Main contactor feedback".	U16
0x510E	1	Software control of the "Interlock" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Interlock".	U16
0x510F	1	Software control of the "Fuse 1" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Fuse 1".	U16
0x5110	1	Software control of the "Fuse 2" signal. Allowable values:	U16

		0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Fuse 2".	
0x5111	1	Software control of the "Fuse 3" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Fuse 3".	U16

4 Contacts

Movicom Electric

7190 Sunset Blvd # 200, Los Angeles, CA, USA

+1 323 633 7033

electric@movicom.com
movicomelectric.com

5 Revision history

Rev. number	Rev. date	Changes
1	03–August–2021	First revision
2	13-January-2022	Added the discrete input signal “Insulation status”, the internal state “Charging/Discharging”, and the error “Insulation fault” to the table of input registers. Added the software-controlled signals “Charging contactor feedback”, “Discharging contactor feedback”, and “Insulation status” to the table of holding registers.
3	06-June-2023	Added internal signals and errors to the table of input registers. Added the software-controlled signals “Charge request”, “Precharge request”, and “Discharge request” to the table of holding registers.
4	22-September-2023	Added internal signals “Battery state” and “Duration of the battery state” to the table of input registers. Added the software-controlled signals “PCH contactor feedback”, “CH/DCH contactor feedback”, “Main contactor feedback”, “Interlock”, “Fuse 1”, “Fuse 2”, and “Fuse 3” to the table of holding registers.
5	24-October-2023	Updated descriptions of the cell states (0x2016-0x2029) and the final current (0x2402) in the table of input registers. Added the command to acknowledge errors to the table of holding registers.