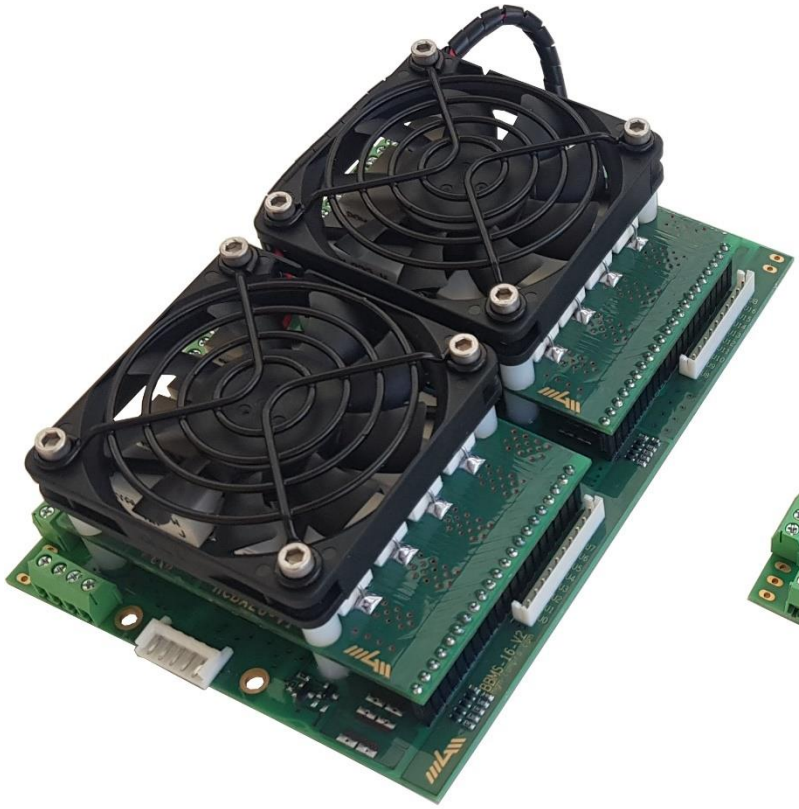
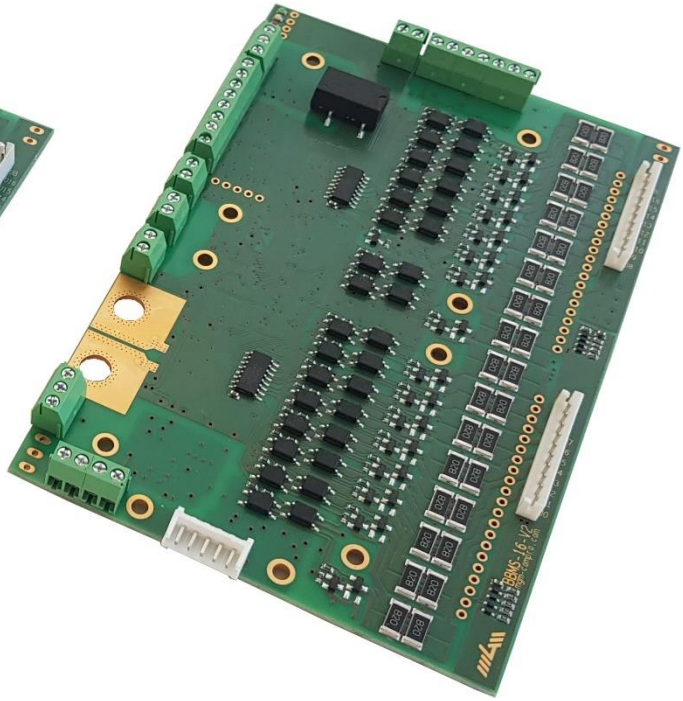
BMS 16i

Version 5.4





Battery Management System

Operating manual

Development, manufacture, service:
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BMS-16i

BMS 16i is the Battery Management System designed for batteries, which use LiPol, Li-Ion, LiFePO4 cells or other cells with operational voltage range 1,8V - 5V per cell. BMS 16i provides protection and enlarge the lifetime of the batteries by measuring the working temperatures (of battery, BMS and balancers) and capacity of the battery and controlling the voltage and flowed current. BMS 16i control the battery during the charging and discharging, manage the balancing of each cell, communicate with superior system and handle a system relay and contactors.

BMS 16i is able to control max. 16 cells, but could be connected into the larger system thru the internal bus (RS485), where could be max. 8× BMS 16i modules (1× Master / 7× Slaves), which could control up to 128 serial connected cells with max. battery voltage 540 V. In the system you could use the BMS 16i and BMS-8i to be able to optimize the amount of the BMS modules for defined amount of the cells. BMS 16i uses balancing current up to 850 mA (version with assembled additional HCBAL8 and FANs), basic version could use balancing current up to 100 mA.

BMS 16i is powered directly from the monitored battery and works independently. BMS 16i has very low power consumption around 20uA in the “OFF” mode.

BMS 16i system automatically do the self-testing, has doubled critical components for balancing, to secure, that even if any component wills failure, then the cells will be protected against the uncontrolled discharging and the system will still correctly works, inform about the failure (via LED status, inform superior system via CAN, inform via display) and ask for the service .

BMS 16i has, of course as well as all other BMSes from MGM Compro, unique measurement of internal voltage of cells, which is fully independent to the internal resistance of the cells and resistant of the system.

With SW application MGM-ProTool and communication interface OPTOCOM-6i is possible to do the settings, real time monitoring and read logs of the system and FW update of the BMS, which helps to have every time the latest version of the SW/FW.

For communication with other systems, BMS-16i uses the CAN bus.

BMS 16i could be modified based on the customer request. In case, that you have any extra requirements, feel free to contact us by an email: info@mgm-compro.com

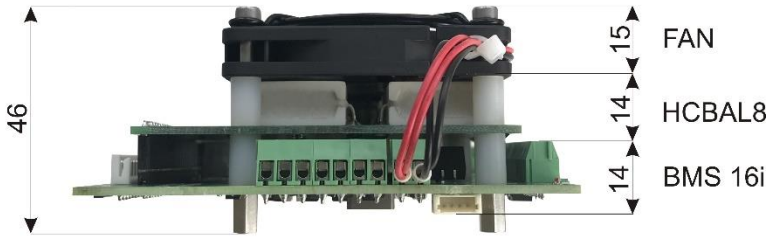
Dictionary

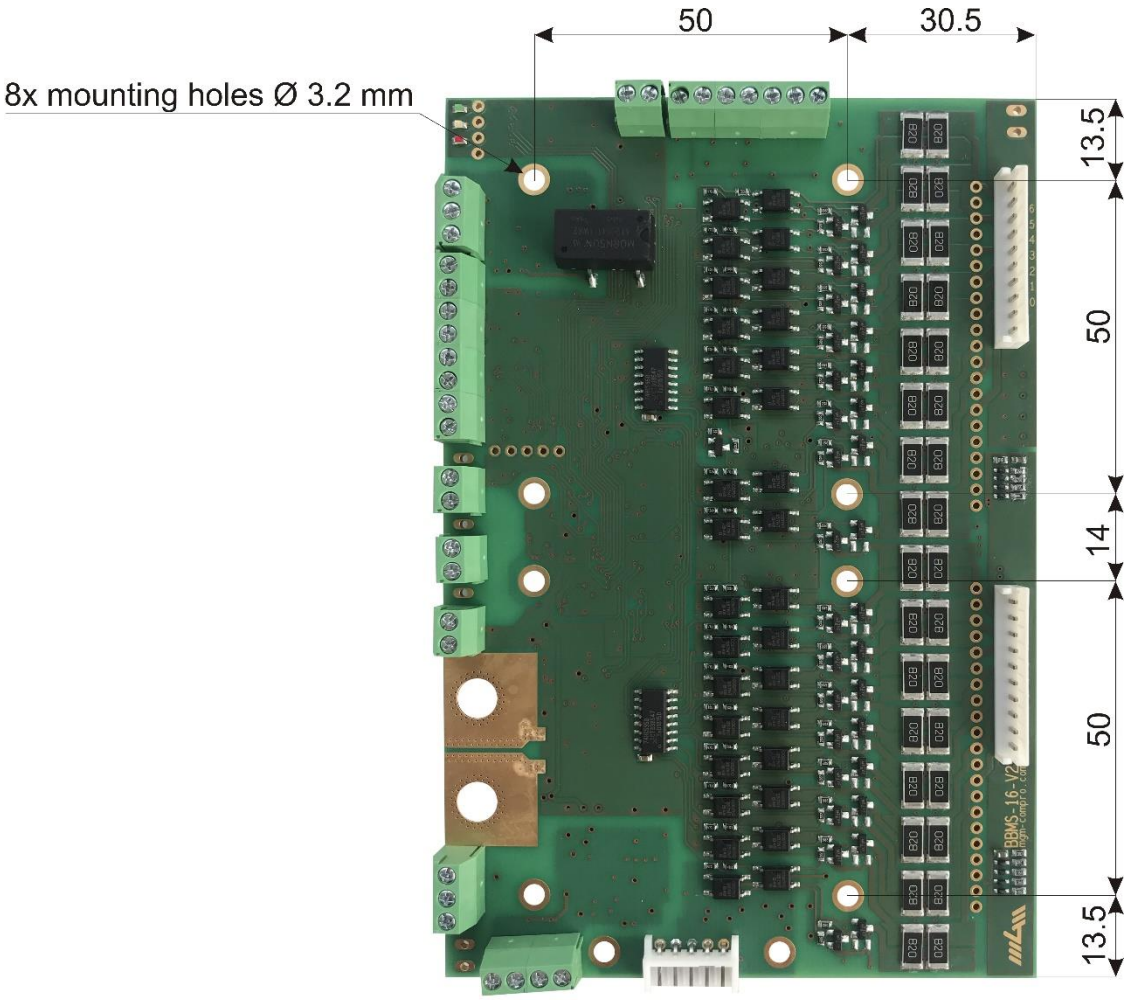
BMS 16i system	More than one BMS 16i connected together
HCBAL8	PCBA with extra balancing resistors, which allows to use higher balancing currents
CAN	Bus for communication with other systems
RS485	Bus for internal communication with different BMS 16i and charger
OPTOCOM-6i	HW interface for connection of BMS 16i and PC (USB)
MGM ProTool	PC software application for setting parameters of BMS and real-time monitoring
ESC	Electric speed controller
Superior system	“Higher” system, which could control the BMS system, controllers and other devices
FAN	Air cooler, placed on the HCBAL8
PCBA	Printed Circuit Board Assembly
N/A	Not applicable
CC/CV charger	Constant current / constant voltage charger

Parameters

Number of cells per one BMS 16i	4 ÷ 16
Max. number of the chained boards	8
Max. number of the cells in BMS 16i system	128
Max. voltage of battery connected to one BMS 16i	68V
Voltage working range per cell	1,8 ÷ 5V
Recommended capacity of the battery	up to 655 Ah
Power supply of BMS 16i	From monitored battery
Power consumption of the BMS 16i in “ON” mode	~ 20 mA
Power consumption of the BMS 16i in “OFF” mode	~ 20 µA
Balancing current with internal balancing resistors	≤ 100mA *)
Balancing current with balancing PCBAs (HCBAL8)	≤ 850mA **)
2× FAN	Max. 12V/350mA Controlled by BMS 16i according to temperatures and balancing state
Communication interface	CAN 2.0 – Communication bus RS485 – Internal communication bus
PC interface (thru USB)	OPTOCOM-6i (+MGM ProTool)
BMS 16i compatibility	BMS 16i is compatible with BMS 8i
Weight of BMS 16i	82 g
Weight of BMS 16i with HCBAL8s and FANs	305 g
Dimensions (L × H × W)	140 × 95 × 15 mm
Dimensions (L × H × W) with HCBAL8s and FANs	140 × 95 × 46 mm
Ambient conditions	-20 up to +50 °C

*) Depending on the conditions of BMS surroundings
**) With HCBAL8s and FANs, depending on the conditions of BMS surroundings





Warnings and recommendations

- **HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH.** The device might operate with higher voltage. Safe electrical installation should be carried out only by skilled professionals (authorized persons).
- Secure correct connections of battery poles (reversal of battery/cells poles will destroy the BMS 16i, the damage may not be visible immediately, but after some runs).
- Connections must follow the user manual.
- Is recommended to cool the BMS 16i in operation with flowing air. Do not obstruct the access of cooling airflow to the BMS 16i.
- Never connect more cells (higher voltage) or other cells, than is specified in technical documentation.
- **Is recommended to do wiring of the system at first, after correct connection of the system, connect traction batteries.**

Basic variants of assembly

According to controlling

Master

Controlling module of the system. Master module includes all measuring, communicating and controlling interfaces and powers the system bus (RS485). As standalone (without any other connected slaves) could balance maximum 16 cells.

- Realizes measuring and balancing of all connected cells of the battery
- Measures and control the voltage, flowed current, working temperatures (of battery, BMS and balancers) and capacity of the battery
- Includes file with all measured data from the system, which are available thru the MGM ProTool
- Is active based on the status of the ON/OFF switch (connected to K5)
- Activates the other BMSes (Slaves) in the system and communicate & control them (via RS485)
- Communicates with the parent system, controller, display (via CAN bus)
- Controls the connected charger
- Has to have system address 0 (visible in PC software MGM ProTool – parameter P11)
- Has to be connected on the “lowest” cells of the battery
- Could be used as standalone (for max. 16 cells) as well as master for the whole BMS system (1 master + max. 7 Slaves)

Slave

Measuring modules in the system. Slave modules include interface for only measuring and balancing of cells and for system communication.

- Does not have the communication interface CAN
- Is not able to control charger
- The external and internal current probe could not be connected
- Output for GMS module and for contactors could not be connected

According to balancing

Balancing with the HCBAL8 and with FANs

- BMS 16i with balancing PCBAs (HCBAL8) and FANs
- Balancing resistors and their temperature sensors are assembled on the HCBAL8
- Maximum balancing currents up to 850mA

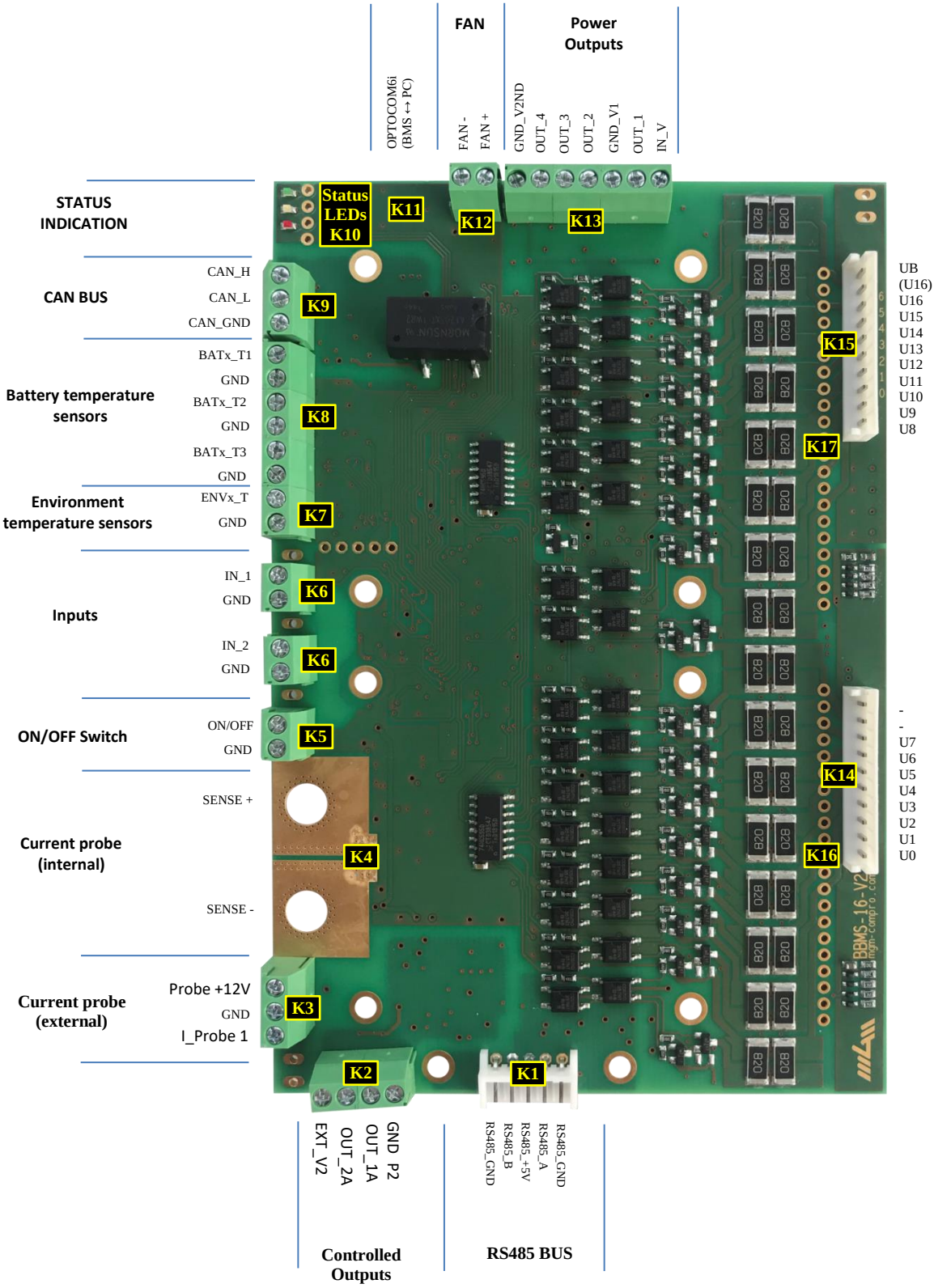
Balancing with the HCBAL8

- BMS 16i with balancing PCBAs (HCBAL8), but without FANs
- Maximum balancing currents is very closely dependent on the conditions of environment and intensity of the cooling

Balancing with the internal balancing resistors

- Balancing resistors and their temperature sensors are assembled directly on the PCBA of BMS 16i
- Maximum balancing currents up to 100mA, depending on the conditions of environment

Connectors and signals



Connector	Name	Signals	Description	Master	Slave
K1	RS485 BUS	Pin. 1 - RS485_GND Pin. 2 - RS485_B Pin. 3 - RS485_+5V Pin. 4 - RS485_A Pin. 5 - RS485_GND	- Internal communication between BMS16i system (Master & Slaves) and with charger - At the end of the RS485 bus has to be placed the termination (Chapter …) - BMS16i Slave is ON/OFF based on the connection via the RS485	1× (not isolated)	1× (isolated)
K2	Controlled Outputs	Pin. 1 - EXT_V2 Pin. 2 - OUT_2A Pin. 3 - OUT_1A Pin. 4 - GND_P2	… Power supply for chargers … For MEANWELL chargers … For activation of GSM module … Ground of the power supply	1×	-
K3	Current probe (external)	Pin. 1 - Probe +12V (Supply) Pin. 2 - GND Pin. 3 - I_Probe 1 (Signal)	Measurement of charging and discharging current by external current sensor HALL 400 B (recommended) or others - I_Probe 1 – External current probe 1 (recommended use for currents higher than 60 A)	1×	-
K4	Current probe (internal)	Pin. 1 - SENSE – Pin. 2 - SENSE +	Internal current probe (for currents up to 60 A)	1×	1×
K5	ON/OFF Switch	Pin. 1 - ON/OFF Pin. 2 - GND	Connector for ON/OFF switch only for Master ON – Connected // OFF – Disconnected	1×	1×
K6	Inputs	Pin. 1 - IN_1 Pin. 2 - GND Pin. 3 - IN_2 Pin. 4 - GND	… Identification of connected charger … Ground of the IN_1 … Input for selection of the charging mode … Ground of the IN_2	1×	-
K7	Environment temperature sensors	Pin. 1 - ENVx_T Pin. 2 - GND	KTY 81-210 Temperature sensor	1×	1×
K8	Battery temperature sensors	Pin. 1 - BATx_T1 Pin. 2 - GND Pin. 3 - BATx_T2 Pin. 4 - GND Pin. 5 - BATx_T3 Pin. 6 - GND	KTY 81-210 Temperature sensors At least one sensor is required / maximum 3 sensors could be used for one BMS 16i	3×	3×
K9	CAN BUS	Pin. 1 - CAN_H Pin. 2 - CAN_L Pin. 3 - CAN_GND	CAN 2.0 BUS	1× (isolated)	-
Status LEDsK10	Status Indication	GREEN YELLOW RED	Indication status of the BMS 16i	1×	1×
K11	ICS	Pin. 1 to 4	For OPTOCOM6i - Communication with PC (PC SW MGM Protool)	1×	1×
K12	FAN	Pin. 1 - FAN+ Pin. 2 - FAN-	FAN for balancers Max. 12V/350mA	1×	1×
K13	Power Outputs	Pin. 1 - IN_V Pin. 2 - OUT_1 Pin. 3 - GND_V1 Pin. 4 - OUT_2 Pin. 5 - OUT_3 Pin. 6 - OUT_4 Pin. 7 - GND_V2	… +12V (IN_V) … Main contactor (OUT_1) … GND (for OUT_1) … Charger contactor (OUT_2) … Charging (OUT_3) … Charging with high current (OUT_4) … GND (for OUT_2-4)	1×	-
K14	CELLS (Low)	Pin. 1 - cell 1, - pole Pin. 2 - cell 1, + pole Pin. 3 - cell 2, + pole Pin. 4 - cell 3, + pole Pin. 5 - cell 4, + pole Pin. 6 - cell 5, + pole Pin. 7 - cell 6, + pole Pin. 8 - cell 7, + pole Pin. 9 - N/A Pin. 10 - N/A	- Pin.1 to Pin 8 for voltage measurement of cells 1 - 7	1×	1×
K15	CELLS (High)	Pin. 1 - cell 8, + pole Pin. 2 - cell 9, + pole Pin. 3 - cell 10, + pole Pin. 4 - cell 11, + pole Pin. 5 - cell 12, + pole Pin. 6 - cell 13, + pole Pin. 7 - cell 14, + pole Pin. 8 - cell 15, + pole Pin. 9 - cell 16, + pole Pin. 10 - cell max, + pole	- Pin.1 to Pin 9 for voltage measurement of cells 8 – 16 - Pin. 10 BMS supply from the highest cell	1×	1×
K16	HCBAL8_1		Connector for balancing module 1	1×	1×
K17	HCBAL8_2		Connector for balancing module 2	1×	1×

LED indication of the BMS working modes

Status of the BMS system is visible on the Master PCBA thru the LEDs (K10).

LED	OFF	ON	FLASHING
GREEN	-	BATTTERY CHARGED	BALANCING
YELLOW	-	BALANCER OVERTEMP	CHARGING
RED	BMS OFF	BMS ERROR	BMS OK

Activation of the BMS 16i

BMS system is activated by ON/OFF Switch (K5). Activation in the system needs to be done only for Master BMS, other BMSes (Slaves) will be activated by internal bus (RS485). After switching OFF (K5) the master BMS 16i switch off itself and all BMS slaves on the bus (RS485) as well.

Charging and balancing

One of the key feature, which BMS 16i has, is management of battery charging. According to the measured parameters of the cells, adjusted charging voltage and current, is running management of the battery charging. At the end of the charging cycle is running the balancing of each cell according to balancing mode and according to set charging voltage. Actual capacity of the battery is calculated according to the charging current and set capacity of battery (in MGM ProTool Parameter P4).

Balancing modes

Setting of the balancing mode is possible in Protool parameter P3 (Cells balancing mode).

From balancing voltage

Balancing is starting, when voltage of the most charged battery cell is higher, than the value of Balancing voltage (parameter P17 in ProTool). Balancing is running until all battery cells are balanced / charged to value of Charged cell voltage (parameter P18 in ProTool).

From charged cell voltage -10 mV

Balancing is starting, when voltage of the most charged battery cell is higher, than the value of Charged cell voltage –10 mV (parameter P18 in ProTool). Balancing is running until all battery cells are balanced / charged to value of Charged cell voltage.

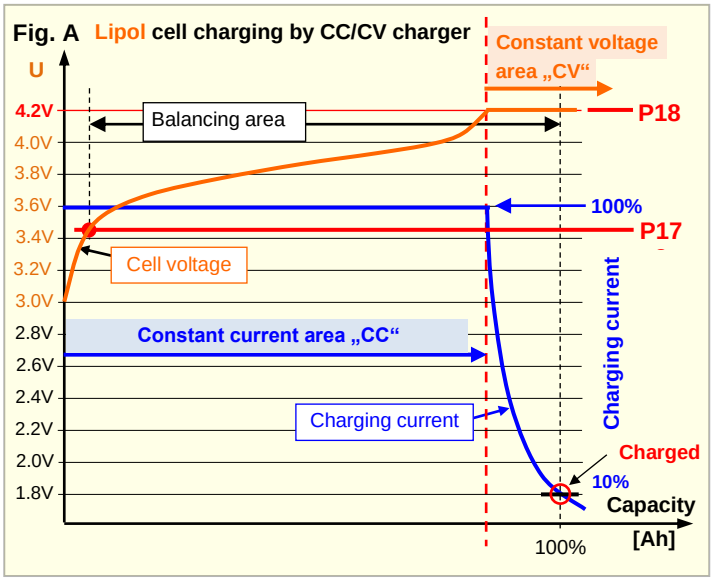
Always

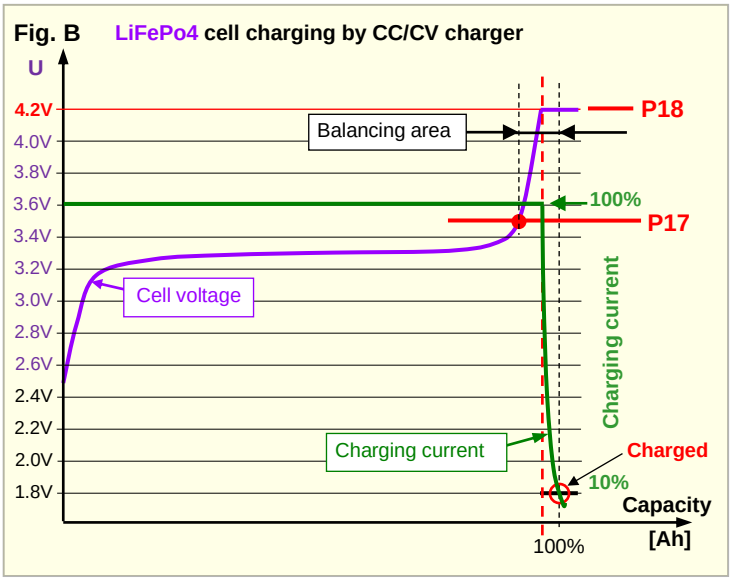
Balancing is starting, when voltage of the most charged battery cell is higher, than the value of Balancing voltage (parameter P17 in ProTool). Balancing is running even after the deactivation of the BMS 16i (Switch [K5] is OFF). Balancing is finished, when all battery cells are balanced / charged to value of Charged cell voltage (parameter P18 in ProTool). In case, that the charger is disconnected, the balancing continues until all cells are balanced, after that the BMS 16i is switched OFF.

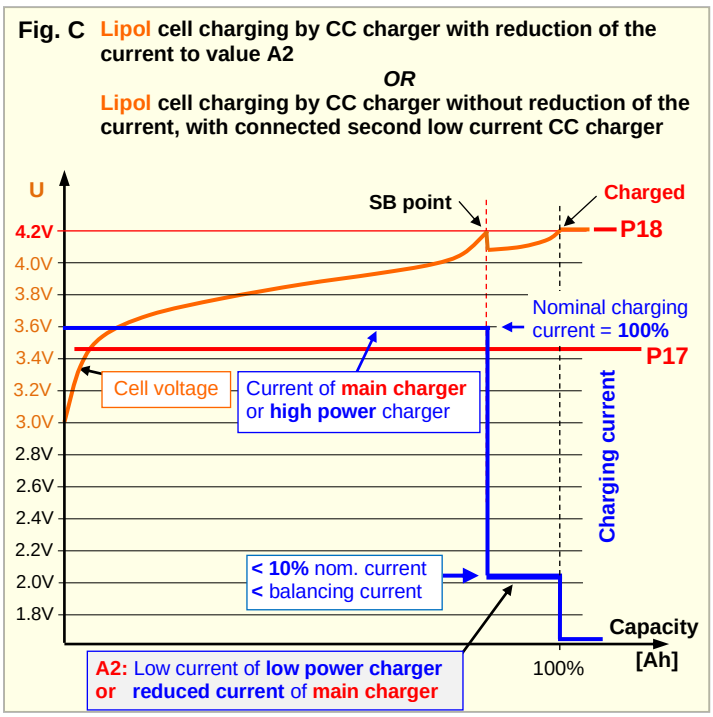
Deactivated

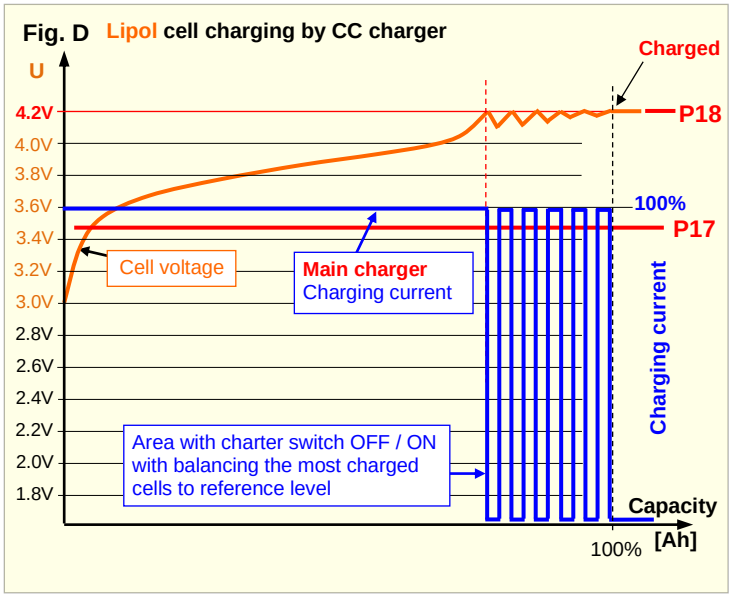
Balancing is OFF.

Example of the charging modes with different chargers / types of battery cells







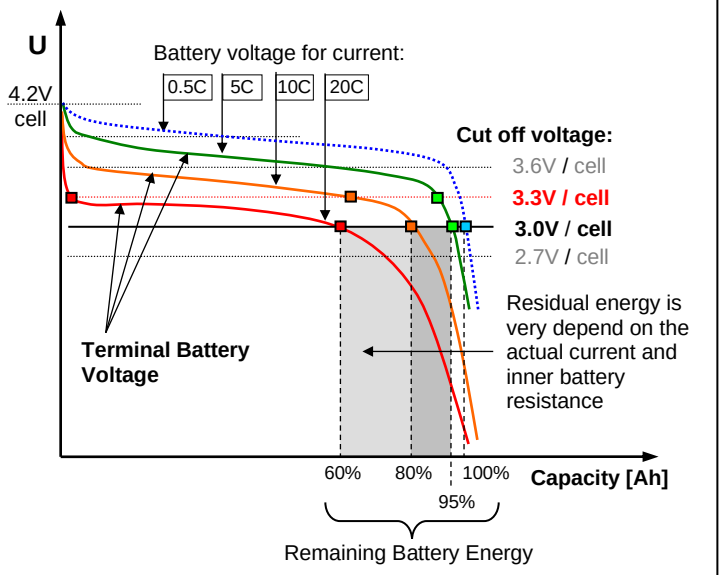


Internal battery resistance

Standard BMSes / controllers, which doesn´t use internal battery voltage [case **a)** bellow], switch-off controller or starts reducing power in case, that the battery terminal voltage U_{TERM} (resp. input voltage U_{LOAD}) drops below set limit [3,0V /cell on the example **a)**]. However Input voltage (U_{LOAD}), which significantly depends on current and internal battery resistance, is not equal to the rest of battery charge and controller switch-off the battery even with remain battery energy 40%.

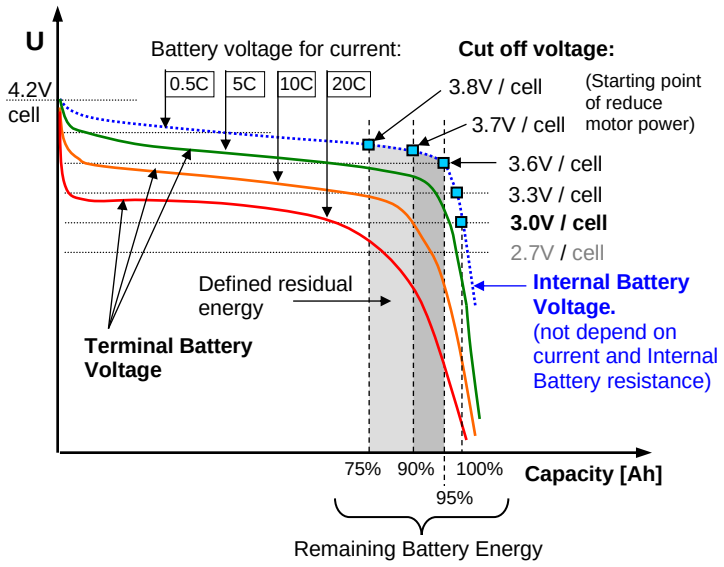
Comparing to this behavioral, ***MGM COMPRO*** BMSes / controllers (chart **b)** ensures, that the remaining energy (after the motor is switched off by the controller) is practically independent on currents and inner resistance of the battery, thanks to special measurement method and counting with all resistances in circuit (as internal battery resistance, cables resistance, connector resistance). Motor switch-off in case of full and correct discharged battery (remain energy is depending on BMSes / controller parameters settings).

a) Standard BMS/controllers, settings for Lipol battery



Regular BMSes / controllers (even Lipol compatible) have either a solid switching off voltage (for example 3V per cell) or it is possible to set this value. For example for set boundary 3V per cell the controller is switch off or it starts to reduce power, when this value is reached, no matter, how big the drawn current is. **It means, that the residual energy significantly changes according to a instantaneous current load of the batteries** (and also according to inner resistance of the cells, cables, …) from 0 to 95 % - depending only on the set voltage limit. If the example on the graph above is considered with a set boundary of 3V per cell the BMS / controller will switch off, when drawn current is 20C, when there is still 40% of energy still left, while for 5C current when only 5% of energy is left. For boundary of 3.3V per cell the controller would switch off for currents of 20C when only few percent of energy were consumed while for 5C after 92% of energy would be consumed.

b) *MGM COMPRO* BMS/controllers, settings for Lipol battery



***MGM COMPRO* BMSes / controllers** handle the situation quite differently. The switching-off voltage is always recalculated to „internal“ voltage of the battery – therefore is independent on both drawn current as well as inner resistance of the battery or resistances in circuit. **It means the set residual energy is always the same and does not depend on currents and inner resistance of the battery.** Batteries are then always discharged to same level, regardless how big currents are drawn. The value of set residual energy is therefore not so dependent on the features of battery and the discharging current. For example for switching voltage 3.7V per cell, BMS / controller switches off the motor or starts to reduce revolutions always after 90% of energy is used up, no matter, if the drawn current is 20C or 5C.
The voltage of battery after switch of the current always rises to a value close to curve of 0.5V – this discharging curve is practically identical to „inner“ voltage of the battery. This curve describes how much the Lipol battery is discharged.

Discharging

During the discharging, BMS system is measuring the temperature, voltage of battery cells and discharging current. Based on the measured discharging current, the BMS calculates actual capacity of the batery. As an outcome from the measurement and the calculation, the BMS evaluate actual state of the battery.

Measured parameters are sent via the CAN bus to other devices like Display, HBC Controller, parent system or others. If the parameters are not aligned with defined limits, then the BMS change status to caution, warning or error variables (more information in chapter Monitoring).

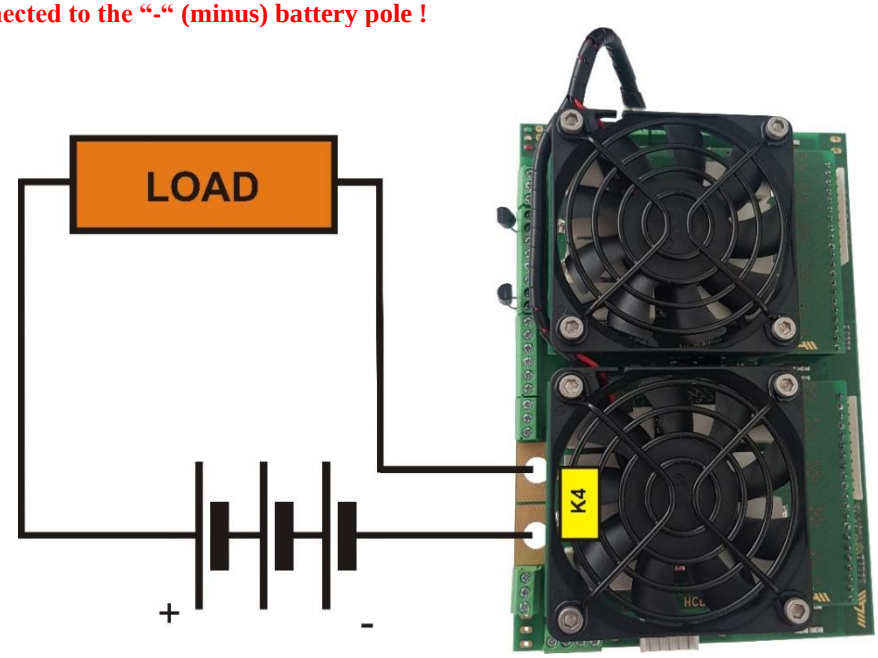
If the system includes main contactor (more information in chapter Power outputs) and voltage of the cells drop under the limit, then this status is sent thru the CAN bus as a “battery error” and after 10 seconds, the BMS disconnect the main contactor as protection against the damage of the battery.

Current probe (Internal / External)

Current probe is used for measuring of the charging / discharging currents. Correct setup use positive value during the discharging and negative value during the charging.

Internal current probe / Connector K4

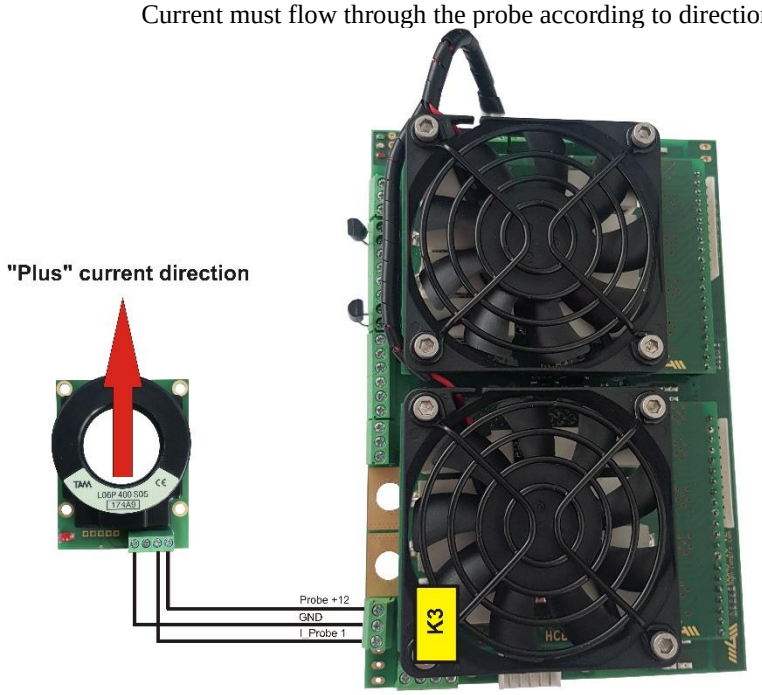
- Is designed for currents up to 60A
- In the MGM ProTool (parameter P30) needs to be set “Current probe 2“
- **Has to be connected to the “-“ (minus) battery pole !**



External current probe

- Galvanicaly isolated current probe
- Has to be connected thru connector K3
- In MGM ProTool (parameter P30) needs to be set “Current probe 1“
- Default setting of the BMS 16i is adjusted for an external probe HAL-400A, for different probes the current constant has to be re-adjusted

Current sensor HALL 400	
Box dimension	55 × 43 × 23 mm
Weight	75 g
Hole for current cable	Ø 22 mm
Sensing current	± 400 A
Insulating voltage	2500 VAC
Supply from control unit	CN-B15
Connection to current circuit	Current cable through sensor hole
Orientation	Current must flow through the probe according to direction of arrow (on picture)



Temperature sensors

Temperature sensor of BMS

- Internal temperature sensor placed on PCBA
- Measure working temperature of PCBA

Temperature sensor of balancers

- Measure temperature of balancing resistors
- In case that balancing temperature exceed the allowed temperature, then the BMS reduce the balancing currents
- The temperature sensors are placed on HCBAL8 balancers or in case of internal balancing resistors on BMS PCBA

Temperature sensor of environment

- Measure temperature of environment, where BMS 16i is placed
- Use external temperature sensor KTY 81-210
- External temperature sensor has to be connected to the connector K7

Temperature sensor of battery

- Measure working temperature of battery / cells
- Use external temperature sensors KTY 81-210
- Three independed temperature sensors could be connected to one BMS 16i (connector K8)

Remark : Case of temperature sensor has to be in contact with measured cells

Remark : Temperature sensor KTY 81-210 could be connected without respect of the polarity

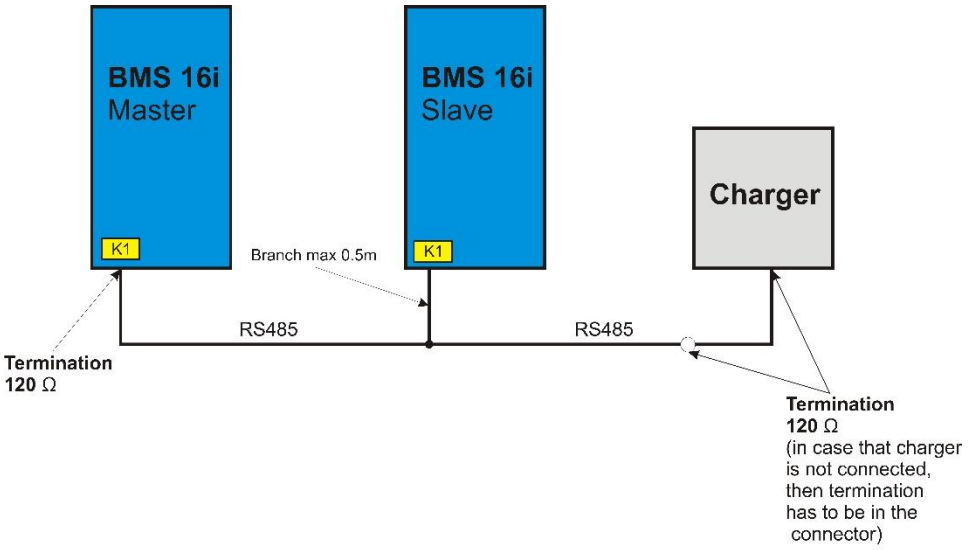
System bus RS485

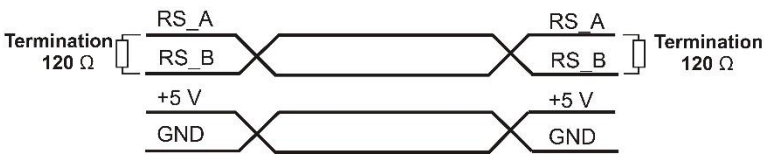
RS485 is an internal communication bus for communication between BMSes and charger in the system. Everytime you need in the system one Master BMS 16i (has to be connected on the "lowest" cells of the battery), which control comunication with other BMS 16i modules (Slaves) or the charger.

Remark : To secure correct behavior, MGM compro recommends to use twisted pair cable for the A & B and NMEA 0183 connectors. Communication has to be terminated. Master BMS 16i already includes the termination, but the "last" slave BMS module has to be terminated by 120 Ω (connect Pin RS485_A and Pin RS485_B thru resistor 120 Ω).

Parameters of the bus :

Standard	RS485
Speed	9600 bit/s
Startbit	1
Stopbit	2
Parity	No parity
Termination	120 Ω / min. 0.25W





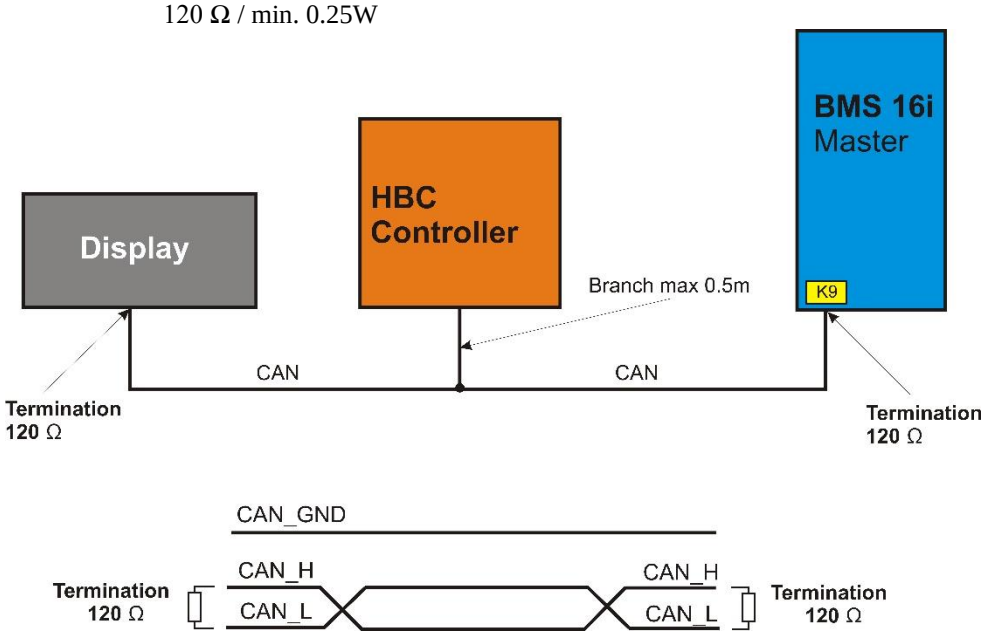
Communication bus CAN 2.0

CAN is comunication interface between BMS 16i and other devices like HBC Controller, display, superior system. BMS 16i is compatible with CAN A and CAN B. The communication protocol is specific for MGM Compro products (more information in appendix), but modifications of CAN bus are possible based on customer request.

Remark : To secure correct behavior, MGM compro recommends to use twisted pair cable for the L & H and NMEA 2000 connectors. Comunication has to be terminated. Master BMS 16i already includes the termination, but termincation on the "last" module of the CAN bus needs to be terminated by 120 Ω (connect CAN_H and CAN_L thru resistor 120 Ω).

Parameters of the bus :

Standard	CAN 2.0 A,B
Speeds	125 kbit/s, 250 kbit/s, 500 kbit/s, 1 Mbit/s
Termination	120 Ω / min. 0.25W



Example of NMEA connectors & termination

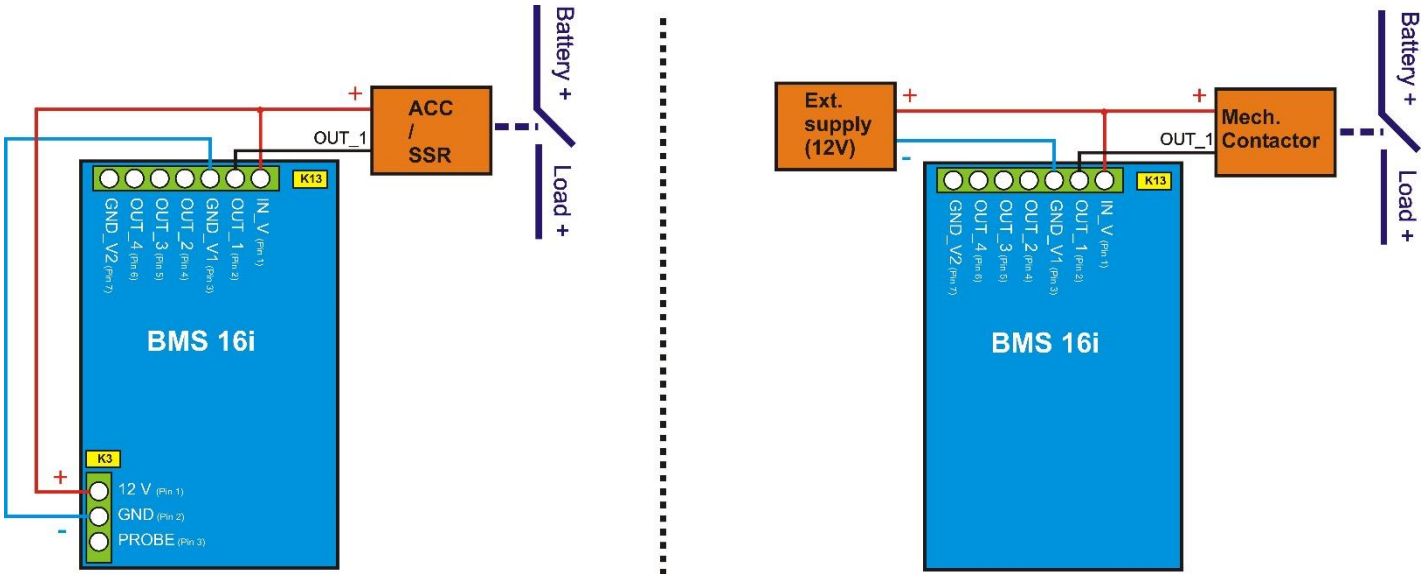
Power outputs

Power outputs are designed for controlling of relays, contactors and chargers (controlled by switching outputs). OUT 1-4 are working as an “open collector” - in state CLOSE are connected to the GND_V1 (for OUT 1) or GND_V2 (for OUT 2-4).

OUT_1 -4 - Max. working current 3A (max. peak current 5A), galvanicaly isolated from BMS
External power supply is needed 12 V (IN_V).

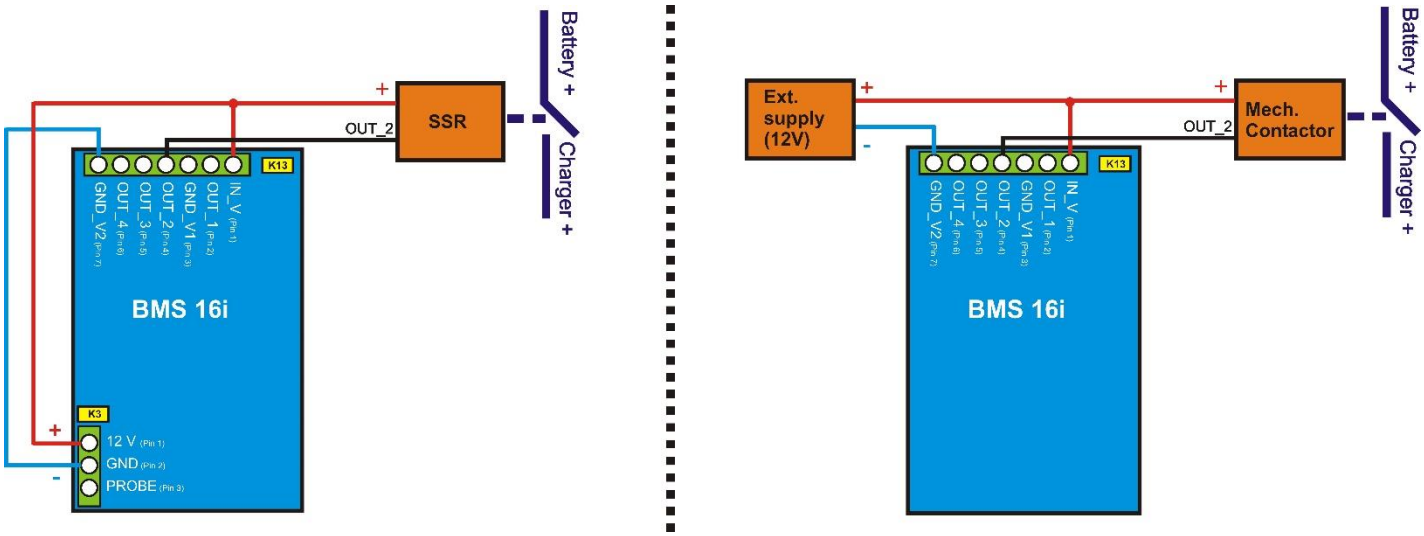
Internal supply from connector K3, could be used for max. 100mA/12V in other case plase use external supply.

OUT_1 → Switching of the main contactor (without / with external supply)



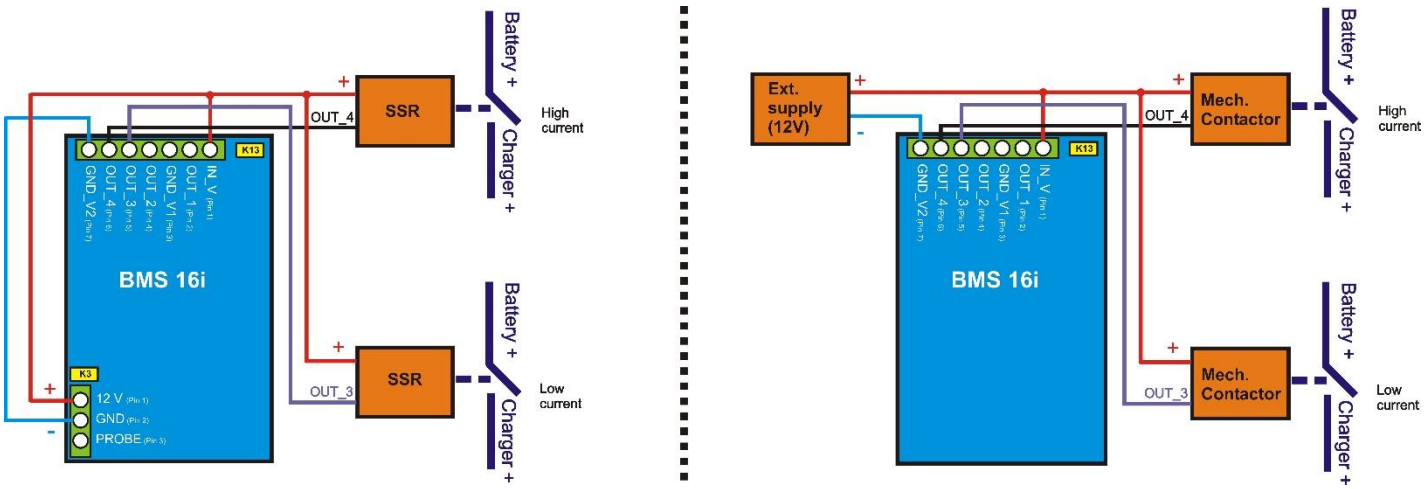
According to parameter P96 (set in MGM ProTool) is contactor closed everytime, when BMS is active or if the voltage is upper the discharging limit of the battery cells.

OUT_2 → Switching of the charger contactor (without / with external supply)



According to parameter P96 (set in MGM ProTool) is contactor closed everytime, when BMS is active or if BMS has request for charging (voltage under the charging limit of the battery).

OUT_3 → Charging
OUT_4 → Charging with high current (without / with external supply)



OUT3 – Charging (ON/OFF current)
OUT4 – Charging with high current (ON/OFF high current)
In case, that is used only OUT3, then the charging is only switching ON or OFF.

Parameter P54 has to be set according to used charger.
Connection / usage of BMS16i and Charger has to be consulted with MGM Compro.

HBC Controller / Motor / Battery system / Display / Battery chargers

Based on the deep experiences, MGM Compro could propose complete system, which could fit to customer needs - in case of any need, please contact us by an email : info@mgm-compro.com

Communication interface OPTOCOM6i (BMS 16i ↔ PC)

Communication module OPTOCOM6i is used for communication of the MGM compro devices (HCBs, BMSes) and PC software MGM Protool (V3.2.2. or later).

Parameters :

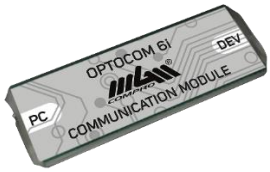
- PC interface : USB 2.0
- Compatibility : BMS16i, BMS 8i

LED statuses :

LED	ON	FLASHING
GREEN	NA	Communication (questioning)
RED	NA	Communication (answering)
YELLOW	Supply from device	NA

Parts :

- Communication module

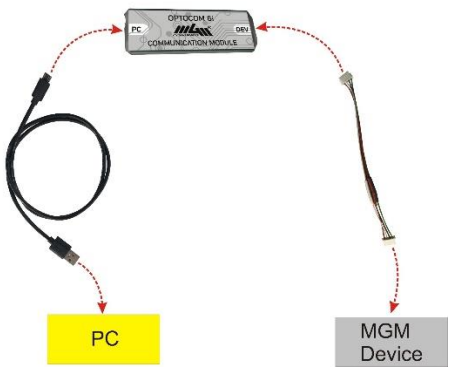


- USB cabel

- UART cabel

Instalation :

1) Connect OPTOCOM 6i with USB cabel
2) Connect OPTOCOM 6i with your PC
3) Download PC SW MGM ProTool (web link) / ensure that you are using the latest version of the SW or make an update
4) Connect OPTOCOM 6i with your MGM device / ensure, that you are using the latest version of the FW or make an update
5) Functions / parameters are ready to use / adjust



MGM ProTool

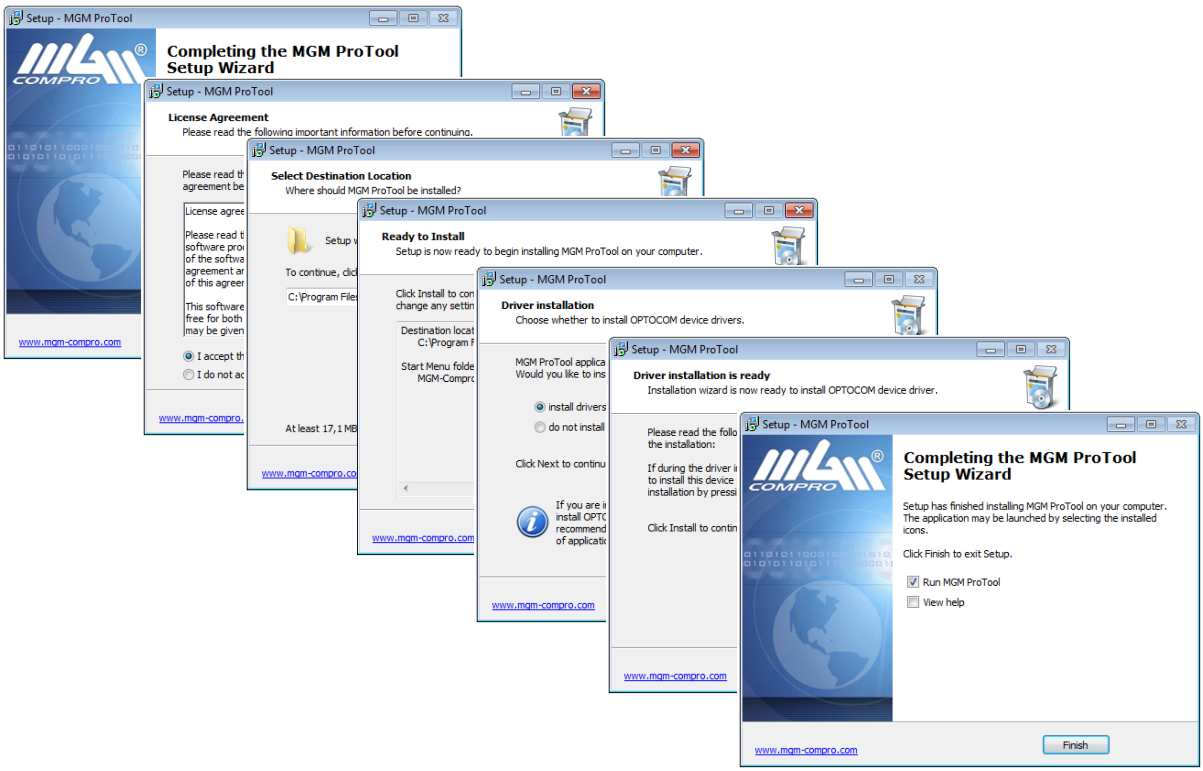
To set parameters or read data from the BMS 16i, is necessary to instal the PC software MGM ProTool and connect BMS 16i to PC via the OPTOCOM 6i.

Instalation of the MGM ProTool

PC software "MGM ProTool", is free to download from our web.

1) Download the MGM ProTool from follow [web link]

2) Connect the OPTOCOM 6i with your PC
3) Instal the SW on your computer



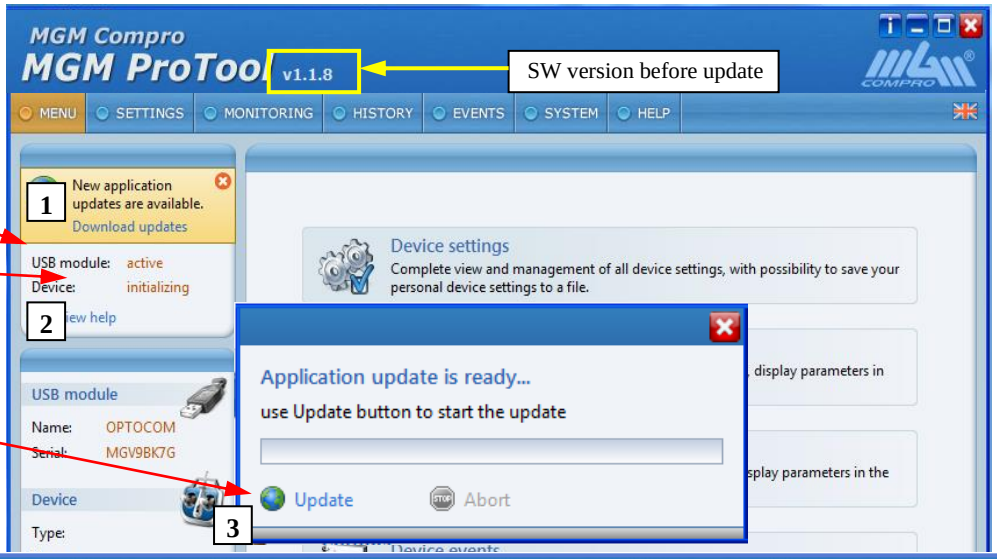
Connection of the BMS 16i with PC

First of all the OPTOCOM6i has to be connected with PC via the USB and then the OPTOCOM6i has to be connected via the UART to the connector K11 placed on the master BMS 16i. Open the PC software MGM Protool on your computer and turn on BMS16i. The green led on BMS 16i (K10) indicate the correct connection between BMS16i and MGM Protool.

Update of MGM ProTool

Update SW version of your program MGM ProTool is possible to make by two ways

1. After start program automatically advice to new version in left upper corner (in case that the new version exists) – start update by this way.

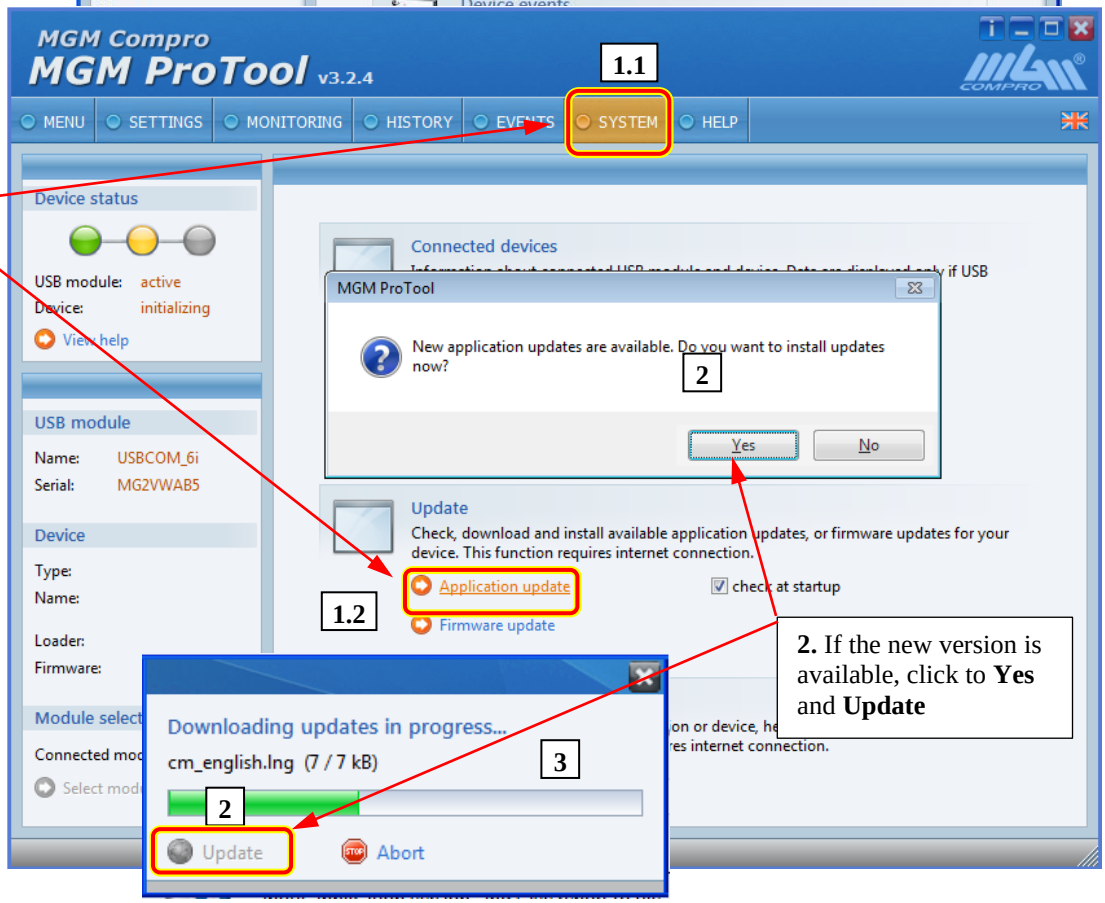


2. Choice "**Download updates**"

3. Push **Update**

OR

1. You can check, if new version is available any time → click to **SYSTEM** and **Application update**



3. Wait for finishing

4. Last step is restart, after this you have the newest version.

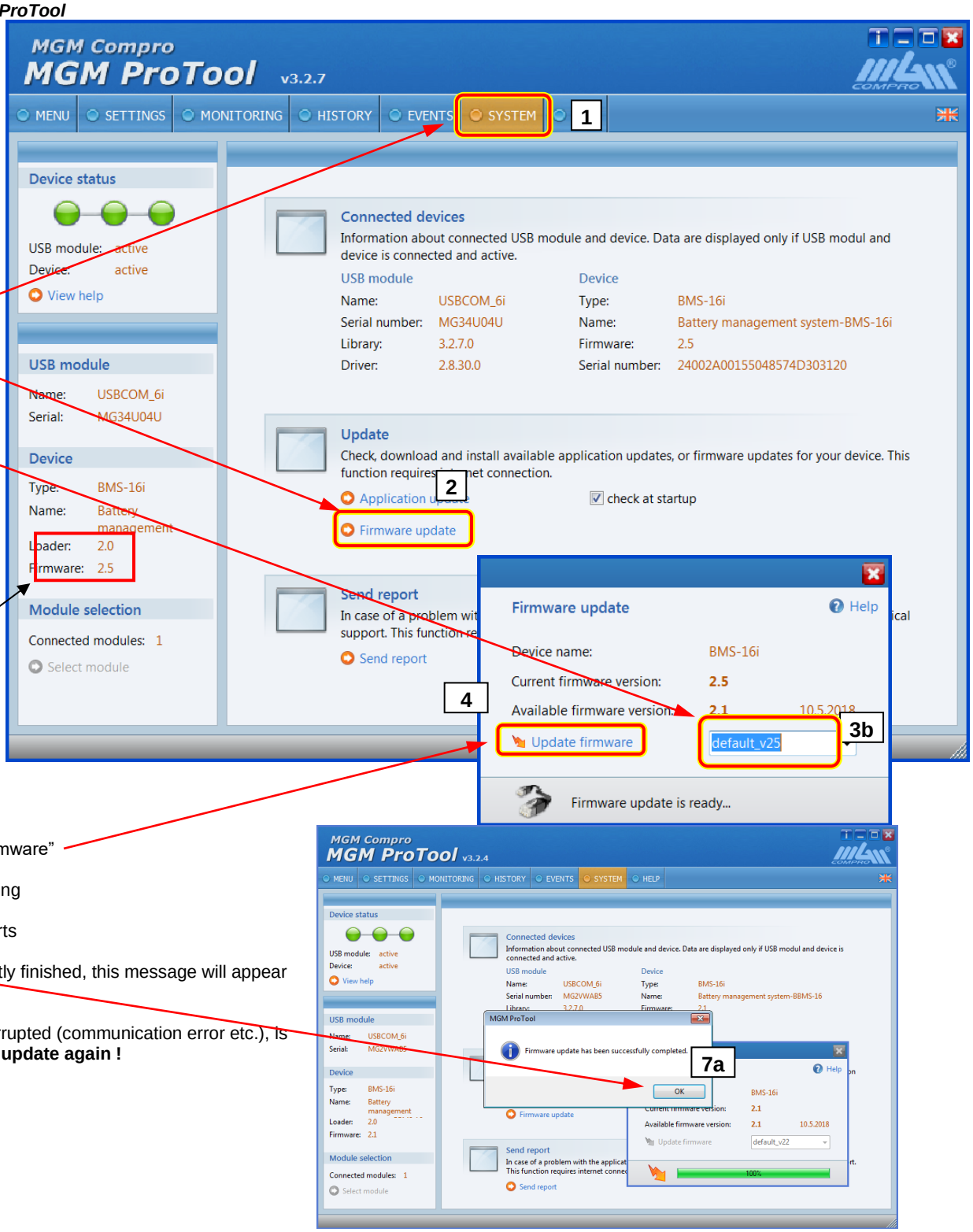
Update of BMS 16i firmware

Remark :
Please remember the parameters, which was already set before the update of the firmware. Data, which was set, might be lost during the firmware update.

Remark:
All BMSes 16i in the system, have to have the same FW version of the device as the others.

In case, that you want to make an update of firmware in your BMS 16i to the latest version, you will need to connect the OPTOCOM 6i to PC (with an internet connection) and to the BMS 16i.

0. Start program ***MGM ProTool***



1 Select “SYSTEM”

2 Select “Firmware update”

3a Switch the BMS-16i ON

3b Select version, which corresponds with your system

Current FW version

4. Push button “Update firmware”

5. Confirm firmware updating

6. Updating procedure starts

7a. When procedure correctly finished, this message will appear Push OK

7b. When procedure is interrupted (communication error etc.), is **necessary to start the update again !**

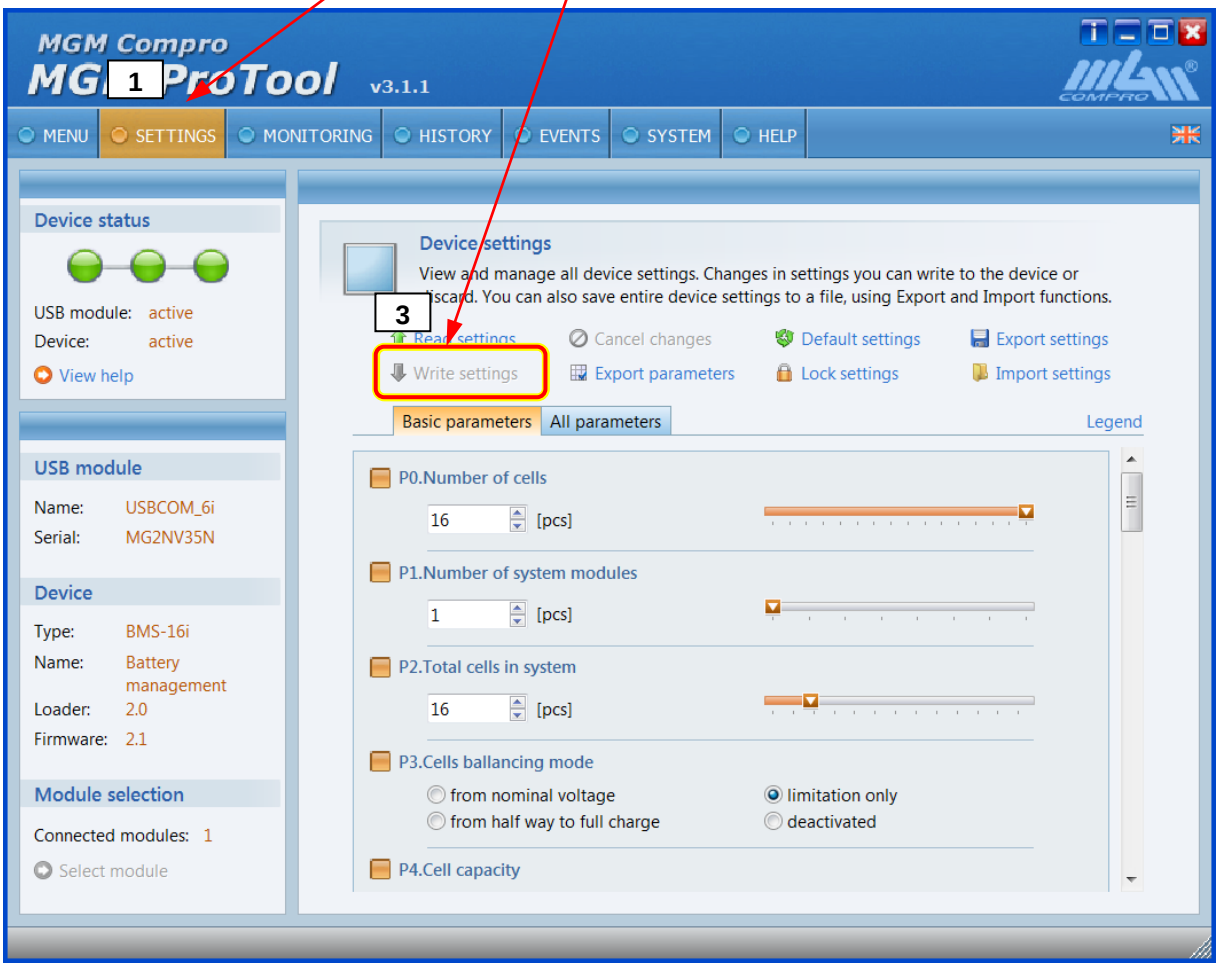
8. Follow next instructions

Remark :
You can start updating procedure for unlimited amount of tries, the BMS cannot be broken down by failed update, but you have to finish the update procedure without errors [7a], before you will use your system or you set the parameters, etc.
When procedure don´t finished correctly [7b], the BMS after next turn-on doesn´t work, is not possible to set parameters, etc. In this case is necessary to repeate the updating procedure !

Setting of the user parameters (in MGM ProTool)

Customized BMS 16i has usually parameters set according to customer requirements. In case that is necessary to write into the BMS 16i new parameters corresponding customer system / customer needs please follow the steps…

1) Push “SETTINGS”
2) Make the changes of the parameters
3) Push “Write settings”
4) Restart the BMS16i (switch OFF and ON)
5) Then the new parameter settings will be available for MASTER and SLAVEs



List of parameters

Index	Name	Range		Step	Default	Master	Slave
P0	Numbers of cells	1	16	1	16	Yes	Yes
P1	Numbers of system modules	1	8	1	1	Yes	-
P2	Total cells in system	1	128	1	16	Yes	-
P3	Cells balancing mode				Limitation only	Yes	-
P4	Cells capacity	0 Ah	655 Ah	10 mAh	1 Ah	Yes	-
P11	RS485 module address	0	7	1	0	Yes	Yes
P15	Cut-off cell voltage	2 V	5 V	1 mV	3 V	Yes	Yes
P16	Low cell voltage	2 V	5 V	1 mV	3,3 V	Yes	-
P17	Nominal cell voltage	2 V	5 V	1 mV	3,8 V	Yes	-
P18	Charged cell voltage	2 V	5 V	1 mV	4,15 V	Yes	-
P19	Nominal cell voltage-MODE 2	2 V	5 V	1 mV	3,5 V	Yes	-
P20	Charging cell voltage-MODE 2	2 V	5 V	1 mV	3,6 V	Yes	-
P21	Charge fuse	0 A	100 A	0,1 A	1 A	Yes	-
P22	Discharge fuse	0 A	500 A	0,1 A	0	Yes	-
P23	Charge efficiency	50%	100%	0,1 %	100%	Yes	-
P30	Current probe				Current probe 1	Yes	-
P31	Current constant 1	0	65535	1	233	Yes	-
P32	Current constant 2	0	65535	1	2620	Yes	-
P33	Current probe multiplier	1	20	1	1	YES	-
P35	Current probe 1 - OFFSET	0	4095	1	0	YES	-
P36	Current probe 2 - OFFSET	0	4095	1	0	YES	-
P45	CAN module address	0	65500	1	16	Yes	-
P46	CAN Speed				250 kbit/s	Yes	-
P47	CAN mode				B	Yes	-
P50	Device ID	0	65500	1	0	Yes	Yes
P52	Number of battery sensors	1	3	1	1	Yes	Yes
P54	Type of charger				AX	Yes	-
P62	Logging mode				OFF	YES	-
P63	Cells voltage output into monitoring				Enabled	Yes	-
P64	Wake up period	0 h	24 h	1 h	0	Yes	-
P88	Display cells details in monitoring				Cells voltage	YES	-
P89	Clear internal resistance of cells				NO	YES	
P90	Internal voltage - mode				Internal voltage	Yes	-
P91	Internal resistance - charging				Disable	Yes	-
P92	Current limit	1 A	100 A	1 A	10 A	Yes	Yes
P93	Voltage limit	1 mV	100 mV	1 mV	10 mV	Yes	Yes
P96	Contactor controlled by voltage				Disable	Yes	-
P97	Max. cell voltage	0 V	5 V	1 mV	0	Yes	Yes
P98	Shutdown delay	0	60s	1s	0	YES	
P62	Logging mode				OFF	Yes	-
P99	Input IN_2				Charging Voltage	YES	
P130	Activation counter - limit	0	1000	0,1	0	YES	

Description of parameters

P0 : Numbers of cells

The sum of cells, which are connected to the BMS 16i.

P1: Numbers of system modules

Amount of the BMSes in the system, which are connected via the RS485.

P2: Total cells in system

Overall amount of the cells in the system.

P3: Cells balancing mode

- **From balancing voltage**

Balancing is starting, when voltage of the most charged battery cell is higher, than the value of Balancing voltage (parameter P17 in ProTool). Balancing is running until all battery cells are balanced / charged to value of Charged cell voltage (parameter P18 in ProTool).

- **From charged cell voltage -10 mV**

Balancing is starting, when voltage of the most charged battery cell is higher, than the value of Charged cell voltage –10 mV (parameter P18 in ProTool). Balancing is running until all battery cells are balanced / charged to value of Charged cell voltage.

- **Always**

Balancing is starting, when voltage of the most charged battery cell is higher, than the value of Balancing voltage (parameter P17 in ProTool). Balancing is running even after the deactivation of the BMS 16i (Switch [K5] is OFF). Balancing is finished, when all battery cells are balanced / charged to value of Charged cell voltage (parameter P18 in ProTool). In case, that the charger is disconnected, the balancing continues until all cells are balanced, after that the BMS 16i is switched OFF.

- **Deactivated**

Balancing is OFF.

P4: Cells capacity

Capacity of monitored battery [Ah]. Is necessary to set for correct calculation of battery capacity.

P11: RS485 module address

Used for the setting of the BMS addresses in the system, which are connected via RS485. Master BMS has to have every time the address 0. In case that system includes other Slaves BMSes, the Slave BMSes has to be addressed from 1 to 7, in order according to connection to battery.

P15: Cut-off cell voltage

Is the lowest allowed voltage of the battery cell. If the voltage is under the set cut-off voltage, then the calculated capacity of the battery decrease to 0, warning message is broadcasted, the main contactor is open.

P16: Low cell voltage

In case that voltage is under the set Low cell voltage, then caution message is broadcasted

P17: Balancing voltage

Is the voltage from which the balancing starts running (for balancing modes “From nominal voltage” and “Always”).

P18: Charged cell voltage

Is the target voltage for the charging and balancing of each cell.

P19: Nominal cell voltage-MODE 2

Is the voltage from which the balancing starts running (for balancing modes “From nominal voltage” and “Always”). The P19 is used mainly for balancing before the transportation or storage of the batteries.

P20: Charging cell voltage-MODE 2

Is the target voltage for the charging and balancing of each cell. The P20 is used mainly for balancing before the transportation or storage of the batteries.

P21: Charge fuse

Is the limitation of the battery charging current, in case that is used the controlled charger.

P22: Discharge fuse

Controlling of maximum discharging current. In case, that discharging current is over the limit, then the overcurrent error is broadcasted. In case, that the value is 0, then the discharge fuse is switched off.

P23: Charge efficiency

Charge efficiency is the rate, which compares the current given to the battery and current, which could be taken from the battery.

P30: Current probe

Selection of the current probe :

- Probe 1 / External current probe - for measurement of the currents from 0 A to 600 A, connected to the K3
- Probe 2 / Internal current probe - for measurement of the currents up to 60 A, connectors K4

P31: Current constant 1

For calculation of the actual capacity of battery based on the measurement of the current. Is related to the current probe 1 / default value for HAL probe is 400A.

P32: Current constant 2

For calculation of the actual capacity of battery based on the measurement of the current. Is related to the current probe 2 / default value for internal probe is 60A.

P33: Current probe multiplier

Current probe multiplier define number of cabel passages thru the hall current probe – more information in datasheet of current probes.

P35: Current probe 1 – OFFSET

In case, that the parameter is 0, then OFFSET of the current probe 1 (external probe [K3]), will be adjusted automatically during the activation of the BMS. In case, that the parameter is higher than 0, then the BMS is working only with adjusted value of the parameter.

P36: Current probe 2 – OFFSET

In case, that the parameter is 0, then OFFSET of the current probe 2 (internal probe [K4]), will be adjusted automatically during the activation of the BMS. In case, that the parameter is higher than 0, then the BMS is working only with adjusted value of the parameter.

P45: CAN module address

Is used for the movement of the CAN addresses in case, that the system includes other devices, which could use same addresses. All devices, which should communicate together via CAN bus, have to have specific address. The movement of the address is not applicable for the Yangming chargers, because they work on the fixed addresses.

P46: CAN Speed

All devices, which should communicate together thru the Can, have to have same speed of the communication.

P47: CAN mode

Is used for switching between CAN mode A / CAN mode B. Because all devices, which should communicate together via the CAN, have to have same mode and speed (Parameter 46).

P50: Device ID

Could be used to set ID of the devices in the system.

P52: Number of battery sensors

To define how many temperature sensors of battery is used (1-3).

P54: Type of charger

Selection of the used charger :

- AXM -> For comunication with BMS 16i uses RS485
- MWSPV -> For comunication with BMS 16i uses RS485 or connector/output K2
- MWRPB -> For comunication with BMS 16i uses RS485 or connector/output K2
- YNG -> For comunication with BMS 16i uses RS485 or CAN
  -> In case, that for communication is used CAN 2.0 B, then communication speed has to be adjusted to 250 kbit/s
- SUPPLY -> External power supply (5-12V) needs to be brought to connector K13
  -> Charger is connected or disconected (switched ON/OFF), charger is not controlled Is connected thru the connector K13

P62: Logging mode

In case that the parameter is adjusted to "OFF", then the logging of the critical statuses of BMS 16i is switched off. In case that the parameter is adjusted to "Critical states", then the logging of the critical statuses of BMS 16i is switched on and logging is running. More in chapter …

P63: Cells voltage output into monitoring

The value of each cell is/is not shown in the monitoring.

P90: Internal voltage - mode

Is used for selection of the mode for measured voltage :

- Measured voltage mode -> BMS is working with measured voltage on the cells
- Internal voltage mode -> BMS is working with calculated internal voltage of the cells, which is calculated from an internal resistance of cells, actual current and measured voltage of the cells

P95: Internal resistance - charging

During the charging with the controlled charger and in case that is allowed, every 5 minutes is running the recalculation of the internal resistance of cells.

P91: Current limit

Is setting minimum current difference between the measurements, in which the recalculations of the internal resistance could run.

P92: Voltage limit

Is setting minimum voltage difference between the measurements, in which the recalculations of the internal resistance could run.

P96: Contactor controlled by voltage

Is switching between two modes :

- Disable: Contactors are closed every time, when BMS is active
- Enable: Contactors are controlled based on voltage of the cells

P97: Max. cell voltage

Maximal cell voltage, which is allowed. In case that the value is exceeded, then the warning state is broadcasted and contactors are open.
In case that value is 0 (default setting), the value is not taking in consideration.

P64: Wake up period

Is time in hours, when deactivated BMS will wake up and check the battery status. In case that the battery has an error status and GSM modul is connected, then the GSM modul will send the SMS message about the error state.

P88: Display cells details in monitoring

Is setting of the visibility of the cells voltage or internal resistance of cell in ProTool (Monitoring).

P89: Clear internal resistance of cells

Is used to clear the measured internal resistances (e.g. in case that you change the batteries). In case that is selected yes, then all calculated internal resistances of all battery cells will be deleted.

P98: Shutdown delay

Delay of the BMS shutdown after switching off the BMS [K5].

P99: Input IN_2

Adjustment of the input IN_2. Could be used for the switching of charging voltage level (MODE 2) or input for the fire extinguish system.

P130: Activation counter - limit

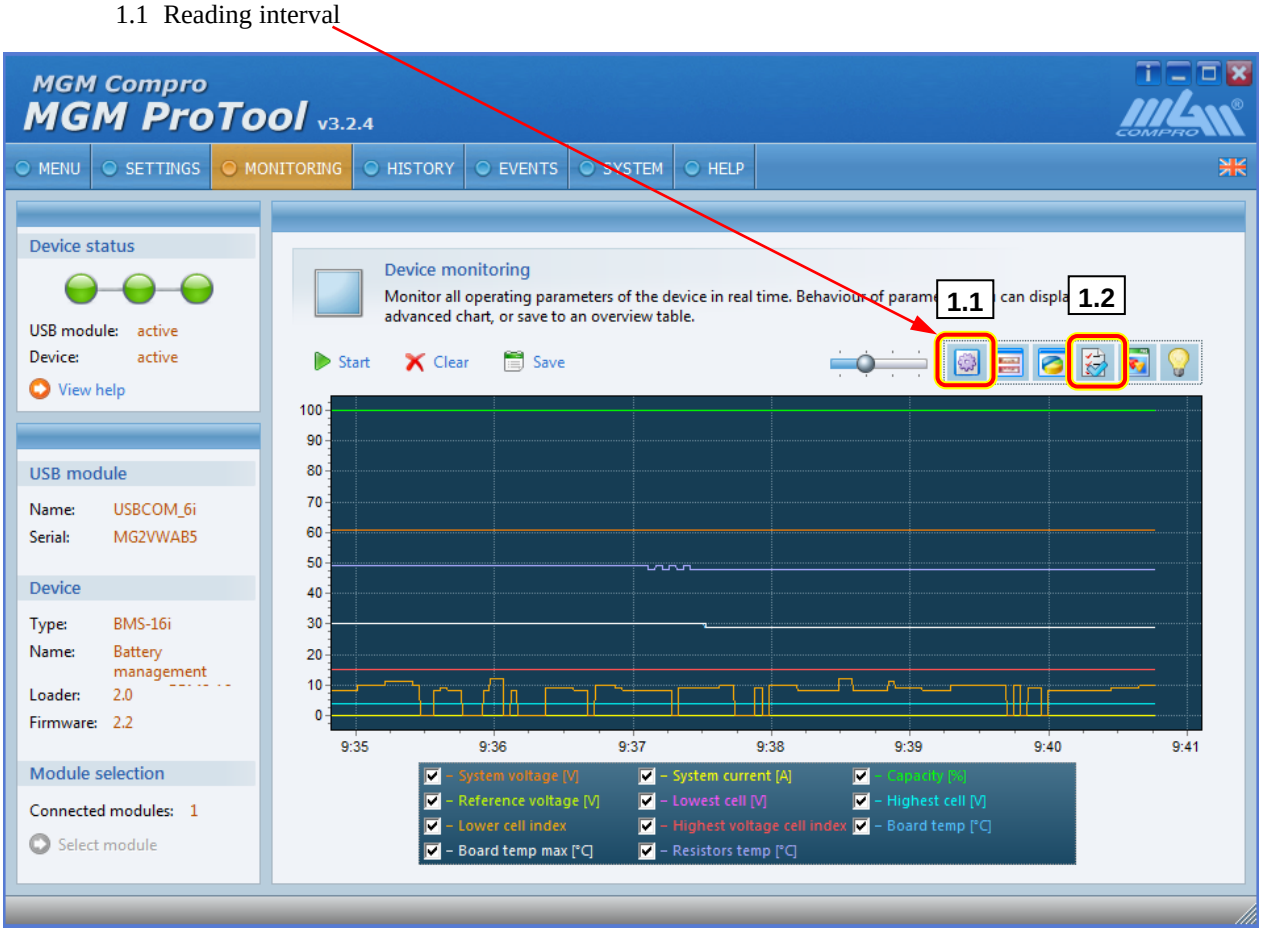
Limit for the moto-hours counter.
In case that parameter value is 0, then the moto-hours reflecting when the BMS is active.
In case that parameter value is higher than 0, then BMS use the value as minimum discharging battery current, from which the BMS is counting the moto-hours.

Real-time monitoring

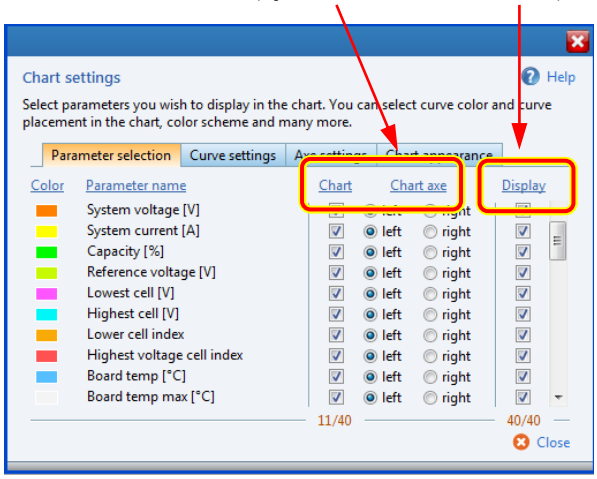
For real time monitoring you has to connect BMS 16i with your PC thru OPTOCOM and you could monitor 2 types of the information :

- Values of the system (voltages, currents, capacity, temperatures)
- Error, warning, caution

1) Select **MONITORING** and before you start, you could chose
   1.1 Reading interval



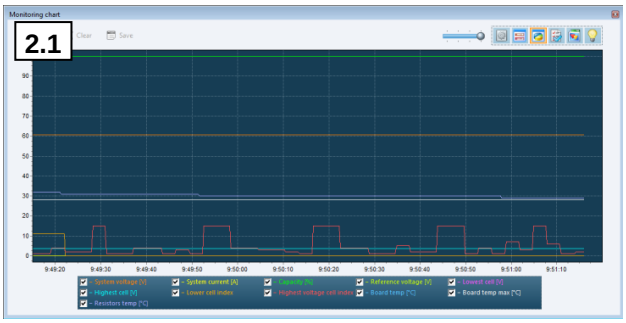
1.2 Values you want to monitor and where (by Chart / Parameter values)



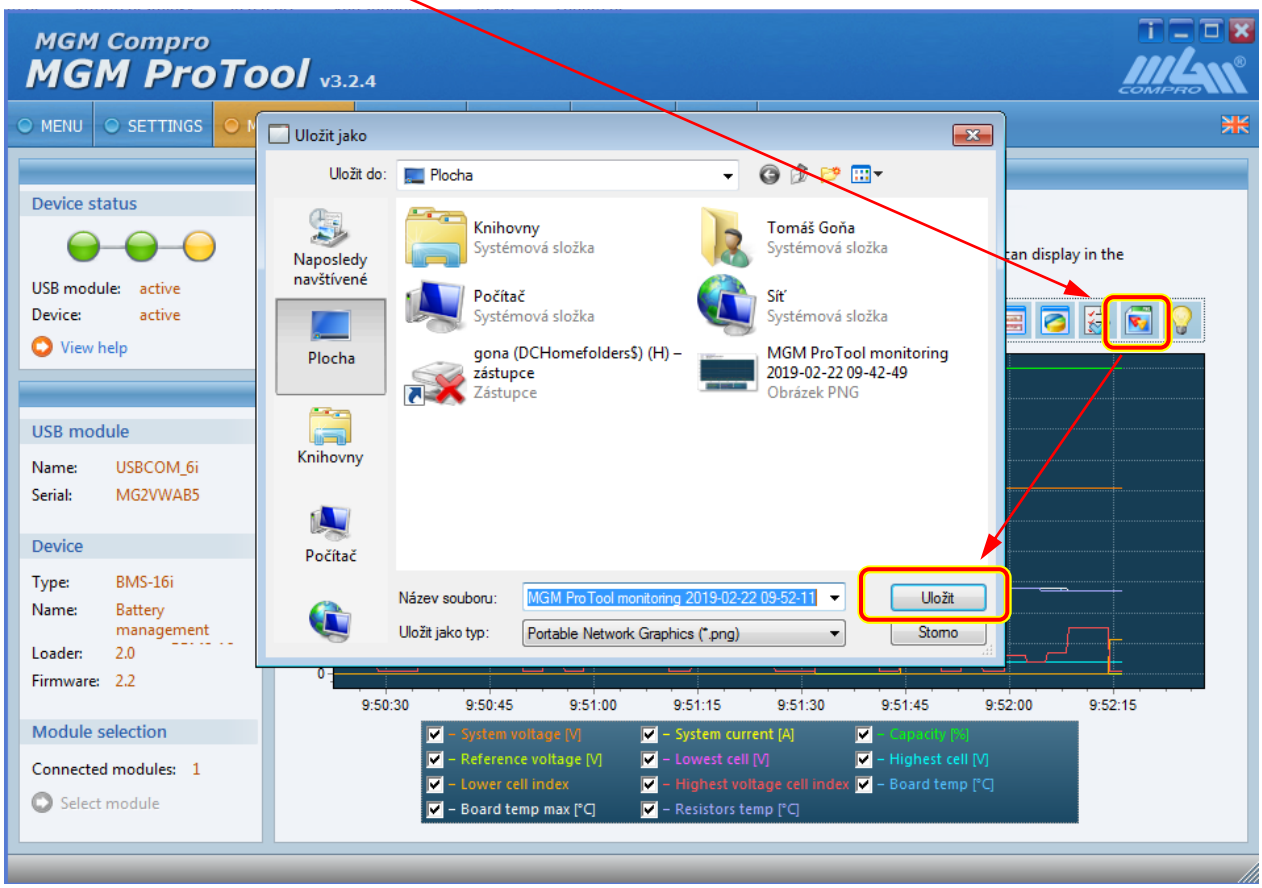
2. Start monitoring

2.1 Chart

2.2 Parameter values



3. After or during the monitoring you could save the chart of monitored values



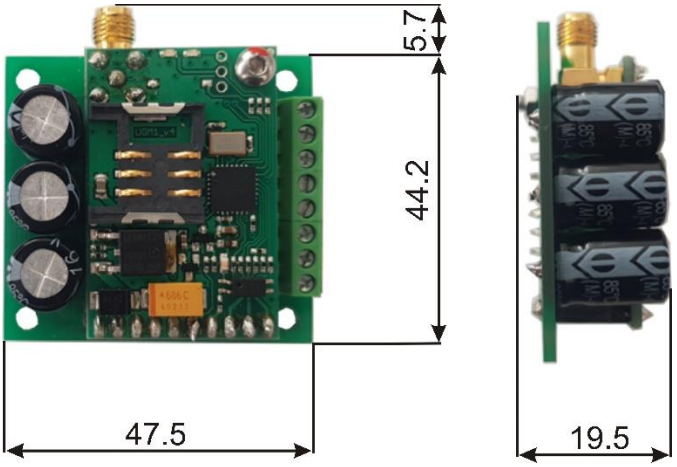
Parameters, which can be monitored

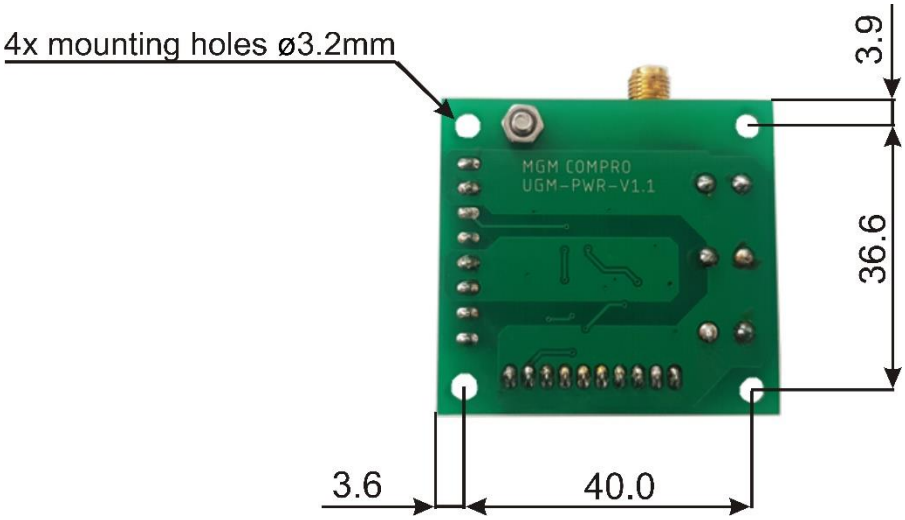
Parameter	Unit	Step	Description
System voltage	V	0,1V	Voltage of the battery / Sum of voltage of all cells in the system
System current	A	0,1A	Battery current / the positive value indicate discharging of battery, negative value indicate charging of battery
Capacity	%	0,1%	Capacity of the battery [%]
Reference voltage	V	0,001V	Reference voltage for balancing of the cells. The value of the reference voltage is automatically set according to actual voltage of the battery and according to balancing mode.
Lowest cell	V	0,001V	The lowest voltage of the cell from the system
Highest cell	V	0,001V	The highest voltage of the cell from the system
Lower cell index	-	-	Index / number of the cell with the lowest voltage (according to an order)
Highest voltage cell index	-	-	Index / number of the cell with the lowest voltage(according to an order)
Board temp	°C	1°C	Temperature measured on internal sensor, placed on the PCBA of connected BMS
Board temp max	°C	1°C	Maximum temperature measured on internal sensor, placed on the PCBA of all BMSes in the system
Resistors temp	°C	1°C	Temperature measured on balancing resistors of connected BMS
Resistors temp max	°C	1°C	Maximum temperature measured on balancing resistors of all BMSes in the system
Battery temperature	°C	1°C	Temperature measured on temperature sensor/sensors connected to BMS and placed on the battery cell/cells
Max battery temperature	°C	1°C	Maximum temperature measured on temperature sensor/sensors in the system and placed on the battery cell/cells
Environment temp	°C	1°C	Temperature measured on temperature sensor / sensors of environment, which are connected to the BMS
Environment temp max	°C	1°C	Maximum temperature measured on temperature sensor / sensors of environment, which are connected to the whole system
Selftest error	-	-	Automatic check of the measurement of the cells, which runs during every activation of the system In case that the number is higher than 0, then the number represent the number of the cell with an issue In case of no issue, then the number is 0
System status	-	-	1 – N/A 2 – N/A 3 – BMS 16i is running 4 – Discharging is allowed 5 – Charging is allowed 6 – Balancing is running 7 – Warning status is broadcasted 8 – Error status is broadcasted
System caution	-	-	1 – Low capacity 2 – Low voltage 3 – Extinguish system activation 4 – N/A 5 – High temperature of the battery 6 – N/A 7 – High temperature of the PCBA 8 – N/A
System warning	-	-	1 – Warning zero capacity 2 – Warning low voltage of the cell (under the CUTT OUT voltage) 3 – Warning discharging current from battery exceeded (current fuse) 4 – Warning charging current exceeded (charging fuse) more than 10% 5 – Warning temperature of the battery exceeded 6 – N/A 7 – Warning temperature of the PCBA exceeded 8 – Maximum cell voltage (P97) had been exceeded
System error	-	-	1 – Error during the selftest 2 – Overcharged battery 3 – System error (error of the amount of the battery cells during the communication) 4 – Voltage of the cell is 100 mV less, than the CUTT OFF voltage 5 - Error temperature of the battery 6 – Error temperature of the environment 7 – Error temperature of the PCBA 8 – Error temperature of the balancing resistors
Max Res. Index	-	-	Number of cell, which has the highest internal resistance
Max Resistance	mΩ	0,01mΩ	The value of the highest internal resistance measured in the system
Batt. Resistance	mΩ	1mΩ	Sum of internal resistances of all cells in the system - internal resistance of the battery
Line x, address y	V	0,001V	Voltage on each cell in the system A set number of cells are displayed, the cells are displayed in order as they are sorted in the system

GSM module

The main propose of the GSM module is to alert the user to a critical battery condition, especially when the batteries are stored for a long time. The notifications are realized by SMS messages, which are sent via GSM network.

Dimensions (L × H × W)	44.2 × 47.5 × 19.5 mm
Weight	31 g

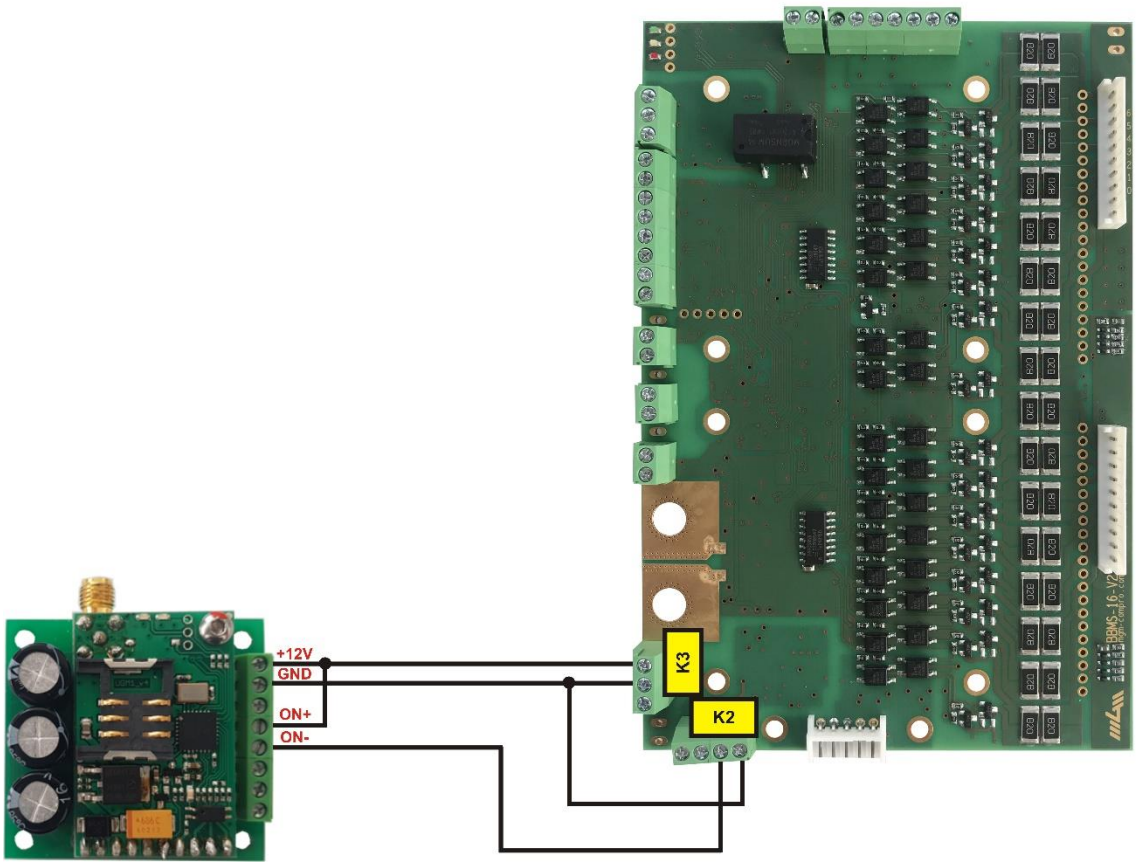




Sending SMS messages is possible for up to 6 unique phone numbers. The message consists of two parts - the identifier and the message itself. The GSM module is connected to the Master BMS (K2 & K3) and powered by the BMS. In case, that GSM module is not activated, then GSM module has zero power consumption. P64 must be set to periodically check the system. The parameter P64 determines the time period for BMS wakes up and the battery status is checking. In case, that during the wake up checking the battery status is OK, the BMS will be immediately switched off (sleep). In case, that during the wake up checking the voltage of the battery is under the critical level - battery is discharged (setting of critical level by parameter P15), then GSM module will be activated and send the SMS message to defined phone numbers. The BMS system will be switched off (sleep), when the SMS message is sent. In case that the voltage of the battery is under the critical level - battery is discharged (setting of critical level by parameter P15), then is necessary to immediately charge the battery to avoid the damage of the battery.

Settings:

- Set parameter P15 in the BMS 16i to define voltage level of discharged battery (Cut off voltage)
- Set parameter P64 in the BMS 16i how often you would like to check the system [hours]
- GSM module has to includes the activated SIM card
- GSM antenna has to be placed on proper place to be able to reach GSM signal



Accessories for GSM module :

- Antenna / Antenna 90°
- Antenna cable

BMS 16i - Logs overview

Activation of the system
BMS system startup complete, XX cells found.

Deactivation of the system
BMS switched off.

Battery charged and balanced
Battery fully charged, cells ballanced to XX V, capacity XX percent.

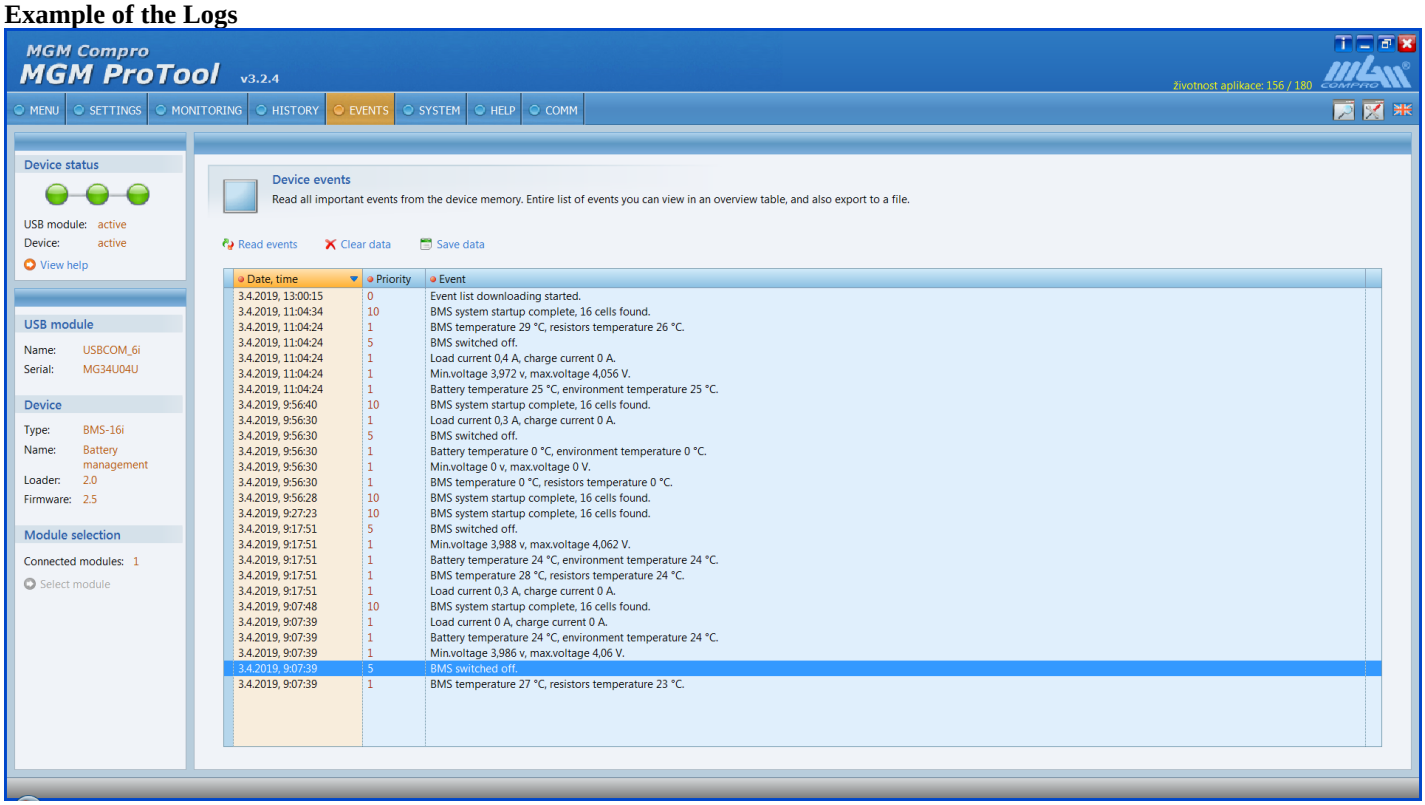
Battery discharged
Emergency shutdown, low voltage XX V on cell no. XX.

Basic parameters of the battery
Min.voltage XX V, max.voltage XX V.
Load current XX A, charge current XX A.
BMS temperature XX °C, resistors temperature XX °C.
Battery temperature XX °C, environment temperature XX °C.

GSM activation
GSM activation, system error.

ERROR logs
Error during the selftest.
Overcharged battery.
System error (error of the amount of the battery cells).
Voltage of the cell is 100 mV less, than the CUTT OFF voltage.
Error temperature of the battery.
Error temperature of the environment.
Error temperature of the PCBA.
Error temperature of the balancing resistors.

Example of the Logs



Examples

1) BMS 16i Master

An example of the setup

Number of cells (Serial)	14S10P
Type of the cell	Li-Ion, 3 Ah
Battery capacity	30Ah
Voltage of bettery	max. 58.8 V (14 x max. 4.2 V)
Number / Type of BMS	1 (Master - with the HCBAL8s and with FANs)
Current probe	Internal
Charger	MGM Compro battery charger (MNWRPB)

Remarks:

- **Be careful during the soldering, the reversal of the battery poles is very dangerous.**
- **Is recommended to do wiring of the system at first, after correct connection of the system, connect traction batteries.**
- **In case of any doubts related to connection, please contact MGM Compro.**

Follow the steps :

1) Solder each serial cell of the battery from the "–" pole of the battery up to the highest cell of the battery ("+" pole of the battery) to the connectors which will be connected with BMS connectors K14 & K15 (U0-1S up to U14-14S for 14 serial battery cells). The U14 and UB will be connected on the "+" pole of the battery.
2) Connect ON/OFF SWITCH to the BMS connector K5 (SWITCH OFF)
3) Connect temperature sensors to the BMS connector K7 (Environment temperature sensors) and K8 (Battery temperature sensors → min. 1x / max 3x)
4) Connect CAN bus to BMS connector K9
5) Connect internal current probe (K4, SENSE-) to the **"–" pole of the battery**
6) Connect battery with K14 of the BMS
7) Connect battery with K15 of the BMS
8) Connect antispark & ESC (**follow the ESC user instruction**) and charger to the connector (K4, SENSE+)

Remark:
Connect antispark to charge ESC capacitros to avoide damage of the BMS.

9) Switch ON the BMS switch, which is connected to K5 (BMS red LED is flashing)
10) Download the MGM ProTool (web link)
11) Install the MGM ProTool
12) Open MGMProtool
13) Connect the OPTOCOM6i with BMS 16i (connector K11) and with the PC (via USB) // OPTOCOMs green and red LEDs are flashing and yellow LED is ON
14) Make an update to the latest version of the MGM ProTool
15) Make an update to the latest version of the BMS 16i firmware
16) Load default settings
17) Set the correct parameters :

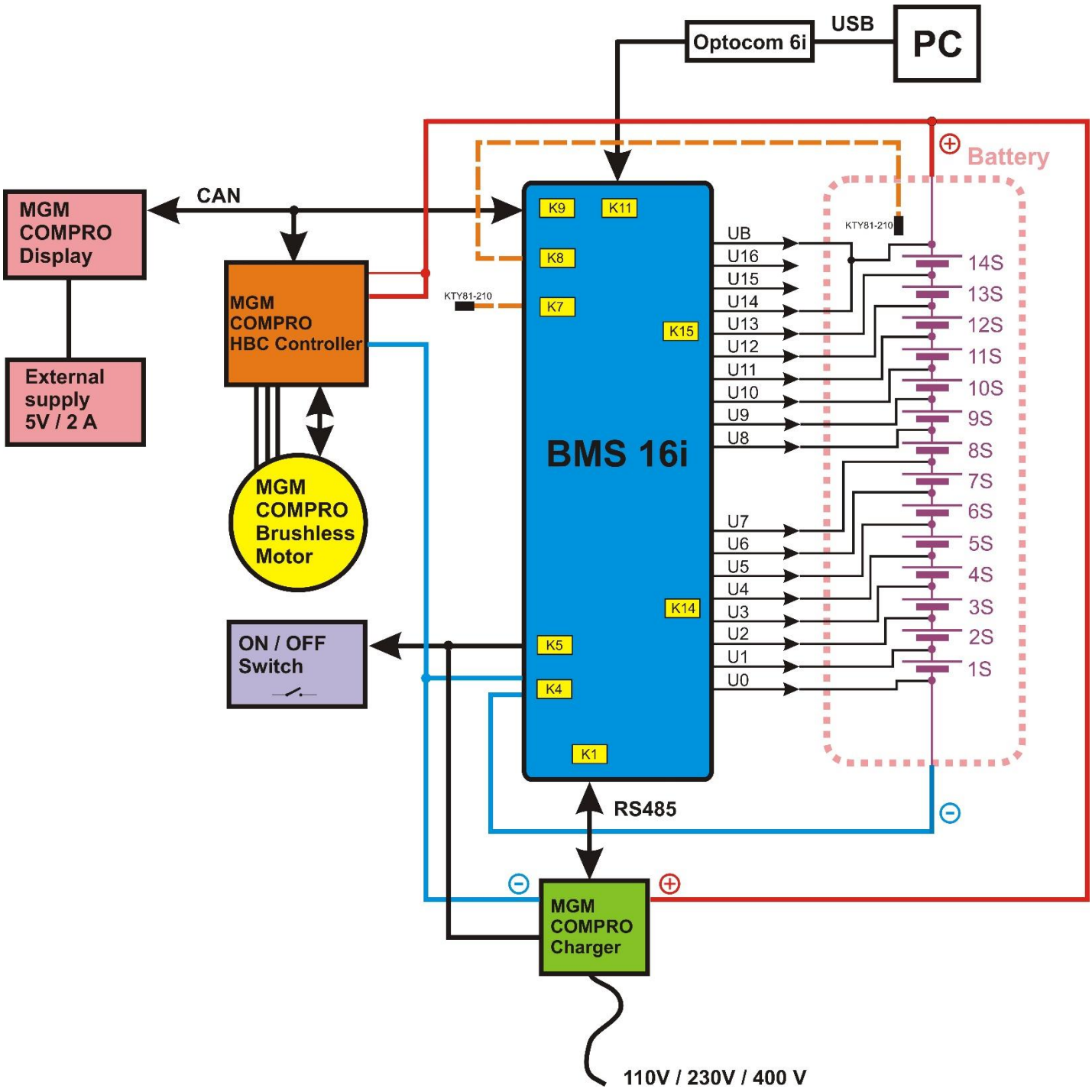
P0	→	14	… Numbers of cells
P2	→	14	… Total cells in system
P4	→	30	… Cells capacity
P21	→	30	… Charge fuse
P30	→	Current probe 2	… Current probe
P54	→	MNWRPB	… Type of charger

18) Push 'Write settings' in MGM ProTool and restart the BMS (switch BMS OFF and then ON by switch connected to K5)
19) Connect the charger (RS485, Battery connectors, Traction)
20) In case that charger is switched ON, then BMS 16i will be activate as well
21) To be able to see values of the battery on the MGM display, BMS has to be switched ON (by switch K5)

Termination RS485:
Master BMS 16i already includes the termination, but last BMS 16i Slave or charger on the communication line RS485 has to includes the termination as well. In case, that the last device on the line is charger, which is disconnected, then the termination has to be placed in the charger connector.

Termination CAN:
Master BMS 16i already includes the termination, but last device on the communication line CAN has to includes the termination as well.

Remark:
Secure, that the battery will not be discharged / overtemperature / overcurrent, otherwise the battery might be damaged.


Optocom 6i
USB
PC
Battery
MGM
COMPRO
Display
CAN
MGM
COMPRO
HBC Controller
External
supply
5V / 2 A
MGM
COMPRO
Brushless
Motor
KTY81-210
KTY81-210
K9
K11
K8
K7
K15
K14
K5
K4
K1
BMS 16i
UB
U16
U15
U14
U13
U12
U11
U10
U9
U8
U7
U6
U5
U4
U3
U2
U1
U0
14S
13S
12S
11S
10S
9S
8S
7S
6S
5S
4S
3S
2S
1S
ON / OFF
Switch
RS485
MGM
COMPRO
Charger
110V / 230V / 400 V

2) BMS 16i Master + Slave

An example of the setup

Number of cells (Serial)	28S20P
Type of the cell	Li-Ion, 3 Ah
Battery capacity	60Ah
Voltage of bettery	max. 117.6 V (28 x max. 4.2 V)
Number / Type of BMSes	2 (Master & Slave - with the HCBAL8s and with FANs)
Current probe	HAL 400
Charger	MGM Compro battery charger (AX)

Remarks:

- **Be careful during the soldering, the reversal of the battery poles is very dangerous.**
- **Is recommended to do wiring of the system at first, after correct connection of the system, connect traction batteries.**
- **In case of any doubts related to connection, please contact MGM Compro.**

Follow the steps :

1) Solder each serial cell of the battery from the "–" pole of the battery up to the highest cell of the battery ("+" pole of the battery). Recommendation is to devide the serial cells in best case 50:50 to Master and Slave to balance similar amount of serial battery cells (make connection for Master (K14, K15) from U0 (Master) -> 1S ("-" pole) up to U14 (Master) together with UB (Master) -> 14S ("+" pole), and then make connection for Slave (K14, K15) from U0 (Slave) -> 14S ("+" pole) up to U14 (Slave) together with UB (Slave) -> 28S ("+" pole))
2) Connect ON/OFF SWITCH to the BMS MASTER connector K5 (SWITCH OFF)
3) Connect temperature sensors to the BMS connector K7 (Environment temperature sensors) and K8 (Battery temperature sensors → min. 1x / max. 3 each BMS 16i)
4) Connect HALL current probe to connector K3
5) Connect CAN and BMS 16i (Master) to connector K9
6) Connect K14 and then K15 to BMS 16i (Master)
7) Connect K14 and then K15 to BMS 16i (Slave)
8) Connect Master and Slave BMS 16i by RS485 cable (connectors K1)
9) Connect antispark and ESC (**follow the ESC user instruction**) and charger
10) Switch ON the switch K5 on the master BMS 16i (red LED is flashing on BMS 16i)
11) Download the MGM ProTool (web link)
12) Instal the MGM ProTool
13) Open MGMProtool
14) Connect the OPTOCOM6i with BMS 16i (connector K11) and with the PC (via USB) // OPTOCOMs green and red LEDs are flashing and yellow LED is ON
15) Make an update to the latest version of the MGM ProTool
16) Make an update to the latest version of the BMS 16i firmware
17) Load default settings
18) Set the correct parameters : MASTER

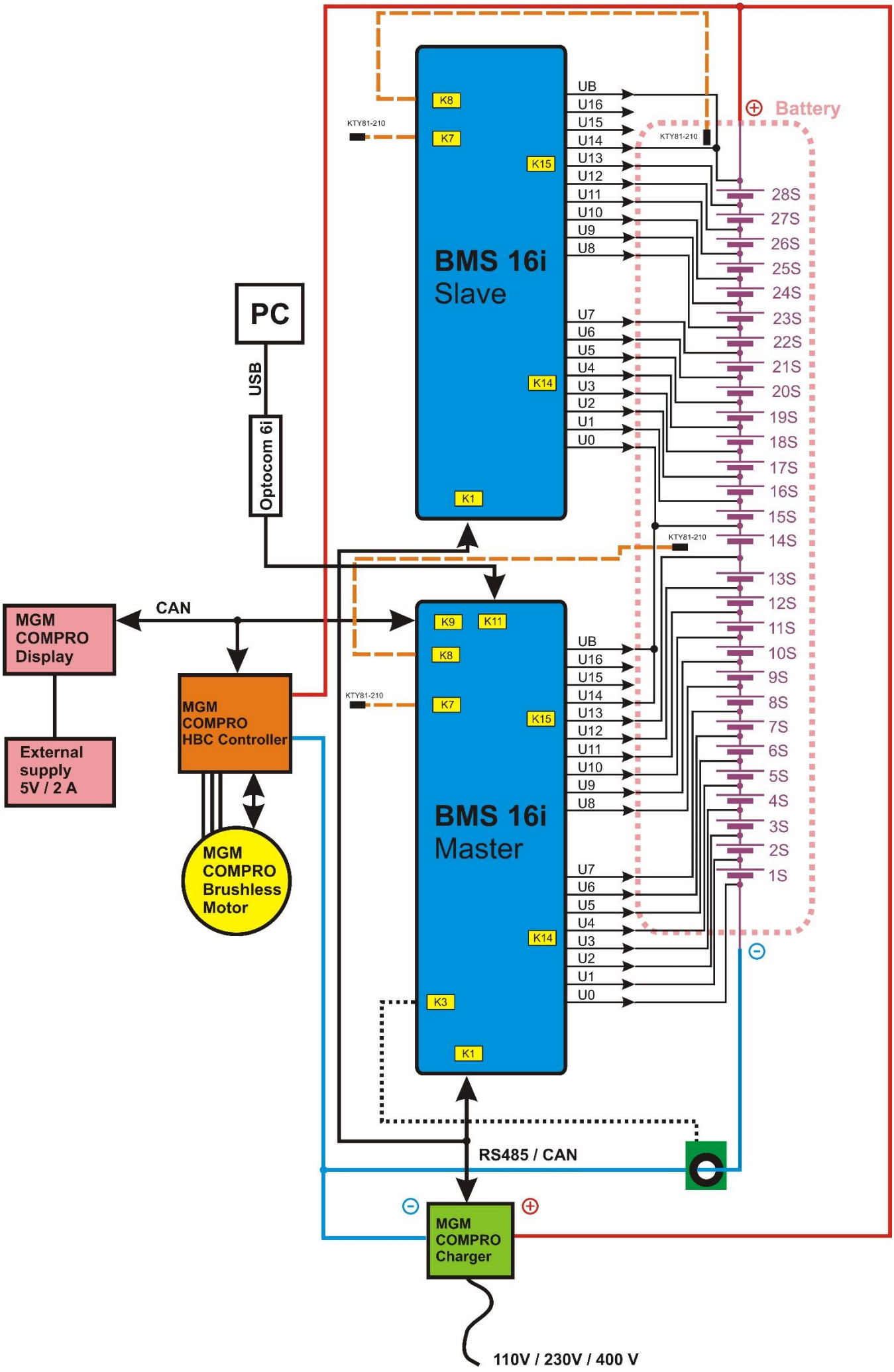
P0	→	14	… Numbers of cells
P1	→	2	… Numbers of system modules
P2	→	28	… Total cells in system
P4	→	60	… Cells capacity
P21	→	30	… Charge fuse
P54	→	AX	… Type of charger

22) Push 'Write settings' in MGM ProTool and restart the BMS (switch BMS OFF and then ON by switch connected to K5)
23) Connect the charger (RS485, Battery connectors, Traction)
24) In case that charger is switched ON, then BMS 16i will be activate as well
25) To be able to see values of the battery on the MGM display, BMS has to be scwitched ON (by switch K5)

Termination RS485:
Master BMS 16i already includes the termination, but last BMS 16i Slave or charger on the communication line RS485 has to includes the termination as well. In case, that the last device on the line is charger, which is disconnected, then the termination has to be placed in the charger connector.

Termination CAN:
Master BMS 16i already includes the termination, but last device on the communication line CAN has to includes the termination as well.

Remark:
Secure, that the battery will not be discharged / overtemperature / overcurrent, otherwise the battery might be damaged.


PC
USB
Optocom 6i
CAN
MGM COMPRO Display
External supply 5V / 2 A
MGM COMPRO HBC Controller
MGM COMPRO Brushless Motor
BMS 16i Slave
BMS 16i Master
K8
K7
K15
K14
K1
K9
K11
K3
KTY81-210
UB
U16
U15
U14
U13
U12
U11
U10
U9
U8
U7
U6
U5
U4
U3
U2
U1
U0
Battery
28S
27S
26S
25S
24S
23S
22S
21S
20S
19S
18S
17S
16S
15S
14S
13S
12S
11S
10S
9S
8S
7S
6S
5S
4S
3S
2S
1S
RS485 / CAN
MGM COMPRO Charger
110V / 230V / 400 V

Product warranty

MGM COMPRO guarantees, this product to be free from factory defects in material and workmanship. Warranty period is of 24 months from date of purchase and purchase within the EU. Warranty for purchases made outside the EU is inline with the respective legal regulations. Warranty liability shall be limited to repairing or replacing the unit to our original specifications.

The warranty may be claimed under the following conditions:
The product has been used in the coherence with the instructions for use and only for purposes stated in the instructions and provided that none of the conditions for which the warranty cannot be claimed (see below) occurred.

It is necessary to provide together with the product for repair:
- a copy of sales receipt (if a warranty repair is claimed)
- detailed description of the problem – how it occurred and what is the problem
- description of the problem, as manifested and under what conditions it happened (number of cells, type cells, capacity, …. etc.)
- your phone number and/or email address in order to allow further consultations regarding the problem

.
The warranty does not cover and therefore cannot be claimed for damages/destroys cause by:
- forced mechanical damage, crash, etc.
- chemical substances
- unqualified manipulation, incorrect installation
- any interference with the equipment (soldering, change of wires, change components, exposed circuit board etc.)
- reversal of poles
- overloading with a higher number of cells than specified
- feeding from unspecified source (e.g. mains source instead of the specified cells)
- shortcut on the output
- overload
- water or any other substances
- salt water
- operations with not recommended (not suitable) connectors
- not following the instruction in the manual or operating in conflict with recommendations or manual

The warranty also does not apply when:
- the controller or its parts are worn by regular use
- acts of God (e.g. strike by lightening)

We do reserve the right to change our product warranty at any time without prior notice.

Service and Technical Support

Send product for service to address: **MGM COMPRO s. r. o., Ruzova 307, 760 01 Zlin, Czech republic**

Call your questions and requests to: **+420 577 001 350** or write on: info@mgm-compro.com

Information about products, technical notes, news, recommendation: www.mgm-compro.com

Update firmware and SW on: www.mgm-compro.com

Recycling

This symbol on the product and / or accompanying documents mean that used electrical and electronic products should not be mixed with general household waste.
For proper treatment, recovery and recycling, please take these products to designated collection points, where they will be accepted on a free of charge basis.

Electromagnetic Conformity declaration

CE

For these products of the BMS family we confirm that the electromagnetic compatibility directives are met.

RoHS

For these products of the BMS family we confirm, that products are RoHS compliant.

Appendix

CAN bus default settings

- CAN PACKET PERIOD approx 1000 mS
- CAN PACKET SPACING approx 10 mS
- CAN_ADRESS 0x0010h (default value, depend on settings BMS)
  Standard address = CAN_ADRESS + x;
  Extended address = 0x14A20101 + CAN_ADRESS + x
- COMMUNICATION_SPEED 250Kb (default, depend on settings BMS)
  1 - 1Mb, 2 - 500Kb, 3 - 250Kb, 4 - 125Kb
- CAN_MODE CAN_MODE_A = Standard address
  CAN_MODE_B = Extended address (default)

Send packets:

Packet 0
Address : std: (CAN_ADRESS + 0x0h) = 0x0010h
ext: (0x14A20101h + CAN_ADRESS + 0x0h) = 0x14A20111h

D0 : Status Bit 0 - Reserved
Bit 1 - Reserved
Bit 2 - RUNNING BMS 16i is running
Bit 3 - DISCHARGING Discharging is allowed
Bit 4 - CHARGING Charging is allowed
Bit 5 - BALANCING Balancing is running
Bit 6 – WARNING Warning status is broadcasted
Bit 7 – ERROR Error status is broadcasted
D1 : Error Bit 0 – Selftest Error during the selftest
Bit 1 – Overcharged Overcharged battery
Bit 2 - System System error (error of the amount of the battery cells during the communication)
Bit 3 – Cutt off Voltage of the cell is 100 mV less, than the CUTT OFF voltage
Bit 4 - overheat battery Error temperature of the battery
Bit 5 - overheat external Error temperature of the environment
Bit 6 - overheat board Error temperature of the PCBA
Bit 7 – overheat bal. resistor Error temperature of the balancing resistors
D2 : Reserved
D3 : Battery pack total capacity (0 to 100 %)
D4 : Actual current (low byte)
D5 : Actual current (high byte) - range -32768 +32767, value/10 = current[A]) , (Current > 0 - discharging, Current < 0 - charging)
D6 : Total voltage (low byte)
D7 : Total voltage (high byte) - range 0 65535, value/10 = voltage[V]

Packet 1
Address : std: (CAN_ADRESS + 0x1h) = 0x0011h
ext: (0x14A20101h + CAN_ADRESS + 0x1h) = 0x14A20112h

D0 : Lowest voltage of the cell (low byte)
D1 : Lowest voltage of the cell (high byte) - range 0-65535, value/1000 = voltage[V]
D2 : The address of the cell with the lowest voltage
D3 : Highest voltage of the cell (low byte)
D4 : Highest voltage of the cell (high byte) - range 0-65535, value/1000 = voltage[V]
D5 : The address of the cell with the highest voltage
D6 : Reserved
D7 : Reserved

Packet 2
Address : std: (CAN_ADRESS + 0x2h) = 0x0012h
ext: (0x14A20101h + CAN_ADRESS + 0x2h) = 0x14A20113h

D0 : Temperature of the cells (-128 +127 °C.) - signed char
D1 : Reserved
D2 : Reserved
D3 : Temperature of the external sensor (-128 +127 °C.) - signed char
D4 : Reserved
D5 : Reserved
D6 : Temperature of the board (-128 +127 °C.) - signed char
D7 : Reserved

Packet 12
Address : std: (CAN_ADRESS + 0xCh) = 0x001Ch
ext: (0x14A20101h + CAN_ADRESS + 0xCh) = 0x14A2011Dh

D0 : Charger voltage (high byte)
D1 : Charger voltage (low byte), value/10 = voltage[V]
D2 : Charger current (high byte)
D3 : Charger current (low byte), value/10 = current[A]
D4 : Reserved
D5 : Reserved
D6 : Display status
0 – Reserved
1 – Reserved
2 – DISP_CHARGING
3 – DISP_BALANCING
4 – DISP_FULL_CAP
5 – Reserved
6 – DISP_COOLING
7 – DISP_ERROR

D7 : Bit 0 - CHARGED
Bit 1 - COOLING
Bit 2 - CHARGING – HIGH CURRENT
Bit 3 - DISCHARGING
Bit 4 - CHARGING

Bit 5 - BALANCING
Bit 6 - WARNING
Bit 7 – ERROR

Packet 13
Address : std: (CAN_ADRESS + 0xDh) = 0x001Dh
ext: (0x14A20101h + CAN_ADRESS + 0xDh) = 0x14A2011Eh

D0 : System status
D1 : System error
D2 : System warning
D3 : System caution
D4 : Systen staus display
D5 : Systen status charger
D6 : System selftest
D7 : Reserved

Packet 14
Address : std: (CAN_ADRESS + 0xEh) = 0x001Eh
ext: (0x14A20101h + CAN_ADRESS + 0xEh) = 0x14A2011Fh

D0 : Lifecounter>>24 (Highest byte) Lifetime counter [sec]
D1 : Lifecounter>>16
D2 : Lifecounter>>8
D3 : Lifecounter>>0 (Lowest byte)
D4 : Reserved
D5 : Reserved
D6 : Reserved
D7 : Reserved

Packet - CHARGER (Only for YNG charger)

Address : only ext: 0x1806E5F4h
D0 : Charger voltage (high byte)
D1 : Charger voltage (low byte), value/10 = voltage[V]
D2 : Charger current (high byte)
D3 : Charger current (low byte), value/10 = current[A]
D4 : 0 – Charging
1 – Stop Charging
D5 : Reserved
D6 : Reserved
D7 : Reserved

Receive packets:

Packet 0
Address : std:0x0020h (ext: 0x14A30101h)
D0 : Charging voltage
0 – Standard charging voltage
1 – Alternative charging voltage (for storage, transportation)

D1 : Reserved
D2 : Reserved
D3 : Reserved
D4 : Reserved
D5 : Reserved
D6 : Reserved
D7 : Reserved

Packet - CHARGER (Only for YNG charger)

Address : only ext: 0x18FF50E5h
D0 : Charger voltage (high byte)
D1 : Charger voltage (low byte), value/10 = voltage[V]
D2 : Charger current (high byte)
D3 : Charger current (low byte), value/10 = current[A]
D4 : Bit 0 – 0：normal。1：hardware failure
Bit 1 - 0：normal。1：charger High temperature protection
Bit 2 - 0：normal 。1： input voltage error, charger stop working
Bit 3 - 0：charger detect battery voltage into start state 。1 ： turnoff state
Bit 4 - 0：communication normal。1：communication receive time-out
Bit 5 - BALANCING
Bit 6 - WARNING
Bit 7 – ERROR
D5 : Reserved
D6 : Reserved
D7 : Reserved