

# MG SmartLink PLC

## - MOD-Bus TCP integration Manual EN -

MG3000307 - MG SmartLink PLC Box Single BMS

MG3000420 - MG SmartLink PLC Box Single BMS+

MG3000421 - MG SmartLink PLC Box Multi BMS

**MG Energy Systems B.V.**





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## 1 GENERAL

Before continuing, read the instructions in this chapter carefully and be sure the instructions are fully understood. If there are questions after reading the instructions please consult MG Energy Systems.

### 1.1 Document history

Table 1 – Document history

Revision	Date	Changes	Revision author
1.0	8-8-2023	Initial document.	MS
1.1	21-10-2023	Small fixes and updates	MS
1.2	22-04-2024	Updated images	MS

## 1.2 Terms, definitions, and abbreviations

Table 2 - List of terms, definitions, and abbreviations

Battery pack	Consists of one or more battery modules in combination with a battery management controller (BMS).
Battery system	Consists of one or multiple battery packs connected to a common DC-bus.
Battery management controller	Controls, manages and protects one or multiple battery modules.
(Master) BMS	Shorthand for a <i>battery management controller</i> in a MG energy systems battery system. Could be a Master LV or Master HV.
Boundary limit	A boundary limit consists of two level values, a set and a clear value, combined with a time condition.
DC-bus	Is the main DC-bus of the application where all user equipment is connected too, like generators, propulsion systems, other chargers and loads.
CAN-bus	<i>Controller Area Network bus</i> ; CAN-bus is a standard serial data bus that provides data communication between two or more devices.
HVIL	<i>High Voltage Interlock Loop</i> ; is a wire loop which is created for protection of disconnecting cables from the battery system while in operation. It isolates the electrical connections of the batteries from the system when loop is not closed.
NMEA 2000	<i>A plug-and-play communications standard used for connecting marine sensors and display units within ships and boats, standardised in the IEC 61162-1</i>
ATC	Allow-to-charge - A digital output used to control chargers.
ATD	Allow to discharge – A digital output used to control loads.
Failsafe	A condition of adequate level that causes an Alarm causing the battery pack to go into failsafe state.
SOC	State-of-Charge – reflects the level of charge of a battery pack or battery module relative to its capacity. The units of SOC are percentage points where 0% indicates fully discharged and 100% indicates fully charged.
EMS	<i>Energy Management System</i> – A system that controls the battery system, inverters and any other loads/chargers.

## 2 SAFETY INSTRUCTIONS

This chapter describes the safety instructions applicable to this manual and product.

### 2.1 Safety message level definition

Table 3 - Safety message levels overview



**WARNING:**

A hazardous situation which, if not avoided, could result in death or serious injury.



**CAUTION:**

A hazardous situation which, if not avoided, could result in minor or moderate injury.



**ELECTRICAL HAZARD:**

The possibility of electrical risks if instructions are not followed in a proper manner.



**LIMITATION:**

A limitation to use which must be considered for safe use of the equipment.



**NOTICE:**

- A potential situation which, if not avoided, could result in an undesirable result or state.
- A practice not related to personal injury.

### 2.2 User health and safety

#### 2.2.1 General precautions

This product is designed and tested in accordance with international standards. The equipment should be used according the intended use only.



**ELECTRICAL HAZARD:**

The product is used in combination with a permanent energy source (battery). Even if the equipment is switched off.

- Wear applicable personal protective equipment when working on a battery system.
- Use insulated tools during when working on a battery system.
- Make sure the local regulations for working on battery systems are followed.

### **2.2.2 Qualifications and training**

The personnel responsible for the assembly, operation, inspection, and maintenance of the battery system must be appropriately qualified. The purchasing company is responsible to:

- Define the responsibilities and competency of all personnel working with this product and all relevant systems.
- Provide instruction and training.
- Ensure that the contents of the operating and safety instructions have been fully understood by the personnel.
- Insure that the system is installed in compliance to all local, federal codes or any other organism with jurisdiction over the system.

MG Energy system can, at the purchaser request provide all necessary training or instructions required for proper installation and usage of the system.

### **2.2.3 Non-compliance risks**

Failure to comply with all safety precautions can result in the following conditions:

- Death or serious injury due to electrical, mechanical, and chemical influences.
- Environmental damage due to emission of hazardous substances.
- Product damage.
- Property damage.
- Loss of all claims for damages.

### **2.2.4 Unacceptable modes of operation**

The operational reliability of this product is only guaranteed when it is used as intended. The operating limits on the identification tag and in the data sheet may not be exceeded under any circumstances. If the identification tag is missing or worn, contact MG Energy Systems B.V. for specific instructions.

### 3 Introduction

The SmartLink PLC Box is the gateway for controlling one or multiple battery strings. The control of the battery system can be performed by manual switches on the SmartLink PLC Box or via the MOD-Bus TCP interface. For more information refer to the [SmartLink PLC Manual](#).

#### 3.1 MOD-Bus TCP interface

Connect to the IP-address of the SmartLink PLC on port **502**.

The MOD-Bus interface has several unit-id or slave-ids. It is possible to read at least the status, warning and failure registers of each connected battery string separately. The table below shows the list of unit-ids. The available registers can be found in the MOD-Bus register list.

Unit-id (decimal)	Description
123	Combined data of the active battery strings.
1	Data of the 1 <sup>st</sup> battery string
2	Data of the 2 <sup>nd</sup> battery string
3	Data of the 3 <sup>rd</sup> battery string
...	
15	Data of the 15 <sup>th</sup> battery string

#### 3.2 MOD-Bus register list

There is a MOD-Bus register list available which describes all available registers.

- Holding registers are read/write.
- Input registers are read only.




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**WARNING:**

Data can be invalid. In that case the maximum value of the data type will be set. For example: The invalid data of a uint16 is **65536**. This can be used to show or exclude this data from any third party calculations or showing on a display.

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## 4 Communication

The basic communication of the MG battery systems consist of a set of control commands and a list of status registers.

### 4.1 Basic communication flow

The below steps describe the communication flow to control and start the MG battery system.

1. Wait for the `State` input register (`190`) to be `14` which is the `Standby` state.
2. Send command `Start` to the `Start/stop/reset` holding register (`1000`). The command consists of a low byte and a high byte.

The commands are as following:

Low byte = Command:

**COMMAND\_START** = 1

**COMMAND\_STOP** = 2

**COMMAND\_RESET** = 4

High byte = NMEA2000 network address. Default = 96 (0x60)

In decimal numbers it will look like the following with the default network address:

**Start** = 24577

**Stop** = 24578

**Reset** = 25480

3. Wait until the `State` input register (`190`) to be `9` which is the `Running` state.
4. Use the Charge and discharge parameter control for controlling the chargers and loads.
5. Monitor the `State` input register (`190`) from changing.




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**NOTICE:**

- In all these steps monitor the warning and failure registers.
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### 4.2 Charge and discharge parameter control

The parameter control is used to notify the EMS about the charge and discharge limits. These limits are dynamically adjusted based on battery module configuration and operation parameters, like temperature, voltage, number of battery packs connected etc.

The following limits are implemented:

- Battery pack charge voltage limit, register **305**.
- Battery pack charge current limit, register **306**.
- Battery pack discharge voltage limit, register **307**.
- Battery pack discharge current limit, register **308**.

These limit values can also be invalid. For example: The invalid data of a uint16 is **65536**. This means that the data cannot be used for control purposes and needs to be filtered out.

**WARNING:**

Charge and discharge parameters do not have any kind of ramping. It can happen that the limit will go from for example, 100 A to 0 A instantaneously.

**4.2.1 Battery pack charge voltage limit**

The master BMS will do an initial check on startup to define the battery pack charge voltage limit. In case the battery is fully charged, the limit will be set to the actual battery pack voltage. Otherwise the limit will be set to maximum charge voltage defined by the charged boundary limit. Due to measurement tolerances of the BMS and EMS an offset is added or subtracted to this limit.

If the fully charged boundary limit is reached, the limit will be set to the actual battery pack voltage added with an offset. If the battery pack continued to be charged during this condition, the limit will be decreased each 10 seconds until below 96 % of the battery pack charged voltage.

The limit will be increased when the battery pack is within the boundary limits working area.

**4.2.2 Battery pack charge current limit**

The master BMS will do an initial check on startup to define the battery pack charge current limit. This limit will be set to the battery pack maximum charge current or maximum current of the battery management controller, whichever is lower. During the initial check the highest battery cell temperature, lowest battery cell temperature or highest battery module power terminal temperature is outside the boundary limits, the battery pack charge current limit will be set to a minimum.

In one of the following conditions the charge current limit will be decreased every 5 seconds until 0 A:

- The highest battery cell voltage is above the charged boundary limit including offset;
- Before reaching the over or under battery cell temperature critical boundary limit, the charge current limit will be decreased until 0 A;
- Before reaching the battery module power connection terminal over temperature critical boundary limit, the charge current limit will be decreased until 0 A;

The limit will be increased when the battery pack is within the boundary limits working area.

**4.2.3 Battery pack discharge voltage limit**

The master BMS will do an initial check on startup to define the battery pack discharge voltage limit. In case the battery is fully discharged, the limit will be set to the actual battery pack voltage. Otherwise the limit will be set to minimum discharge voltage defined by the discharge boundary limit. Due to measurement tolerances of the BMS and EMS an offset is added or subtracted to this limit.

If the fully discharged boundary limit is reached, the limit will be set to the actual battery pack voltage subtracted with an offset. If the battery pack continued to be discharged during this condition, the limit will be increased each 10 seconds until above 105 % of the battery pack discharged voltage.

The limit will be decreased when the battery pack is within the boundary limits working area.

#### **4.2.4 Battery pack discharge current limit**

The master BMS will do an initial check on startup to define the battery pack discharge current limit. This limit will be set to the battery pack maximum discharge current or maximum current of the battery management controller, whichever is lower. In case at this initial check the highest battery cell temperature, lowest battery cell temperature or highest battery module power terminal temperature is outside the boundary limits, the battery pack discharge current limit will be set to a minimum.

In one of the following conditions the discharge current limit will be decreased every 5 seconds until 0 A:

- The lowest battery cell voltage is below the discharged boundary limit subtracted with an offset;
- Before reaching the over or under battery cell temperature critical boundary limit, the discharge current limit will be decreased until 0 A;
- Before reaching the battery module power connection terminal over temperature critical boundary limit, the discharge current limit will be decreased until 0 A;

The limit will be increased when the battery pack is within the boundary limits working area.

### 4.3 State table

The table below shows the state in comparison with the status registers.

State (reg. 190)	Status description	Optional actions in state	Status bit 0 (reg. 200)	Status bit 1 (reg. 200)	Status bit 2 (reg. 200)	All warning flags	All error flags
Initializing ()	System is starting or searching for a BMS.	no action can be taken	1	0	0	Don't care	No errors
Standby (14)	System is waiting for start command.	Allows start command	0	1	0	Don't care	No errors
Running (9)	System is running on at least one BMS.	Allows stop command	0	1	1	Don't care	No errors
Error ()	System contains at least one BMS with an error.	Allows reset command	0	1	Don't care	Don't care	Error(s)

## 5 CONTACT DETAILS

For specific questions please feel free to contact us.

### 5.1 Sales

For sales related questions, please contact a [local dealer](#).

For specific sales questions, please contact our sales team:

#### MG Sales team

[sales@menergysystems.eu](mailto:sales@menergysystems.eu)

### 5.2 Technical support

For technical support, please follow the steps below:

1. Consult the Manual.  
Manual can be found on the [MG Download Center](#).
2. Watch the Installation Videos.  
Videos can be found on [MG's You Tube channel](#).
3. Check Your Software Version.  
Check and update the products software version to latest using the MG Connect App ([Apple](#) or [Android](#)) or [MG Diagnostic Tool](#).
4. Consult the [Knowledge Center](#) for information.
5. Contact [MG Service Point](#).
6. Contact MG technical support.  
Send an email with your technical questions to [support@menergysystems.eu](mailto:support@menergysystems.eu).