Innovation in energy storage

Version 1.5 – 15-4-2024

MG SmartLink MX

- Communication guide -

MG Energy Systems B.V.

TABLE OF CONTENTS

1 GENERAL

This communication guide will give insight on the data that is transmitted by the SmartLink MX and it is applicable to software version 1.12 or higher.

1.1 Document history

Rev	Date	Revision author
1.5	2024-4-15	N.D. Yntema
	Modifications: • VE-reg 'Charger link percentage' is no longer supported in the SmartLink MX software version 1.12. Therefor it has been removed from the VE-reg list in chapter 3.4.2	
1.4	2024-2-7	N.D. Yntema
	Modifications: • Added extra information about how values are combined • Changed MG-reg Periodically/on change settings, see 3.5.2	
1.3	2023-11-13	N.D. Yntema
	Modifications: • Changed the text BMS to SmartLink MX from VE-reg ID 'Re-start request', see 3.4.2 • Added 'Temporary (dis)charge current limit' MG-regs, see 3.5.2 • Added 'Restart command' to the 'combined control state commands' VE-reg. See 3.4.2 • Added MG-reg examples, see 3.5.3	
1.2	2023-07-14	N.D. Yntema
	Modifications: • Added SOH to PGN list and DC-detailed status message, see 3.3	
1.1	2023-06-14	N.D. Yntema
	Modifications: • Typo fix, kelvin data type from "int16" to "uint16", see 3.3.3 • Removed 'Output not active' value from MG-reg ID 'System voltage', see 3.5.2	
1.0	2023-01-23	N.D. Yntema
	• Initial document.	

2 COMMUNICATION WITH THE MG SMARTLINK MX

Communication with the MG SmartLink MX can be established via CAN-Bus. In this document the following protocol is described:

- MG NMEA2000 PROTOCOL

2.1 CAN Interface

The public CAN-bus RJ45 connectors (CAN-A) are located at the most left side of the SmartLink MX, below visible with letter **E**.

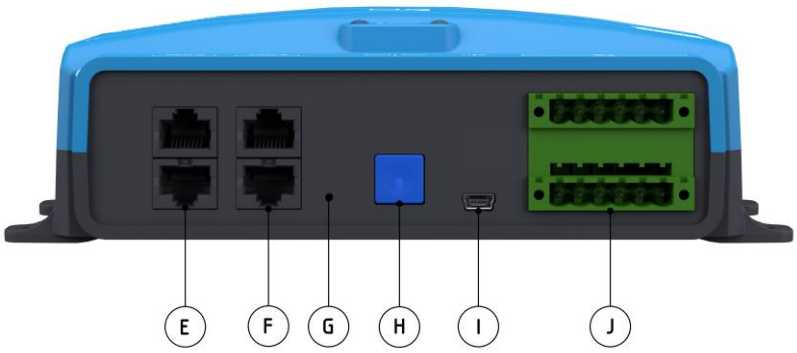

Figure 1 - SmartLink MX Public CAN-bus connection

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.

NOTICE:
Connector **CAN-A** is an **Isolated CAN-bus**. This means it is not connected electrically to the all other connections of the SmartLink MX.

NOTICE:
Always use standard prefabricated Ethernet network patch cables (straight).

RJ45 Connector pinout (T-568B)

Figure 2 - RJ45 connector pinout

CAN-A: Public connector pins and specifications (ISOLATED)				
Pin	I/O	Voltage	Current	Purpose
1	-			
2	-			
3	-			GND
4	-			
5	-			
6	-			
7	CAN			CAN-H
8	CAN			CAN-L

3 MG NMEA2000 PROTOCOL

The MG NMEA2000 protocol is used as public CAN-bus protocol that can control a list of chargers and loads.

NOTICE:
When additional CAN-bus chargers are enabled in the settings, CAN messages will be added on the NMEA2000 bus to control these chargers. 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 1 - 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
State-Of-Health (SOH)	DC detailed status	127506	0x1F212	5	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

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 SmartLink MX 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 2 - 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 SmartLink MX
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: Combined:	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: Combined:	16 bit, int16 Voltage, DC 0.01 V +/- 327.64 V Highest
3	Byte 3 Byte 4	Battery Current, + = battery is charged, - = battery is discharged.	
		Data Length: Unit: Resolution: Range: Combined:	16 bit, int16 Current, Electric 0.1 A +/- 3276.4 A Sum
4	Byte 5 Byte 6	Highest Battery Temperature	
		Data Length: Unit: Resolution: Range: Combined:	16 bit, uint16 Generic Temperature, Kelvin 0.01 K 0 to 655.32 deg K Highest
5	Byte 7	Sequence ID, an upward counting number used to tie related information together between different PGNs.	
		Data Length: Unit: Resolution: Range: Combined:	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:		1500 milliseconds	
Priority Default:		6	
Format:		Little Endian/Intel convention	
Single Frame:		Yes	
1	Byte 0	**Battery Instance = 1.**	
		Data Length:	8 bit, uint8
		Unit:	Generic numeric ID, short
		Resolution:	1 bit
		Range:	0 to 252
		Combined:	-
2	Byte 1 Byte 2	Lowest cell voltage in pack	
		Data Length:	16 bit, int16
		Unit:	Voltage, DC
		Resolution:	0.01 V
		Range:	+/- 327.64 V
		Combined:	Lowest
3	Byte 3 Byte 4	not implemented (0x7FFF)	
		Data Length:	16 bit, int16
		Unit:	-
		Resolution:	-
		Range:	-
		Combined:	-
4	Byte 5 Byte 6	Lowest cell temperature in pack	
		Data Length:	16 bit, uint16
		Unit:	Generic Temperature, Kelvin
		Resolution:	0.01 K
		Range:	0 to 655.32 deg K
		Combined:	Lowest
5	Byte 7	Sequence ID, an upward counting number used to tie related information together between different PGNs.	
		Data Length:	8 bit, uint8
		Unit:	Sequence ID, short
		Resolution:	1 bit
		Range:	0 to 252
		Combined:	-

3.3.3.3 Battery Instance "2"

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

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: Combined:	8 bit, uint8 Sequence ID, short 1 bit 0 to 252 -
2	Byte 1	DC Instance.	
		Data Length: Unit: Resolution: Range: Combined:	8 bit, uint8 Generic numeric ID, short 1 bit 0 to 252 -
3	Byte 2	DC Type	
		Data Length: Unit: Resolution: Range: Combined:	8 bit, int8 - 1 bit Variable -
		0x00 = Battery, 0x01 = Alternator, 0x02 = Convertor, 0x03 = Solar Cell, 0x04 = Wind Generator, 0x05 = Reserved, 0xFD = Reserved 0xFE = Error 0xFF = Data Not Available	
4	Byte 3	State-Of-Charge	
		Data Length: Unit: Resolution: Range: Combined:	8 bit, uint8 Generic Absolute Percentage 0-252% 1 % 0 to 252 % Average
5	Byte 4	State-Of-Health (Only available for RS-batteries)	
		Data Length: Unit: Resolution: Range: Combined:	8 bit, uint8 Generic Absolute Percentage 0-252% 1 % 0 to 252 % Lowest
6	Byte 5 Byte 6	Time remaining	
		Data Length: Unit:	16 bit, uint16 Time

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

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 3 - 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 4 - 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	Combined
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 MG SmartLink MX = 0xB0E0 MG SmartLink MX PLC = 0xB0E0	No
Firmware version	0x0102	No/No	un8 = Identifier : un24 = Firmware Version, 0xFFFFFF = no firmware present, Firmware version: 0x123456=v12.34.56	No
Serial number	0x010A	No/No	stringZeroEnded[32] = Serial : un8 = padding, 0 =zeropadding (not implemented yet)	No
Model name	0x010B	No/No	stringZeroEnded[64] = Model : un8 = padding, 0 = zeropadding(not implemented yet)	No
BMS Status values				
Voltage	0xED8D	Yes/No	sn16 = DC Channel 1 Voltage [0.01V], 0x7FFF = Not Available	Highest

Description	VREG ID	Period-ically/on Change	Comments	Combined
Current	0xED8F	Yes/No	sn16 = DC Channel 1 Current [0.1A], 0x7FFF = Not Available	Sum
Cell Volt. max/min	0x0385	Yes/No	un16 = Minimum voltage [0.01V] un16 = Maximumvoltage [0.01V]	Lowest Highest
Cell Temperature max/min	0x0386	Yes/No	un16 = Minimum temperature [0.01K] un16 =Maximum temperature [0.01K]	Lowest Highest
State-of-Charge	0x0FFF	Yes/Yes	un16 = SOC [0.01%]	Average
Time-to-go	0x0FFE	No/No	un16 = Time to go [1minutes], 0xFFFF = not available	Average
Consumed Ah	0xEEFF	No/No	sn32 = Consumed Ah [0.1Ah]	Sum
Last error 1-4	0x2110	No/Yes	un8 = Error 1, Last error : un8 = Error 2 : un8 = Error 3 : un8 = Error 4, Oldest error (not implemented yet)	No
Last error 1 time	0x2111	No/Yes	un32 = BMS: UTC time of last error 1 (not implemented yet)	No
Last error 2 time	0x2112	No/Yes	un32 = BMS: UTC time of last error 2 (not implemented yet)	No
Last error 3 time	0x2113	No/Yes	un32 = BMS: UTC time of last error 3 (not implemented yet)	No
Last error 4 time	0x2114	No/Yes	un32 = BMS: UTC time of last error 4 (not implemented yet)	No
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 = Not implemented bit 10 = Warning over voltage bit 11 = Not implemented bit 12 = Warning under voltage bit 13 = Warning high charge current bit 14 = Warning high discharge current bit 15 = Not implemented bit 16 = Warning over temperature bit 17 = Warning under temperature charge bit 18 = Not implemented bit 19 = Warning under temperature discharge bit 20 = Not implemented bit 21 = Low SOC (< 20%)	Bitwise OR if not noted. Current + Current –

Description	VREG ID	Period-ically/on Change	Comments	Combined
			bit 22 = Not implemented bit 23 = Not implemented bit 24 = Not implemented bit 25 = Allowed to charge bit 26 = Allowed to discharge bit 27 = Pre-alarm (not implemented) bit 28 = Warning bad contactor (not implemented) bit 29 = Alarm high current bit 30 = Warning cell imbalance bit 31 = Warning service requested	And And
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	Based on system state
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	First error

Description	VREG ID	Period-ically/on Change	Comments	Combined
Programmable relay state	0x034E	No/Yes	un8 = programmable relay state, 0 = open, 1 = closed.	No
System configuration				
Battery installed capacity	0x1000	No/Yes	un16 = Battery capacity [Ah]	Sum
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	No
History values				
Deepest discharge	0x0300	No/No	sn32 = Deepest discharge [0.1Ah]	Sum
Total Ah drawn	0x0305	No/No	sn32 = Cumulative Ah drawn from the battery [0.1Ah]	Sum
Minimum voltage	0x0306	No/No	sn32 = Minimum battery voltage [0.01V]	Lowest
Maximum voltage	0x0307	No/No	sn32 = Maximum battery voltage [0.01V]	Highest
Automatic syncs	0x0309	No/No	sn32 = Number of automatic synchronizations (not supported yet)	No
Discharged energy	0x0310	No/No	un32 = The amount of energy drawn from the source [0.01kWh]	Sum
Charged energy	0x0311	No/No	un32 = The amount of energy put into the source [0.01kWh]	Sum
Maximum temperature	0x0312	No/No	un16 = The maximum temperature [0.01K]	Highest
Minimum temperature	0x0313	No/No	un16 = The minimum temperature [0.01K]	Lowest
Min/Max cell voltage	0x0384	No/No	un16 = Minimum voltage [0.01V] un16 = Maximum voltage [0.01V]	Lowest Highest
BMS Limits				
Battery charge voltage	0x0390	Yes/Yes	un32 = Charge voltage [0.01V], 0xFFFFFFFF = Not Available	Lowest
DC charge current limitation	0x0391	Yes/Yes	un32 = Charge current [0.1A], 0xFFFFFFFF = Not Available	Multi lowest
DC discharge voltage	0x0392	Yes/Yes	un32 = Discharge voltage [0.01V] , 0xFFFFFFFF = Not Available	Highest
Battery discharge current limitation	0x0393	Yes/Yes	un32 = Discharge current [0.1A] , 0xFFFFFFFF = Not Available	Multi lowest

Description	**VREG ID**	**Period-ically/on Change**	**Comments**	**Combined**
Charger link current limit	0x2015	Yes/Yes	un16 = Link Charge Current Limit [0.1A], 0xFFFF =Not Available	Multi lowest
Settings	This VREG's can be read and written.			
Re-start request	0x0379	No / Yes	Un8 = Restart request, 0 = Disabled, 1 = Enabled, SmartLink MX will shut down and startup again.	No
Control	These VREG's can be read and written.			

Combined control State commands	0x0378	No / Yes	Un8 = Combined BMS state/commands : Un8 = address:
			
			// Combined BMS state:
			RECEIVED_CANBUS_START_COMMAND = 0x11
			
			When master BMS or SmartLink MX is transmitting a received start command, other Masters will go into interrupted state and for 5 seconds they will not accept any command.
			
			// Command send by SmartLink MX
			HEARTBEAT_COMMAND = 0x20, send each 1 second.
			
			// Commands send by system integrator and SmartLink MX:
			START_COMMAND = 0x21
			STOP_COMMAND = 0x22
			RESTART_COMMAND = 0x23
			
			// Address:
			Network address of the SmartLink MX where a start or stop command is transmitted to. Heartbeat is broadcasted 0xFF.
			
			Example:
			System integrator NAD: 0x**20**
			
			Start command to SmartLink MX with NAD *0x50*:
			START_COMMAND = 0x21
			ID=0x1CEFFF**20**,Length=8,Data=0x6699-7803-21-*50*-0000
			
			Reply from SmartLink MX when received start command:
			RECEIVED_CANBUS_START_COMMAND = 0x11
				No

Description	VREG ID	Period-ically/on Change	Comments	Combined
			ID=0x1CEFFF50,Length=8,Data=0x6699-7803-11-00-0000 From this moment, the SmartLink will startup all Masters after a 6 second delay. **Note:** - Multiple masters and SmartLink MX will dynamically assign a new NAD starting at 0x50 and increasing. - The restart command(0x23) will only restart BMSs that are in failsafe.	
	Read 0xFF = Not available (System is in error state)			

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 5 - 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	Combined
System Voltage	0x48EE	250ms/No	Sn32 = Voltage [0.001V]	Highest
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,	Bitwise OR if not noted. Own status Own status AND AND

Description	MGREG ID	Period-ically/on Change	Comments	Combined
			Bit 28 = battery power terminal over temperature alert	
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	Bitwise OR
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,	Bitwise OR

Description	MGREG ID	Period-ically/on Change	Comments	Combined
			Bit 25 = Pre-charge fuse broken, Bit 26 = Fuse broken. [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,	Bitwise OR
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.	Bitwise OR

Description	MGREG ID	Period-ically/on Change	Comments	Combined
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.	Bitwise OR
Control	These MG-REG's can be read and written.			
Temporary charge current limit	0xDEF0	No/No	un32 = charge current limit [0.001A], 0xFFFFFFFF = Disabled Note: this value can be used as temporary current limit. It will be disabled automatically after a restart of the SmartLink MX.	No
Temporary discharge current limit	0xB902	No/No	un32 = discharge current limit [0.001A], 0xFFFFFFFF = Disabled Note: this value can be used as temporary current limit. It will be disabled automatically after a restart of the SmartLink MX.	No

3.5.3 Examples

Set the User charge current limit (0xDEF0) to 100A (100.000 mA = 0x186A0) of node at address 0x50 from address 0x20:

CAN-ID	Data
0x1CEF5020	0x88 0x9C 0xF0 0xDE 0xA0 0x86 0x01 0x00

Request (0x0001) for User charge current limit (0xDEF0) of node at address 0x50 from address 0x20:

CAN-ID	Data
0x1CEF5020	0x88 0x9C 0x01 0x00 0xF0 0xDE 0xFF 0xFF

Reply (is always broadcast) of the User charge current limit 100A:

CAN-ID	Data
0x1CEFFF50	0x88 0x9C 0xF0 0xDE 0xA0 0x86 0x01 0x00

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	0x88 0x9C 0x02 0x00 0xF0 0xDE 0x00 0x80