Innovation in energy storage

Version 1.36 – 07-02-2024

MG Master LV

- Communication guide -

MG Master LV 24-48V / 72-96V

MG Energy Systems B.V.

TABLE OF CONTENTS

1 GENERAL

This communication guide will give insight on the data that is transmitted by the Master LV according to the selected protocol. Required Master LV firmware version is 1.36 or higher.

1.1 Document history

Table 1 - Document history

Rev	Date	Revision author
1.36	2024-02-07	W. Portinga
	Modifications: • Changed MG REGS Periodically/on change settings, see 3.5.2	
1.35	2023-07-14	W. Portinga
	Modifications: • Added bit 29 to System Status external 1, see 3.5.2 • Added bit 27 to System warning external 1, see 3.5.2 • Added bit 6 to System warning external 2, see 3.5.2 • Added bit 20 and 21 to System failure external 1, see 3.5.2	
1.34	2023-06-14	W. Portinga
	Modifications: • Typo fix, kelvin data type from “int16” to “uint16”, see 3.3.3 • Added warning flag to System warning external 2 bit 5, see 3.5.2 • Relocated “Output voltage” from MGREG 3.5 to VREG 3.4 • Typo fix, battery voltage data type from Battery basic info, “uint16” to “int16”, see 4.2 and 5.2	
1.32	2023-01-10	W. Portinga
	Modifications: • Updated status flags VREG 0x2100, see 3.4.2 “Status flags”. • Updated BMS error values VREG 0x2101, see 3.4.2 “BMS error”. • Added PGN information, see 3.3.1 and 3.3.2.	
1.31	2022-10-05	W. Portinga
	Modifications: • Added MG NMEA2000 Protocol • Removed deprecated VE NMEA2000 Protocol. • Added system voltage, status, warning and failure MG registers to 3.5.2	
8	2020-09-07	W. Portinga
	Modifications: • Added General BMS protocol, see 5 “General BMS protocol”.	
7	2020-07-01	W. Portinga
	Modifications: • Typo, name of “DC discharge voltage” and “DC discharge current limitation” swapped, see 3.4.2 “BMS Limits”. • Added status flags VREG 0x2100, bit 13 and 14, see 3.4.2 “Status flags”. • Added BMS error value VREG 0x2101, value 18, see 3.4.2 “BMS error”. • Added setting Bluetooth enable VREG 0x0090, see 3.4.2 “Bluetooth enable”. • Typo, removed “(not implemented yet)” from VREG’s Battery charge voltage, DC charge current limitation, Battery discharge voltage, DC discharge current limitation, see 3.4.2.	

2 COMMUNICATION WITH THE MG MASTER LV

Communication with the MG Master LV can be established via CAN-Bus. In this document there are 3 protocols that are described:

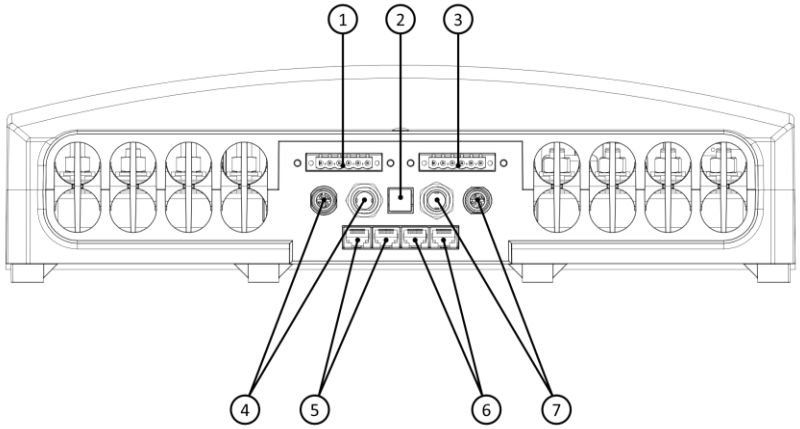
- MG NMEA2000 PROTOCOL;
- SMA PROTOCOL;
- GENERAL BMS PROTOCOL;

Other protocol's that are available on the Master LV are deprecated and no longer supported for new systems designs.

Note:
- Only one protocol can be selected, a combination of SMA with NMEA2000 is not possible.
- General BMS protocol is the SMA protocol with added messages not supported by SMA.

2.1 CAN Interface

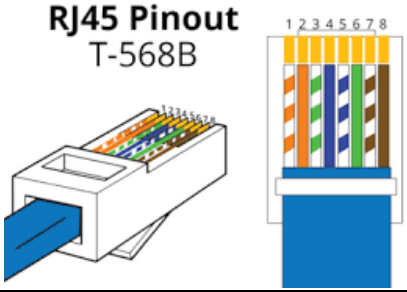
The CAN interface on Master LV is available in two different physical connectors: RJ45 and M12. The location at the Master LV are the two most right side connectors, see image below, number 6 and 7.



2.1.1 RJ45 Connector details

Typical cables that are used for the RJ45 CAN-Bus connections are standard CAT 5 Ethernet network patch cables.

Table 2 – RJ45 connector details

Pin	Description	Connector view
1		
2		
3	GND	
4		
5		
6	V+	
7	CAN-H	
8	CAN-L	

2.1.2 M12 Connector details

The connectors used for connecting the CAN-bus are all of the same type, namely a circular M12 connector with 5 positions and A-coded keying.

Table 3 – Circular M12 connector with 5 positions A-coded details

Pin	Description	Connector view
1	Shield	
2	V+	
3	GND	
4	CAN-H	
5	CAN-L	

Cables to be used for the battery system are typically referred to as NMEA 2000 or DeviceNet compatible cables. The minimum requirements for cables are:

- Twisted pair connected to pins 4 and 5 for communication with a minimum wire cross sectional area of 0.2 mm^2 (24 AWG).
- Pair of conductors connected to pin 2 and 3 for power and HVIL with a minimum wire cross sectional area of 0.34 mm^2 (22 AWG).
- Cable with braided shielding connected to pin 1.

NOTICE:
Do not use sensor/actor cables. They often don't have any twisted pairs and are therefore not suitable for this application.

3 MG NMEA2000 PROTOCOL

There are 3 NMEA2000 protocol options. The MG-NMEA2000 protocol is using a NMEA2000 manufacturer code assigned for “MG energy systems”, recommended for new designs. The VE-NMEA2000 protocols are using a NMEA2000 manufacturer code assigned for “Victron Energy”.

NOTICE:
When Micropower chargers are enabled in the settings, 11-bit CAN messages with ID 0x600 will be added on the NMEA2000 bus. These messages are not explained in this document.

3.1 Interface definition

Speed : 250 kbps
ID : 29-bit CAN 2.0B

3.2 Message definition

NMEA2000 Identifier definition.

<3-bits priority><1-bit reserved><1-bit datapage>< 16-bits PGN >< 8-bit source address >
As described in the list below a PGN consists of datapage + PGN. For example 0x1F214 means:
Datapage = 1
PGN = 0XF214

3.3 PGN list

Table 4 - PGN list

Data	PGN Name	PGN dec	PGN hex	Field	Remarks
	ISO Address Claim	060928	0xEE00		
	Product information	126996	0x1F014		
Battery pack voltage	Battery Status	127508	0x1F214	2	Battery instance 0
Battery pack current	Battery Status	127508	0x1F214	3	Battery instance 0
Battery pack highest temperature	Battery Status	127508	0x1F214	4	Battery instance 0
State-Of-Charge (SOC)	DC detailed status	127506	0x1F212	4	DC instance 0
Time-To-Go (TTG)	DC detailed status	127506	0x1F212	6	DC instance 0
Lowest cell voltage in pack	Battery Status	127508	0x1F214	2	Battery instance 1
Lowest cell temperature in pack	Battery Status	127508	0x1F214	4	Battery instance 1
Highest cell voltage in pack	Battery Status	127508	0x1F214	2	Battery instance 2
Highest cell temperature in pack	Battery Status	127508	0x1F214	4	Battery instance 2

Notes:

- Battery instance 0 and DC Instance 0 are the same;
- One or more MG Lithium-Ion batteries together in one system are a Battery pack;
- The DC detailed status is a NMEA2000 fast packet;
- The default source address of the MG Master HV is 0x50;
- PGN name BATTERY_BANK is also named BATTERY_STATUS.

The Data instance from PGN: 127508 BATTERY_BANK or PGN: 127506 DC_DETAILED can be changed by steps of 32 -> 0, 32, 64, 96, 128. If data instance from BATTERY_BANK is changed, also data instance of DC_DETAILED will change, vice versa. Data instance from BATTERY_BANK_MIN, BATTERY_BANK_MAX are increased with the data instance from BATTERY_BANK.

Table 5 - Data instance from PGN's

BATTERY_BANK DC_DETAILED	BATTERY_BANK_MIN	BATTERY_BANK_MAX
0	1	2
32	33	34
64	65	66
...	...	...
224	225	226

- Data instance is stored, if during boot data instance is invalid, it will be restored to 0.
- DeviceInstance can be changed and is stored.
- DeviceFunctionInstance can be changed and is stored.
- Device Class Instance can be changed and is stored.

3.3.1 PGN: ISO Address Claim, 060928 (0xEE00)

NMEA2000 manufacturer code for MG Energy Systems B.V. is 1160

Unique Number (ISO Identity Number): unique number subtracted from serial number.
Manufacturer Code (industry marine + manufacturer code): 0x9C88
Device Instance Lower (ISO ECU Instance): 0
Device Instance Upper (ISO Function Instance): 0
Device Function (ISO Function): 170
Device Class: 35
System Instance (ISO Device Class Instance): 0 ->(ISO Function Instance)
Industry Group: 4 (Marine)
NMEA Reserved (ISO Self Configurable): 1

3.3.2 PGN: Product information, 126996 (0x1F014)

NMEA Network Message Database Version: 1301
NMEA Manufacturer's Product Code: 0xFFFF
Manufacturer's Model ID: String containing device name, example MG BMS 24-48V/600A
Manufacturer's Software Version Code: String containing software version
Manufacturer's Model Version: String containing hardware version
Manufacturer's Model Serial Code: MGE(SerialNumber)
NMEA 2000 Certification Level: 1
Load Equivalency: 1

3.3.3 PGN: Battery Status, 127508 (0x1F214)

There are three battery status messages that are separated by the "Battery Instance".

3.3.3.1 Battery Instance "0"

0x1F214 - Battery Status			
Periodicity: Priority Default: Format: Single Frame:		1500 milliseconds 6 Little Endian/Intel convention Yes	
1	Byte 0	**Battery Instance = 0**.	
		Data Length: Unit: Resolution: Range:	8 bit, uint8 Generic numeric ID, short 1 bit 0 to 252
2	Byte 1 Byte 2	Battery Voltage DC.	
		Data Length: Unit: Resolution: Range:	16 bit, int16 Voltage, DC 0.01 V +/- 327.64 V
3	Byte 3 Byte 4	Battery Current, + = battery is charged, - = battery is discharged.	
		Data Length: Unit: Resolution: Range:	16 bit, int16 Current, Electric 0.1 A +/- 3276.4 A
4	Byte 5 Byte 6	Highest Battery Temperature	
		Data Length: Unit: Resolution: Range:	16 bit, uint16 Generic Temperature, Kelvin 0.01 K 0 to 655.32 deg K
5	Byte 7	Sequence ID, an upward counting number used to tie related information together between different PGNs.	
		Data Length: Unit: Resolution: Range:	8 bit, uint8 Sequence ID, short 1 bit 0 to 252

3.3.3.2 Battery Instance "1"

0x1F214 - Battery Status Lowest Value's			
Periodicity: Priority Default: Format: Single Frame:		1500 milliseconds 6 Little Endian/Intel convention Yes	
1	Byte 0	**Battery Instance = 1.**	
		Data Length: Unit: Resolution: Range:	8 bit, uint8 Generic numeric ID, short 1 bit 0 to 252
2	Byte 1 Byte 2	Lowest cell voltage in pack	
		Data Length: Unit:	16 bit, int16 Voltage, DC

		Resolution: Range:	0.01 V +/- 327.64 V
3	Byte 3 Byte 4	not implemented (0x7FFF)	
		Data Length: Unit: Resolution: Range:	16 bit, int16 - - -
4	Byte 5 Byte 6	Lowest cell temperature in pack	
		Data Length: Unit: Resolution: Range:	16 bit, uint16 Generic Temperature, Kelvin 0.01 K 0 to 655.32 deg K
5	Byte 7	Sequence ID, an upward counting number used to tie related information together between different PGNs.	
		Data Length: Unit: Resolution: Range:	8 bit, uint8 Sequence ID, short 1 bit 0 to 252

3.3.3.3 Battery Instance "2"

0x1F214 - Battery Status Highest Value's			
Periodicity: Priority Default: Format: Single Frame:		1500 milliseconds 6 Little Endian/Intel convention Yes	
1	Byte 0	**Battery Instance = 2.**	
		Data Length: Unit: Resolution: Range:	8 bit, uint8 Generic numeric ID, short 1 bit 0 to 252
2	Byte 1 Byte 2	Highest cell voltage in pack	
		Data Length: Unit: Resolution: Range:	16 bit, int16 Voltage, DC 0.01 V +/- 327.64 V
3	Byte 3 Byte 4	not implemented (0x7FFF)	
		Data Length: Unit: Resolution: Range:	16 bit, int16 - - -
4	Byte 5 Byte 6	Highest cell temperature in pack	
		Data Length: Unit: Resolution: Range:	16 bit, uint16 Generic Temperature, Kelvin 0.01 K 0 to 655.32 deg K
5	Byte 7	Sequence ID, an upward counting number used to tie related information together between different PGNs.	
		Data Length: Unit:	8 bit, uint8 Sequence ID, short

		Resolution: Range:	1 bit 0 to 252

3.3.4 PGN: DC Detailed Status, 127506 (0x1F212)

0x1F212 -DC Detailed Status			
Periodicity: Priority Default: Format: Single Frame:		1500 milliseconds 6 Little Endian/Intel convention No (fast packet)	
1	Byte 0	Sequence ID, an upward counting number used to tie related information together between different PGNs.	
		Data Length: Unit: Resolution: Range:	8 bit, uint8 Sequence ID, short 1 bit 0 to 252
2	Byte 1	DC Instance.	
		Data Length: Unit: Resolution: Range:	8 bit, uint8 Generic numeric ID, short 1 bit 0 to 252
3	Byte 2	DC Type	
		Data Length: Unit: Resolution: Range:	8 bit, int8 - 1 bit Variable
		0x00 = Battery, 0x01 = Alternator, 0x02 = Convertor, 0x03 = Solar Cell, 0x04 = Wind Generator, 0x05 … 0xFD = Reserved, 0xFE = Error, 0xFF = Data Not Available	
4	Byte 3	State-Of-Charge	
		Data Length: Unit: Resolution: Range:	8 bit, uint8 Generic Absolute Percentage 0-252% 1 % 0 to 252 %
5	Byte 4	State-Of-Health	
		Data Length: Unit: Resolution: Range:	8 bit, uint8 Generic Absolute Percentage 0-252% 1 % 0 to 252 %
6	Byte 5 Byte 6	Time remaining	
		Data Length: Unit: Resolution: Range:	16 bit, uint16 Time 1 minute 0 to 65532 minutes

7	Byte 7 Byte 8	Ripple voltage (not implemented)	
		Data Length: Unit: Resolution: Range:	16 bit, uint16 AC ripple voltage 1 mV 0 to 65532 mV
8	Byte 9 Byte 10	Amp hours	
		Data Length: Unit: Resolution: Range:	16 bit, uint16 Battery capacity 1 Ah 0 to 65532 Ah

The DC detailed status is actually two messages that are combined as one.

NOTE: The DC detailed message is a NMEA2000 fast packet. This means that it has a little protocol overhead.

The message consists out of 2 messages.

Table 6 - DC detailed fast packet

Message	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
1	b0 to b4 = 00000 b4 to b7 = 3-bit Sequence counter	Total number of data bytes. For this PGN it is 0x0B.	SID	DC Instance	DC type	SOC	SOH (=0xFF)	Time remaining byte 0
2	b0 to b4 = frame counter b4 to b7 = 3-bit Sequence counter	Time remaining byte 1	0XFF	0XFF	Amp hours byte 0	Amp hours byte 1	0XFF	0XFF

= DC Detailed Status PGN

3.4 Victron VREGS

3.4.1 Message definition

CAN-ID : 1CEF <target address><source address>
Example : 1CEF5030 means source address 0x30 end target address 0x50

0xFF as target address means broadcast message. Every node will receive this message.

All fields are sent in Little Endian order. Message data of a VREG looks like the following:

Table 7 - VREG message data

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x66	0x99	regId.L	regId.H	Data	Data	Data	Data

3.4.2 VREG ID List

If “periodically” is “Yes” the VREG is broadcasted with an interval of 5 seconds. If “on change” is “yes” the VREG will be broadcasted directly if the value has been changed. The “on change” condition can have a maximum delay of 1 second.

Description	VREG ID	Period-ically/on Change	Comments
Device			
Product ID	0x0100	No/No	Lynx Ion BMS General = 0xA390 Lynx Ion BMS 150A = 0xA391 Lynx Ion BMS 400A = 0xA392 Lynx Ion BMS 600A = 0xA393 Lynx Ion BMS 1000A = 0xA394 MG BMS 24-96V General = 0xB0C0 MG BMS 24-48V/150A = 0xB0C1 MG BMS 24-48V/400A = 0xB0C2 MG BMS 24-48V/600A = 0xB0C3 MG BMS 24-48V/1000A = 0xB0C4 MG BMS 72V/400A = 0xB0C5 MG BMS 96V/600A = 0xB0C6 MG BMS 72-96V/500A = 0xB0C7
Firmware version	0x0102	No/No	un8 = Identifier : un24 = Firmware Version, 0xFFFFFF = no firmware present, Firmware version: 0x123456=v12.34.56
Serial number	0x010A	No/No	stringZeroEnded[32] = Serial : un8 = padding, 0 = zero padding (not implemented)
Model name	0x010B	No/No	stringZeroEnded[64] = Model : un8 = padding, 0 = zero padding (not implemented)
BMS Status values			
Voltage	0xED8D	Yes/No	sn16 = DC Channel 1 Voltage [0.01V], 0x7FFF = Not Available
Current	0xED8F	Yes/No	sn16 = DC Channel 1 Current [0.1A], 0x7FFF = Not Available
Cell Volt. max/min	0x0385	Yes/No	un16 = Minimum voltage [0.01V] : un16 = Maximumvoltage [0.01V]

Description	VREG ID	Period-ically/on Change	Comments
Cell Temperature max/min	0x0386	Yes/No	un16 = Minimum temperature [0.01K] : un16 =Maximum temperature [0.01K]
State-of-Charge	0x0FFF	Yes/Yes	un16 = SOC [0.01%]
Time-to-go	0x0FFE	No/No	un16 = Time to go [1minutes], 0xFFFF = not available
Consumed Ah	0xEEFF	No/No	sn32 = Consumed Ah [0.1Ah]
Last error 1-4	0x2110	No/Yes	un8 = Error 1, Last error : un8 = Error 2 : un8 = Error 3 : un8 = Error 4, Oldest error
Last error 1 time	0x2111	No/Yes	un32 = BMS: UTC time of last error 1
Last error 2 time	0x2112	No/Yes	un32 = BMS: UTC time of last error 2
Last error 3 time	0x2113	No/Yes	un32 = BMS: UTC time of last error 3
Last error 4 time	0x2114	No/Yes	un32 = BMS: UTC time of last error 4
Status flags	0x2100	No/Yes	un32 = BMS page BMV flags (bit flags) bit 0 = Charged bit 1 = Almost charged bit 2 = Discharged bit 3 = Almost discharged bit 4 = Charging bit 5 = Discharging bit 6 = Balancing in progress bit 7 = Main safety contactor closed bit 8 = Main safety contactor closed bit 9 = Alarm over voltage bit 10 = Warning over voltage bit 11 = Alarm under voltage bit 12 = Warning under voltage bit 13 = Warning high charge current bit 14 = Warning high discharge current bit 15 = Alarm over temperature bit 16 = Warning over temperature bit 17 = Warning under temperature charge bit 18 = Alarm under temperature charge bit 19 = Warning under temperature discharge bit 20 = Alarm under temperature discharge bit 21 = Low SOC (< 20%) bit 22 = Alarm under temperature bit 23 = Alarm short circuit (not implemented) bit 24 = Alarm hardware failure bit 25 = Allowed to charge bit 26 = Allowed to discharge bit 27 = Pre-alarm (not implemented) bit 28 = Warning bad contactor (not implemented)

Description	VREG ID	Period-ically/on Change	Comments
			bit 29 = Alarm high current bit 30 = Warning cell imbalance bit 31 = Warning service requested
BMS State	0x0371	No/Yes	un8 =BMS state (Value) 0-8= Initializing 9 = Running 10= Error 12 = Shutting down 13 = Updating battery firmware 14 = Standby 15 = Going to running state 16 = Pre-charging
BMS Error	0x2101	No/Yes	un8 = BMS error (Value) 0 = No error, system OK 2 = No batteries found 4 = Batteries connected are not the same type 5 = Number of batteries connected incorrect 7 = Measure error 11 = Hardware failure 12 = Watchdog error 13 = Over voltage detected 14 = Under voltage detected 15 = Over temperature detected 16 = Under temperature detected 18 = Battery protection automatic shutdown 23 = BMS slave failure 25 = Pre-charge failure 26 = Contactor failure 27 = Over current 28 = Slave update failure 29 = Slave update unavailable 35 = Pre-charge timeout 37 = Interlock 38 = Emergency stop 39 = Communication timeout 41 = Terminal over temperature
Programmable relay state	0x034E	No/Yes	un8 = programmable relay state, 0 = open, 1 = closed.
System configuration			
Battery installed capacity	0x1000	No/Yes	un16 = Battery capacity [Ah]

Description	VREG ID	Period-ically/on Change	Comments
Battery installed configuration	0x0380	No/Yes	un8 = Number of batteries : un8 = Cells per battery : un8= Number of batteries in parallel : un8 =Number of batteries in series
History values			
Deepest discharge	0x0300	No/No	sn32 = Deepest discharge [0.1Ah]
Total Ah drawn	0x0305	No/No	sn32 = Cumulative Ah drawn from the battery [0.1Ah]
Minimum voltage	0x0306	No/No	sn32 = Minimum battery voltage [0.01V]
Maximum voltage	0x0307	No/No	sn32 = Maximum battery voltage [0.01V]
Automatic syncs	0x0309	No/No	sn32 = Number of automatic synchronizations
Discharged energy	0x0310	No/No	un32 = The amount of energy drawn from the source [0.01kWh]
Charged energy	0x0311	No/No	un32 = The amount of energy put into the source [0.01kWh]
Maximum temperature	0x0312	No/No	un16 = The maximum temperature [0.01K]
Minimum temperature	0x0313	No/No	un16 = The minimum temperature [0.01K]
Min/Max cell voltage	0x0384	No/No	un16 = Minimum voltage [0.01V] : un16 = Maximum voltage [0.01V]
BMS Limits			
Battery charge voltage	0x0390	Yes/Yes	un32 = Charge voltage [0.01V], 0xFFFFFFFF = Not Available
DC charge current limitation	0x0391	Yes/Yes	un32 = Charge current [0.1A], 0xFFFFFFFF = Not Available
DC discharge voltage	0x0392	Yes/Yes	un32 = Discharge voltage [0.01V] , 0xFFFFFFFF = Not Available
Battery discharge current limitation	0x0393	Yes/Yes	un32 = Discharge current [0.1A] , 0xFFFFFFFF = Not Available
Charger link percentage	0x2014	Yes/Yes	un8 = Percentage [1%], 0xFF = Not Available, valid range 0 till 100
Charger link current limit	0x2015	Yes/Yes	un16 = Link Charge Current Limit [0.1A], 0xFFFF =Not Available
Settings	This VREG's can be read and written.		
Synchronize group number	0x0374	No / Yes	Un8 = group, 0 = Disabled, 1-3 = Enabled. Used to synchronize multiple BMSS in parallel that are set to this group number.

Description	VREG ID	Period-ically/on Change	Comments
Battery strategy	0x0376	No / Yes	Un8 = Battery strategy, 0 = Default, 1 = Performance.
Combined BMS	0x0377	No / Yes	Un8 = Combined BMS, 0 = Disabled, 1 = Enabled.
Re-start request	0x0379	No / Yes	Un8 = Restart request, 0 = Disabled, 1 = Enabled, BMS will shut down and startup again.
Number of batteries in parallel	0x0387	No / Yes	Un8 = batteries parallel, 0 = automatically detected, 1-96 = Number of batteries connected to BMS in parallel.
Number of batteries in series	0x0388	No / Yes	Un8 = batteries series, 0 = automatically detected, 1-96 = Number of batteries connected to BMS in series.
	Read 0xFF = Not available (System is in error state)		
Control	This VREG's can be read and written.		

Combined control State	0x0378	No / Yes	Un8 = Combined BMS state: Un8 = address:
			
			// Combined BMS state:
			WAITING_FOR_USER = 0x00
			PRECHARGING = 0x01
			OPERATING = 0x02
			RECEIVED_SWITCH_START_COMMAND = 0x10
			RECEIVED_CANBUS_START_COMMAND = 0x11
			
			When master BMS is transmitting a received start command, other master will go into interrupted state and for 5 seconds they will not accept any command.

Output Voltage	0x037A	Yes/No	Un32 = Voltage [0.01V], 0xFFFFFFFF = Output not active.

3.4.3 Examples

Request (0x0001) for Firmware Version (0x0102) of node at address 0x50 from address 0x20:

CAN-ID	Data
0x1CEF5020	0x66 0x99 0x01 0x00 0x02 0x01 0xFF 0xFF

Reply (is always broadcast) firmware version 1.04:

CAN-ID	Data
0x1CEFFF50	0x66 0x99 0x02 0x01 0x00 0x00 0x04 0x01

If the request was not supported for this register, the reply will be an ACK (0x0002) with code 0x8000, invalid request:

CAN-ID	Data
0x1CEF2050	0x66 0x99 0x02 0x00 0x02 0x01 0x00 0x80

3.5 MG energy systems REGS

3.5.1 Message definition

CAN-ID : 1CEF <target address><source address>
Example : 1CEF5030 means source address 0x30 end target address 0x50

0xFF as target address means broadcast message. Every node will receive this message.

All fields are sent in Little Endian order. Message data of a MGREG looks like the following:

Table 8 - MGREG message data

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x88	0x9C	regId.L	regId.H	Data	Data	Data	Data

3.5.2 MGREG ID List

Description	MGREG ID	Period-ically/on Change	Comments
System Voltage	0x48EE	250ms/No	Sn32 = Voltage [0.001V], 0x80000000 = Not Available.
System Status external 1	0x2140	250ms/Yes	un32 = Status 1 flags (bit flags) Bit 0 = Initializing, Bit 1 = Operational (ready to active DC-bus connection), Bit 2 = DC-bus connected, Bit 3 = Warning, Bit 4 = Failure, Bit 5 = Updating batteries, Bit 6 = Requested for system reset, Bit 7 = Input 1 state, Bit 8 = Input 2 state, Bit 9 = Input 3 state, Bit 10 = Programmable relay active, ... Bit 14 = Contactor close request by user, Bit 15 = Contactor is going to be opened, Bit 16 = DC-Bus Pre-Charging, Bit 17 = Charged, Bit 18 = Discharged, Bit 19 = Cell balancing, Bit 20 = Almost charged, Bit 21 = Almost discharged, Bit 22 = Charging allowed, Bit 23 = Discharging allowed , Bit 24 = Charging over temperature alert, Bit 25 = Discharging over temperature alert, Bit 26 = Charging under temperature alert, Bit 27 = Discharging under temperature alert, Bit 28 = battery power terminal over temperature alert, Bit 29 = battery contactor over temperature alert

Description	MGREG ID	Period-ically/on Change	Comments
System Status external 2	0x2141	250ms/Yes	un32 = Status 2 flags (bit flags) Bit 0 = Combined standby, Bit 1 = Combined monitoring for equal battery-to-system voltage, Bit 2 = Service mode
System warning external 1	0x2142	5 sec./Yes	un32 = Warning 1 flags (bit flags) Bit 0 = Battery cell voltage too high, Bit 1 = Redundancy Unit battery voltage too high, Bit 2 = Battery cell voltage too low, Bit 3 = Redundancy Unit battery voltage too low, Bit 4 = Battery cell temperature too high for charging, Bit 5 = Battery cell temperature too high for discharging, Bit 6 = Redundancy Unit battery temperature too high, Bit 7 = Battery cell temperature too low for charging, Bit 8 = Battery cell temperature too low for discharging, Bit 9 = Redundancy Unit battery temperature too low, Bit 10 = Private CAN-bus communication timeout, Bit 11 = Public CAN-bus communication timeout, Bit 12 = Internal 12V power supply stability problem, Bit 13 = External 24V power supply stability problem, Bit 14 = Hardware failure, Bit 15 = Service request, Bit 16 = Battery terminal temperature too high, Bit 17 = Redundancy Unit minus terminal temperature too high, Bit 18 = Redundancy Unit plus terminal temperature too high, Bit 19 = Master internal temperature too high, Bit 20[a] = Input 1, Bit 21[a] = Input 2, Bit 22[a] = Input 3, Bit 23 = Battery humidity high, Bit 24 = Private CAN-bus protocol violated, Bit 25 = Pre-charge fuse broken, Bit 26 = Fuse broken, Bit 27 = Battery contactor temperature too high. [a]) Only present when configured.
System warning external 2	0x2143	5 sec./Yes	un32 = Warning 2 flags (bit flags) Bit 0 = Battery cell voltages deviation detected, Bit 1 = Battery cell temperatures deviation detected, … Bit 3 = Charge current too high, Bit 4 = Discharge current too high, Bit 5 = Battery leakage detected, Bit 6 = Master current overload.

Description	MGREG ID	Period-ically/on Change	Comments
System failure external 1	0x2144	5 sec./Yes	un32 = Failure 1 flags (bit flags) Bit 0 = Battery cell voltage too high, Bit 1 = Redundancy Unit battery voltage too high, Bit 2 = Battery cell voltage too low, Bit 3 = Second stage protection battery voltage too low, Bit 4 = Battery cell temperature too high for charging, Bit 5 = Battery cell temperature too high for discharging, Bit 6 = Second stage protection battery temperature too high, Bit 7 = Battery cell temperature too low for charging, Bit 8 = Battery cell temperature too low for discharging, Bit 9 = Redundancy Unit battery temperature too low, Bit 10 = Private CAN-bus communication timeout, Bit 11 = Public CAN-bus communication timeout, Bit 12 = Internal 12V power supply stability problem, Bit 13 = External 24V power supply stability problem, Bit 14 = Hardware failure, … Bit 16 = Battery terminal temperature too high, Bit 17 = Redundancy Unit minus terminal temperature too high, Bit 18 = Redundancy Unit plus terminal temperature too high, Bit 19 = Battery redundancy unit interrupted the interlock, Bit 20 = Battery over current, Bit 21 = Battery contactor temperature too high.
System failure external 2	0x2145	5 sec./Yes	un32 = Failure 2 flags (bit flags) Bit 0 = Pre-Charging critical overload detected, Bit 1 = Pre-Charging took too long, Bit 2 = Contactor minus welding, Bit 3 = Contactor plus welding, Bit 4 = Contactor minus failure detected, Bit 5 = Contactor plus failure detected, Bit 6 = High voltage interlock circuits, Bit 7 = E-Stop shutdown, Bit 8 = Battery initializing, Bit 9 = Battery updating, Bit 10 = Current sensor failure, Bit 11 = Initialization.

4 SMA PROTOCOL

The SMA protocol will only support 48V systems based on the specifications of the Sunny Island 6.0H. Invalid value of a un16 is marked with 0xFFFF and a sn16 with 0x8000.

4.1 Interface definition

Speed : 500 kbps

ID : 11-bit CAN 2.0A

4.2 Message definition

BMS Limits				Dir	Interval	
	CAN-ID 0x351			Tx	500 ms	
			Name	**Type**	**Res.**	**Length**
	Byte 0	Low	Battery charge voltage	un16	0,1V	16 bits
	Byte 1	High				
	Byte 2	Low	DC Charge current limitation	sn16	0,1A	16 bits
	Byte 3	High				
	Byte 4	Low	DC Discharge current limitation	sn16	0,1A	16 bits
	Byte 5	High				
	Byte 6	Low	Battery discharge voltage	un16	0,1V	16 bits
	Byte 7	High				

Battery status				Dir	Interval	
	CAN-ID 0x355			Tx	500 ms	
			Name	**Type**	**Res.**	**Length**
	Byte 0	Low	SOC value	un16	1%	16 bits
	Byte 1	High				
	Byte 2	Low	SOH value	un16	1%	16 bits
	Byte 3	High				
	Byte 4	Low	SOC high resolution	un16	0,01%	16 bits
	Byte 5	High				

Battery basic info				Dir	Interval	
	CAN-ID 0x356			Tx	500 ms	
			Name	**Type**	**Res.**	**Length**
	Byte 0	Low	Battery voltage	sn16	0,01V	16 bits
	Byte 1	High				
	Byte 2	Low	Battery current	sn16	0,1A	16 bits
	Byte 3	High				
	Byte 4	Low	Temperature	sn16	0,1°C	16 bits
	Byte 5	High				

Alarm and warning information				**Dir**	**Interval**	
	CAN-ID 0x35A			Tx	500 ms	
		Bit	**Name**	**Type**	**Res.**	**Length**
Alarms	Byte 0	0	General alarm	Bitfield	1=Alarm raised, 2=Alarm cleared	2 bits
		2	Battery high voltage alarm			2 bits
		4	Battery low voltage alarm			2 bits
		6	Battery high temperature alarm			2 bits
	Byte 1	0	Battery low temperature alarm			2 bits
		2	Battery high temperature charge alarm			2 bits
		4	Battery low temperature charge alarm			2 bits
		6	Battery high current alarm			2 bits
	Byte 2	0	Battery high charge current alarm			2 bits
		2	Contactor alarm			2 bits
		4	Short circuit alarm			2 bits
		6	BMS internal alarm			2 bits
	Byte 3	0	Cell imbalance alarm			2 bits
		2	Reserved			2 bits
		4	Reserved			2 bits
		6	Reserved			2 bits
Warnings	Byte 4	0	General warning	Bitfield	1=Warn. raised, 2=Warn. cleared	2 bits
		2	Battery high voltage warning			2 bits
		4	Battery low voltage warning			2 bits
		6	Battery high temperature warning			2 bits
	Byte 5	0	Battery low temperature warning			2 bits
		2	Battery high temperature charge warning			2 bits
		4	Battery low temperature charge warning			2 bits
		6	Battery high current warning			2 bits
	Byte 6	0	Battery high charge current warning			2 bits
		2	Contactor warning			2 bits
		4	Short circuit warning			2 bits
		6	BMS internal warning			2 bits
	Byte 7	0	Cell imbalance warning			2 bits
		2	Reserved			2 bits
		4	Reserved			2 bits
		6	Reserved			2 bits

Event information				Dir	Interval	
	CAN-ID 0x35B			Tx	500 ms	

		Bit	Name	Type	Res.	Length
Events	Byte 0	0	Start of SOC Recalibration (not used)	Bitfield	1=active	1 bits
		1	Stop of SOC Recalibration (not used)			1 bits
		2	Start of Power limitation (not used)			1 bits
		3	Stop of Power limitation (not used)			1 bits
		4	Preventive battery shutdown			1 bits
		5	reserved			1 bits
		6	reserved			1 bits
		7	reserved			1 bits

Manufacturer name			Dir	Interval	
	CAN-ID 0x35E		Tx	500 ms	

		Name	Type	Res.	Length
	Byte 0	Manufacturer name: “MG-BMS”	Char		
	Byte 1				
	Byte 2				
	Byte 3				
	Byte 4				
	Byte 5				
	Byte 6				
	Byte 7				

System Information				Dir	Interval	
	CAN-ID 0x35F			Tx	500 ms	

			Name	Type	Res.	Length
	Byte 0	Low	Master type ID 0x3A9B -> 15003	un16		16 bits
	Byte 1	High				
	Byte 2	High	Software version (note: MSB first) 0x0118 -> V1.24	un16		16 bits
	Byte 3	Low				
	Byte 4	Low	Total battery capacity Ah	un16	1 Ah	16 bits
	Byte 5	High				
	Byte 6	Low	Master product ID hardware configuration.	un16		16 bits
	Byte 7	High				

5 GENERAL BMS PROTOCOL

The general BMS protocol will support 24 and 48V systems. Invalid value of a un16 is marked with 0xFFFF, sn16 with 0x8000 and a un32 with 0xFFFFFFFF.

5.1 Interface definition

Speed : 500 kbps

ID : 11-bit CAN 2.0A

5.2 Message definition

BMS Limits				Dir	Interval	
	CAN-ID 0x351			Tx	500 ms	
			Name	**Type**	**Res.**	**Length**
	Byte 0	Low	Battery charge voltage	un16	0,1V	16 bits
	Byte 1	High				
	Byte 2	Low	DC Charge current limitation	sn16	0,1A	16 bits
	Byte 3	High				
	Byte 4	Low	DC Discharge current limitation	sn16	0,1A	16 bits
	Byte 5	High				
	Byte 6	Low	Battery discharge voltage	un16	0,1V	16 bits
	Byte 7	High				

Battery status				Dir	Interval	
	CAN-ID 0x355			Tx	500 ms	
			Name	**Type**	**Res.**	**Length**
	Byte 0	Low	SOC value	un16	1%	16 bits
	Byte 1	High				
	Byte 2	Low	SOH value	un16	1%	16 bits
	Byte 3	High				
	Byte 4	Low	SOC high resolution	un16	0,01%	16 bits
	Byte 5	High				

Battery basic info				Dir	Interval	
	CAN-ID 0x356			Tx	500 ms	
			Name	**Type**	**Res.**	**Length**
	Byte 0	Low	Battery voltage	sn16	0,01V	16 bits
	Byte 1	High				
	Byte 2	Low	Battery current	sn16	0,1A	16 bits
	Byte 3	High				
	Byte 4	Low	Temperature	sn16	0,1°C	16 bits
	Byte 5	High				

Alarm and warning information				**Dir**	**Interval**	
	CAN-ID 0x35A			Tx	500 ms	
			Name	**Type**	**Res.**	**Length**
Alarms	Byte 0	0	General alarm	Bitfield	1=Alarm raised, 2=Alarm cleared	2 bits
		2	Battery high voltage alarm			2 bits
		4	Battery low voltage alarm			2 bits
		6	Battery high temperature alarm			2 bits
	Byte 1	0	Battery low temperature alarm			2 bits
		2	Battery high temperature charge alarm			2 bits
		4	Battery low temperature charge alarm			2 bits
		6	Battery high current alarm			2 bits
	Byte 2	0	Battery high charge current alarm			2 bits
		2	Contactor alarm			2 bits
		4	Short circuit alarm			2 bits
		6	BMS internal alarm			2 bits
	Byte 3	0	Cell imbalance alarm			2 bits
		2	Reserved			2 bits
		4	Reserved			2 bits
		6	Reserved			2 bits
Warnings	Byte 4	0	General warning	Bitfield	1=Warn. raised, 2=Warn. cleared	2 bits
		2	Battery high voltage warning			2 bits
		4	Battery low voltage warning			2 bits
		6	Battery high temperature warning			2 bits
	Byte 5	0	Battery low temperature warning			2 bits
		2	Battery high temperature charge warning			2 bits
		4	Battery low temperature charge warning			2 bits
		6	Battery high current warning			2 bits
	Byte 6	0	Battery high charge current warning			2 bits
		2	Contactor warning			2 bits
		4	Short circuit warning			2 bits
		6	BMS internal warning			2 bits
	Byte 7	0	Cell imbalance warning			2 bits
		2	Reserved			2 bits
		4	Reserved			2 bits
		6	Reserved			2 bits

Event information				Dir	Interval	
	CAN-ID 0x35B			Tx	500 ms	

		Bit	Name	Type	Res.	Length
Events	Byte 0	0	Start of SOC Recalibration (not used)	Bitfield	1=active	1 bits
		1	Stop of SOC Recalibration (not used)			1 bits
		2	Start of Power limitation (not used)			1 bits
		3	Stop of Power limitation (not used)			1 bits
		4	Preventive battery shutdown			1 bits
		5	reserved			1 bits
		6	reserved			1 bits
		7	reserved			1 bits

Manufacturer name			Dir	Interval	
	CAN-ID 0x35E		Tx	500 ms	

		Name	Type	Res.	Length
	Byte 0	Manufacturer name: “MG-BMS”	Char		
	Byte 1				
	Byte 2				
	Byte 3				
	Byte 4				
	Byte 5				
	Byte 6				
	Byte 7				

System Information			Dir	Interval	
	CAN-ID 0x35F		Tx	500 ms	

			Name	Type	Res.	Length
	Byte 0	Low	Master type ID 0x3A9B -> 15003	un16		16 bits
	Byte 1	High				
	Byte 2	High	Software version (note: MSB first) 0x0118 -> V1.24	un16		16 bits
	Byte 3	Low				
	Byte 4	Low	Total battery capacity Ah	un16	1 Ah	16 bits
	Byte 5	High				
	Byte 6	Low	Master product ID hardware configuration.	un16		16 bits
	Byte 7	High				

Battery cell info				Dir	Interval	
	CAN-ID 0x373			Tx	500 ms	

			Name	Type	Res.	Length
	Byte 0	Low	Lowest cell voltage	un16	1mV	16 bits
	Byte 1	High				
	Byte 2	Low	Highest cell voltage	un16	1mV	16 bits
	Byte 3	High				
	Byte 4	Low	Lowest cell temperature	un16	1Kelvin	16 bits
	Byte 5	High				
	Byte 6	Low	Highest cell temperature	un16	1Kelvin	16 bits
	Byte 7	High				

Energy charged and discharged				Dir	Interval	
	CAN-ID 0x378			Tx	500 ms	

			Name	Type	Res.	Length
	Byte 0	Low	Energy charged	un32	0,01KWh	32 bits
	Byte 1					
	Byte 2					
	Byte 3	High				
	Byte 4	Low	Energy Discharged	un32	0,01KWh	32 bits
	Byte 5					
	Byte 6					
	Byte 7	High				

Serial number high part				Dir	Interval	
	CAN-ID 0x380			Tx	500 ms	

			Name	Type	Res.	Length
	Byte 0		BMS serial number, first 8 characters.	Char		
	Byte 1					
	Byte 2					
	Byte 3					
	Byte 4					
	Byte 5					
	Byte 6					
	Byte 7					

Serial number low part				**Dir**	**Interval**	
	CAN-ID 0x381			Tx	500 ms	

			Name	**Type**	**Res.**	**Length**
	Byte 0		BMS serial number, last 8 characters.	Char		
	Byte 1					
	Byte 2					
	Byte 3					
	Byte 4					
	Byte 5					
	Byte 6					
	Byte 7					