MOVICOM
ELECTRIC

BMS Main X 2.x

Modbus protocol

Revision 2 (02-April-2024)

Contents

1 General information

The BMS Main X 2.x board provides 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).

The 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) — 64.

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

CHAR – character (signed 8-bit integer number);

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]
		Battery state	
0x1000	1	Battery state of charge (SOC), %	U16
0x1001	1	Battery state of health (SOH), % Note – The value is calculated as a minimal SOH among battery modules.	U16
0x1002	1	Battery balancing efficiency, % Note – The value is calculated as a minimal balancing efficiency among battery modules.	U16

0x1003	1	Battery state (enumeration): 0 – Off (battery is off); 1 – Pre-balancing (battery modules are precharging); 2 – Balancing (battery modules are joined and balancing); 3 – Precharging (modular battery is precharging); 4 – Idle (battery is idle (charging and discharging currents are not detected)); 5 – Charging (modular battery is charging); 6 – Discharging (modular battery is discharging).	U16
0x1004-0x1005	2	Battery voltage, V	REAL32
0x1006-0x1007	2	Battery current, A	REAL32
0x1008-0x1009	2	Battery resistance, Ohm	REAL32
0x100A-0x100B	2	Temperature measured by the external sensor 1, °C	REAL32
0x100C-0x100D	2	Temperature measured by the external sensor 2, °C	REAL32
0x100E-0x100F	2	Minimum temperature among modules, °C	REAL32
0x1010-0x1011	2	Maximum temperature among modules, °C	REAL32
0x1012-0x1013	2	Battery capacity, A×h	REAL32
0x1014-0x1015	2	Sum of energy received from the charger, W×h	REAL32
0x1016-0x1017	2	Sum of energy consumed by the load, W×h	REAL32

0x1018-0x1019	2	Sum of energy dissipated by the balancing resistors, W×h	REAL32
0x101A-0x101B	2	Battery charge current limit, A	REAL32
0x101C-0x101D	2	Battery discharge current limit, A	REAL32
0x101E-0x101F	2	Duration of stay in state (0x1003), second	U32
0x1020-0x1021	2	Internal signals (bitfield): bit 0 – flag “Init” of initialization of the device; bit 1 – main charge contactor state (0 – open, 1 – closed); bit 2 – main discharge contactor state (0 – open, 1 – closed); bit 3 – signal “Charging current present”; bit 4 – signal “Discharging current present”; bit 5 – main charge/discharge contactor state (0 – open, 1 – closed); bit 6 – main precharge contactor state (0 – open, 1 – closed); bits 7-29 – reserved; bit 30 - set to “1”; bit 31 – reserved.	U32
0x1022-0x1023	2	Common errors (bitfield): bit 0 – “Battery cover error”; bit 1 – “Modules offline”; bit 2 – “Critical error”; bit 3 – “Voltage unbalance (CH)”; bit 4 – “Voltage unbalance (DCH)”;	U32

		bit 5 – “Current unbalance (CH)”; bit 6 – “Current unbalance (DCH)”; bit 7 – “Charging current unbalance”; bit 8 – “Discharging current unbalance”; bit 9 – set to “0”; bit 10 – “CH contactor feedback”; bit 11 – “DCH contactor feedback”; bit 12 – “CH/DCH contactor feedback”; bit 13 – “Insulation fault”; bits 14-31 – reserved.	
0x1024-0x1025	2	Voltage unbalance CH errors (bitfield): bit 0 – Module 1; bit 1 – Module 2; bit 2 – Module 3; bit 3 – Module 4; bit 4 – Module 5; bit 5 – Module 6; bit 6 – Module 7; bit 7 – Module 8; bits 8-31 – reserved.	U32
0x1026-0x1027	2	Voltage unbalance DCH errors (bitfield). Note – Registry mapping is the same as for registers 0x1024-0x1025	U32
0x1028-0x1029	2	Current unbalance CH errors (bitfield).	U32

		Note – Registry mapping is the same as for registers 0x1024-0x1025	
0x102A-0x102B	2	Current unbalance DCH errors (bitfield). Note – Registry mapping is the same as for registers 0x1024-0x1025	U32
0x102C-0x102D	2	Charging current unbalance errors (bitfield). Note – Registry mapping is the same as for registers 0x1024-0x1025	U32
0x102E-0x102F	2	Discharging current unbalance errors (bitfield). Note – Registry mapping is the same as for registers 0x1024-0x1025	U32
0x1030-0x1031	2	Cumulative internal signals (logical OR of all “Internal signals” values of the battery modules; bitfield): bit 0 — signal "Low SOC"; bit 1 — signal "High charging current"; bit 2 — charge contactor state (0 – open, 1 – closed); bit 3 — signal "Allow charging"; bit 4 — signal "Charging current present"; bit 5 — discharge contactor state (0 – open, 1 – closed); bit 6 — signal "Discharging current present"; bit 7 — signal "High voltage" (EV); bit 8 — signal "Heater" (0 – off, 1 – on);	U32

		bit 9 — signal "Cooler" (0 – off, 1 – on); bit 10 — shutdown request from the HYG truck; bit 11 — initialization of the BMS Main (current sensor is calibrating, or BMS Logic boards are scanning); bit 12 — precharge contactor state (0 – open, 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 – open, 1 – closed); bit 18 — shutdown acknowledge; bit 19 — EWS signal from the Crown truck; bit 20 — main contactor state (0 – open, 1 - closed); bit 21 – signal to reset the BMS (service reset); bit 22 - state of the charging/discharging contactor (0 – open, 1 – closed); bit 23 – signal “Ready to charge”; bit 24 – signal “Ready to discharge”; bit 25 – signal “Power up”; bits 26-31 – reserved.	
0x1032-0x1033	2	Cumulative errors 1 (logical OR of all “Errors 1”	U32

		values of the battery modules; 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"; 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 – reserved.	
0x1034-0x1035		Cumulative errors 2 (logical OR of all “Errors 2” values of the battery modules; bitfield): 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”;	U32

		bit 11 – “Main contactor feedback error”; bit 12 – reserved; bit 13 – “General error”; bits 14-31 – reserved.	
0x1036-0x1037	2	Remaining discharge time, second. Note – The value 0xFFFFFFFF corresponds to the case when the device cannot calculate the remaining time.	U32
Module #1 state: base address 0x2000			
0x2000 (offset 0x0000)	1	Module state (enumeration): 0 – Unknown; 1 – Charging ON; 2 - Charging OFF; 3 – Relaxed (after charging); 4 – Discharging ON; 5 – Discharging OFF; 6 – Relaxed (after discharging).	U16
0x2001 (offset 0x0001)	1	Module state of charge (SOC), %	U16
0x2002 (offset 0x0002)	1	Module state of health (SOH), %	U16
0x2003 (offset 0x0003)	1	Module balancing efficiency, %	U16

0x2004-0x2008 (offset 0x0004)	5	BMS firmware version. Example: "1.59.1"	CHAR[10]
0x2009 (offset 0x2009)	1	Reserved	U16
0x200A-0x200B (offset 0x000A)	2	Module voltage, V	REAL32
0x200C-0x200D (offset 0x000C)	2	Module current, A	REAL32
0x200E-0x200F (offset 0x000E)	2	Module resistance, Ohm	REAL32
0x2010-0x2011 (offset 0x0010)	2	Minimum cell temperature	REAL32
0x2012-0x2013 (offset 0x0012)	2	Maximum cell temperature	REAL32
0x2014-0x2015 (offset 0x0014)	2	Minimum cell voltage	REAL32
0x2016-0x2017 (offset 0x0016)	2	Maximum cell voltage	REAL32
0x2018-0x2019 (offset 0x0018)	2	Effective capacity, A×h	REAL32
0x201A-0x201B (offset 0x001A)	2	Charge current limit, A	REAL32
0x201C-0x201D	2	Discharge current limit, A	REAL32

(offset 0x001C)			
0x201E-0x201F (offset 0x001E)	2	Energy received from the charger, W×h	REAL32
0x2020-0x2021 (offset 0x0020)	2	Energy consumed by the load, W×h	REAL32
0x2022-0x2023 (offset 0x0022)	2	Energy dissipated by the balancing resistors, W×h	REAL32
0x2024-0x2025 (offset 0x0024)	2	Number of 80% charge/discharge cycles	REAL32
0x2026-0x2027 (offset 0x0026)	2	Internal signals (bitfield). Note – Registry mapping is the same as for 0x1030-0x1031.	U32
0x2028-0x2029 (offset 0x0028)	2	Errors 1 (bitfield). Note – Registry mapping is the same as for 0x1032-0x1033.	U32
0x202A-0x202B (offset 0x002A)	2	Errors 2 (bitfield). Note – Registry mapping is the same as for 0x1034-0x1035.	U32
0x202C-0x202D (offset 0x002C)	2	Discrete input signals (bitfield): bit 0 — signal "Battery cover"; bit 1 — signal "Charger connected"; bit 2 — signal "Power up/down request"; bit 3 — signal "Inhibit charging"; bit 4 — signal "Inhibit discharging";	U32

		bit 5 — signal “CH contactor feedback”; bit 6 — signal “DCH contactor feedback”; bit 7 — signal “Insulation status”; bit 8 – signal “Charge request”; bit 9 – signal “Precharge request”; bit 10 – signal “Discharge request”; bit 11 – signal “PCH contactor feedback”; bit 12 – signal “CH/DCH contactor feedback”; bit 13 – signal “Main contactor feedback”; bit 14 – signal “Interlock”; bit 15 – signal “Fuse 1”; bit 16 – signal “Fuse 2”; bit 17 - signal “Fuse 3”; bit 18 – signal “Circuit breaker status”; bits 19-31 – reserved.	

Module #2 state: base address 0x2200

Note – Registries have the same format as for Module #1

Module #3 state: base address 0x2400

Note – Registries have the same format as for Module #1

Module #4 state: base address 0x2600

Note – Registries have the same format as for Module #1

Module #5 state: base address 0x2800

Note – Registries have the same format as for Module #1

Module #6 state: base address 0x2A00

Note – Registries have the same format as for Module #1
Module #7 state: base address 0x2C00 Note – Registries have the same format as for Module #1
Module #8 state: base address 0x2E00 Note – Registries have the same format as for Module #1
Module #9 state: base address 0x3000 Note – Registries have the same format as for Module #1
Module #10 state: base address 0x3200 Note – Registries have the same format as for Module #1
Module #11 state: base address 0x3400 Note – Registries have the same format as for Module #1
Module #12 state: base address 0x3600 Note – Registries have the same format as for Module #1
Module #13 state: base address 0x3800 Note – Registries have the same format as for Module #1
Module #14 state: base address 0x3A00 Note – Registries have the same format as for Module #1
Module #15 state: base address 0x3C00 Note – Registries have the same format as for Module #1
Module #16 state: base address 0x3E00 Note – Registries have the same format as for Module #1
Module #17 state: base address 0x4000 Note – Registries have the same format as for Module #1

Module #18 state: base address 0x4200 Note – Registries have the same format as for Module #1
Module #19 state: base address 0x4400 Note – Registries have the same format as for Module #1
Module #20 state: base address 0x4600 Note – Registries have the same format as for Module #1
Module #21 state: base address 0x4800 Note – Registries have the same format as for Module #1
Module #22 state: base address 0x4A00 Note – Registries have the same format as for Module #1
Module #23 state: base address 0x4C00 Note – Registries have the same format as for Module #1
Module #24 state: base address 0x4E00 Note – Registries have the same format as for Module #1
Module #25 state: base address 0x5000 Note – Registries have the same format as for Module #1
Module #26 state: base address 0x5200 Note – Registries have the same format as for Module #1
Module #27 state: base address 0x5400 Note – Registries have the same format as for Module #1
Module #28 state: base address 0x5600 Note – Registries have the same format as for Module #1
Module #29 state: base address 0x5800

Note – Registries have the same format as for Module #1
Module #30 state: base address 0x5A00 Note – Registries have the same format as for Module #1
Module #31 state: base address 0x5C00 Note – Registries have the same format as for Module #1
Module #32 state: base address 0x5E00 Note – Registries have the same format as for Module #1

3 Holding registers

Register address	Number of registers	Content	Type
0x5000	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
0x5001	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
0x5002	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
0x5003	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

0x5004	1	Software control of the "CH contactor feedback" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "CH contactor feedback".	U16
0x5005	1	Software control of the "DCH contactor feedback" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input “DCH contactor feedback".	U16
0x5006	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
0x5007	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
0x5008	1	Software control of the "Join to charge" signal. Allowable values:	U16

		0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Join to charge".	
0x5009	1	Software control of the "Join to discharge" signal. Allowable values: 0 – clear the signal; 1 – set the signal; 2-65535 – use the physical input "Join to discharge".	U16

4 Contacts

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5 Revision history

Rev. number	Rev. date	Changes
1	02–June–2023	First revision
2	02-April-2024	Updated “Cumulative errors 2” (input registers 0x1034-0x1035) Fixed modules’ “Discrete input signals” (input registers 0x202C-0x202D) Added input registers for battery modules #9-32