

MG SmartLink PLC

- 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 chapter 15.2 for technical support.

1.1 Document history

Table 1 - Document history

Revision	Date	Changes	Revision author
1.0	26-04-2024	Initial document.	M. Scholten

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.

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 TRANSPORT, STORAGE AND UNPACKING

3.1 Transport

The package and transport instructions provided by the manufacturer must be followed under all circumstances.



NOTICE:

No liability can be accepted for damage during transport if the equipment is not transported in its original packaging or if the original packaging is opened before the destination is reached.

3.2 Storage

The storage instructions provided by the manufacturer must be followed in all circumstances.

Notes on storage:

- Store in a dry and clean location.
- Store in the original packaging.

3.3 Unpacking

Follow these handling guidelines when handling the product to prevent damage during unpacking:

- Use care when handling the product.
- Leave protective caps and covers on the product until installation.

3.3.1 Scope of delivery

The scope of delivery is as following:

- One of the following MG SmartLink PLC Box versions:
 - MG3000307 - MG SmartLink PLC Box Single BMS
 - MG3000420 - MG SmartLink PLC Box Single BMS+
 - MG3000421 - MG SmartLink PLC Box Multi BMS

4 GENERAL DESCRIPTION

The SmartLink PLC is the smart link between all MG products and third party devices. The SmartLink PLC gathers and combines all battery and communication data in the MG battery system. As a result, third party devices in a system no longer need to collect data from multiple BMSs. The standard protocol to connect to third party devices is MOD-Bus TCP. The SmartLink PLC provides all necessary controls to start, stop and reset the entire battery system.

- NMEA2000.
- MOD-Bus TCP.
- Redundant system control.
- Combined battery system data.
- Marine class type approved hardware (PLC).

Use the SmartLink PLC for battery systems with two or more MG Masters HV or LV. The SmartLink PLC collects and combines the received information from all the MG Masters in a battery system. It transmits the combined data as a new device on the same CAN-bus and to the MOD-Bus TCP interface making it available for third party devices. It also makes combined battery data available in such a way that parallel connected systems are shown as one battery bank. The SmartLink PLC is able to communicate with both the Master LV for low voltage systems and the Master HV for high voltage systems.

Besides collecting data, the SmartLink PLC controls the MG Masters. It detects the state of the system, including warnings and errors. It can turn the BMS on or off, and restart the entire battery system.

5 Installation examples

The SmartLink PLC is a battery system combiner and controller. Different system configurations can be made, from a small single string battery system to a multiple string high voltage hybrid system.

5.1 Basic system setup

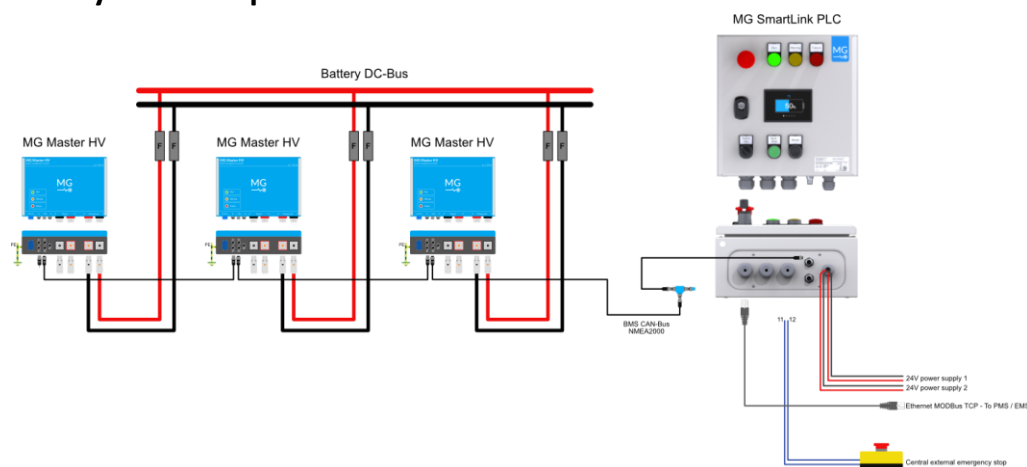


Figure 1 - Basic system example

6 MODELS

This chapter shows the available models of the SmartLink PLC.

6.1 Models and configurations

Product	Article number
MG SmartLink PLC Box Single BMS	MG3000307
MG SmartLink PLC Box Single BMS+	MG3000420
MG SmartLink PLC Box Multi BMS	MG3000421

Table 4 - Models

6.1.1 MG SmartLink PLC Box Single BMS

This model is the basic configuration and is intended for use with a Single Master HV BMS. The power supply and the emergency stop of the Master HV can be connected to the SmartLink PLC Box.

6.1.2 MG SmartLink PLC Box Single BMS+

In addition to the basic version, the SmartLink PLC Box Single BMS+ contains a monitoring device for external connected emergency stops.

6.1.3 MG SmartLink PLC Box Multi BMS

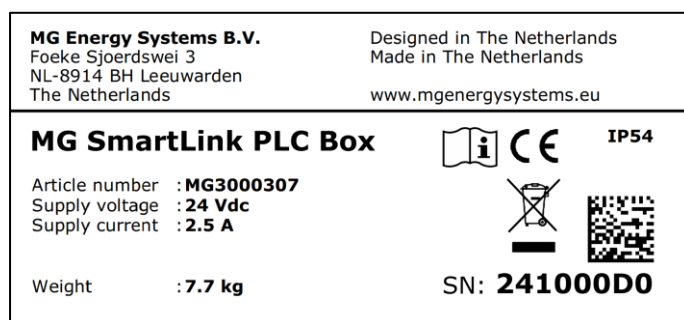
This version contains six emergency stop outputs for connecting up to six Master HVs. The power supply for the six Master HVs must be connected to an external supply. This unit is used in system with multiple Master HVs.

6.2 Identification label

There are two identification labels located on the SmartLink PLC.




One of the Identification label is located at the right side of the device. The other one is located on the PLC itself inside the box.

Example identification label:



The identifications label shown in Table 5 - Identification lable logo explanation. Contains written information about the product. The explanation of the symbols used on the identification label is stated in table 5.

Table 5 - Identification lable logo explanation

	Declaration of conformity with health, safety, and environmental protection standards for products sold within the European Economic Area as per directive 2014/35/EU.
	Symbol indication the manual must be red before installation and use of the device.
	Device is treated according the Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU.

7 OVERVIEW

This chapter shows and overview of the SmartLink PLC.

7.1 General overview

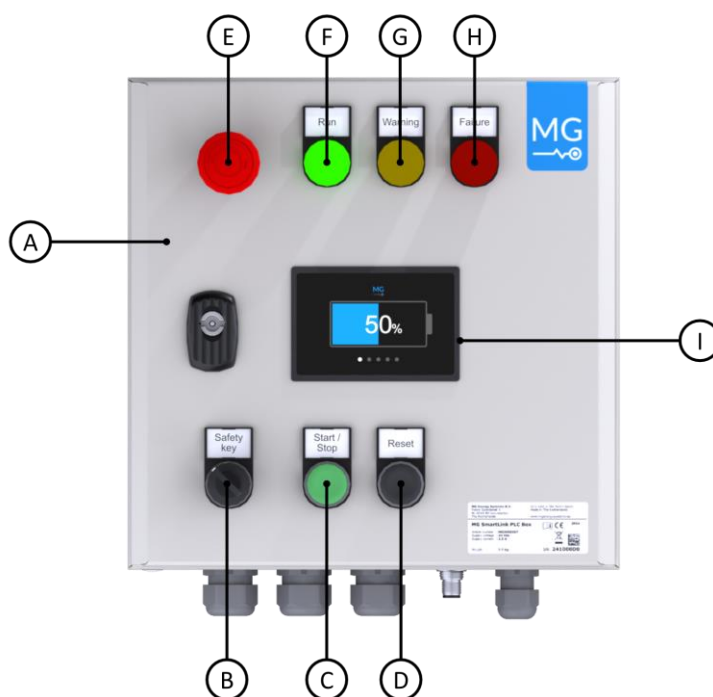


Figure 2 - SmartLink PLC overview front

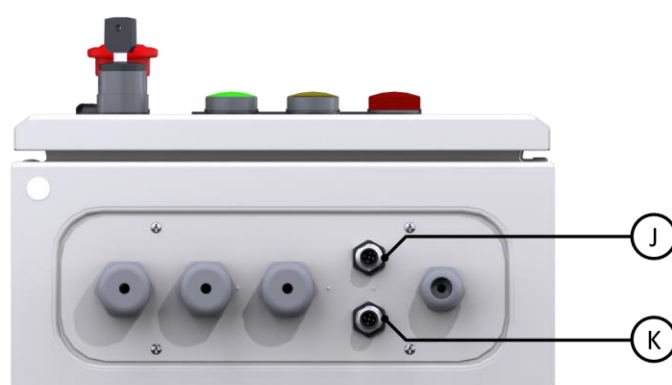


Figure 3 - SmartLink PLC overview bottom

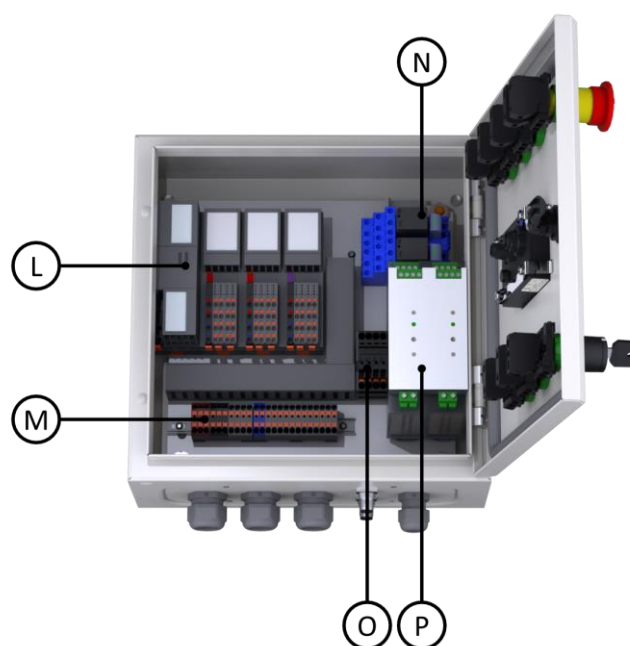


Figure 4 - SmartLink PLC Multi BMS (MG3000421) inside overview

Part	Description
A	Enclosure
B	Safety Key
C	Start/Stop button
D	Reset Button
E	Emergency Stop button
F	Status: Run
G	Status: Warning
H	Status: Failure
I	MG Energy Monitor
J	NMEA2000 CAN-Bus port – M12
K	Diagnostics CAN-Bus port – M12
L	PLC
M	IO connection terminals
N	Emergency Stop relays
O	Fuses
P	2x Power supply units

7.2 Connection details

7.2.1 IO connection terminals

Terminal IO connections are different for the three models of SmartLink PLC Boxes.

7.2.1.1 MG3000421 - MG SmartLink PLC Box Multi BMS

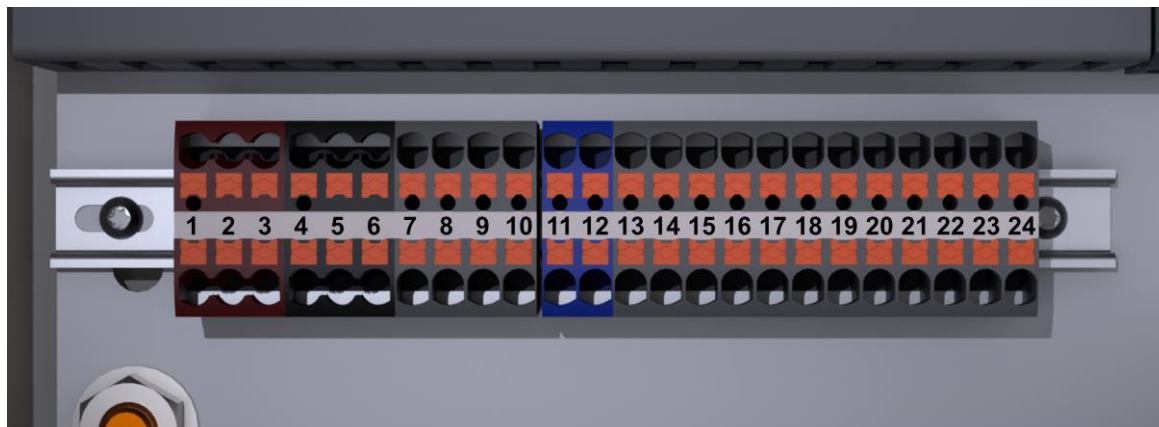


Figure 5 - IO connector pinout

IO terminals specifications				
Pin	I/O	Voltage	Current	Purpose
1	Out	+24 VDC	2.5 A	Power output for MG Master HV
2				
3				
4		0 VDC		0 VDC output for MG Master HV
5				
6				
7	Out	+24 VDC	500 mA	Warning
8	Out	+24 VDC	500 mA	Allow to charge
9	Out	+24 VDC	500 mA	Allow to discharge
10	Out	+24 VDC	500 mA	Pre-Warning allow to discharge
11	Out	External E-Stop connection loop.		
12	In			
13	Out	Max. voltage: +24 VDC	1 A	E-Stop contact BMS 1.
14				
15	Out	Max. voltage: +24 VDC	1 A	E-Stop contact BMS 2.
16				
17	Out	Max. voltage: +24 VDC	1 A	E-Stop contact BMS 3.
18				
19	Out	Max. voltage: +24 VDC	1 A	E-Stop contact BMS 4.
20				
21	Out	Max. voltage: +24 VDC	1 A	E-Stop contact BMS 5.
22				
23	Out	Max. voltage: +24 VDC	1 A	E-Stop contact BMS 6.
24				

Table 6 - IO connector pinout

7.2.2 Ethernet connection

There is an ethernet connection on the PLC. This can be connected to a network for use of the MOD-Bus TCP communication of the SmartLink PLC Box. There are two connectors on the bottom of the PLC inside the box at the position shown in Figure 6. Both connection are the same and act like a network switch. Connector type is standard RJ45.

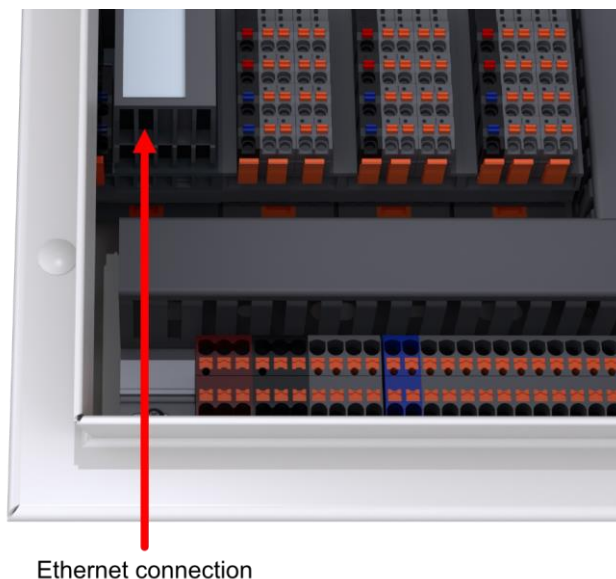


Figure 6 - Ethernet connection location

7.2.3 Power supply connections

The power supply connections are directly connected to the two power supply units inside the SmartLink PLC Box.

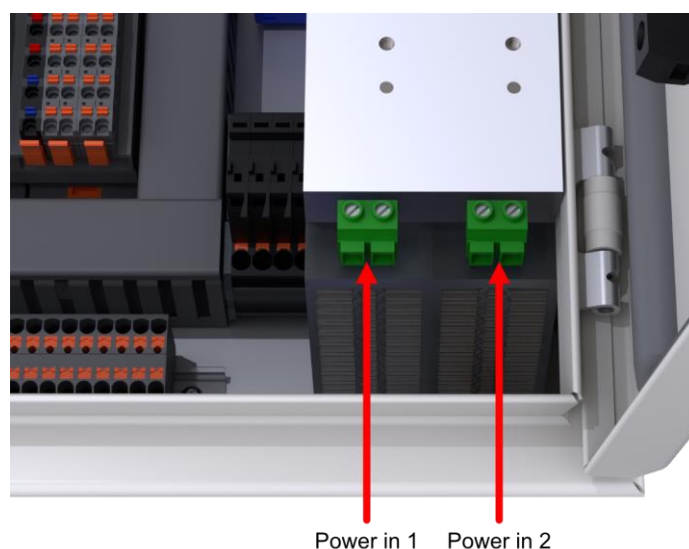


Figure 7 - Power supply connections


7.2.4 M12 CAN-bus connector details

The SmartLink PLC Box uses M12 CAN-Bus connections for communicating with the Master BMSs and for diagnostic purposes.

7.2.4.1 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 7 - Circular M12 connector with 5 positions A-coded details

Pin	Description	Connector view
1	Shield	<p>M12, 5-pin, A-coded</p>  <p>Male Female</p>
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 mm² (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 mm² (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.

7.3 Fuses

There are four fuses installed in the SmartLink PLC Box. For location of these fuses see Figure 8.

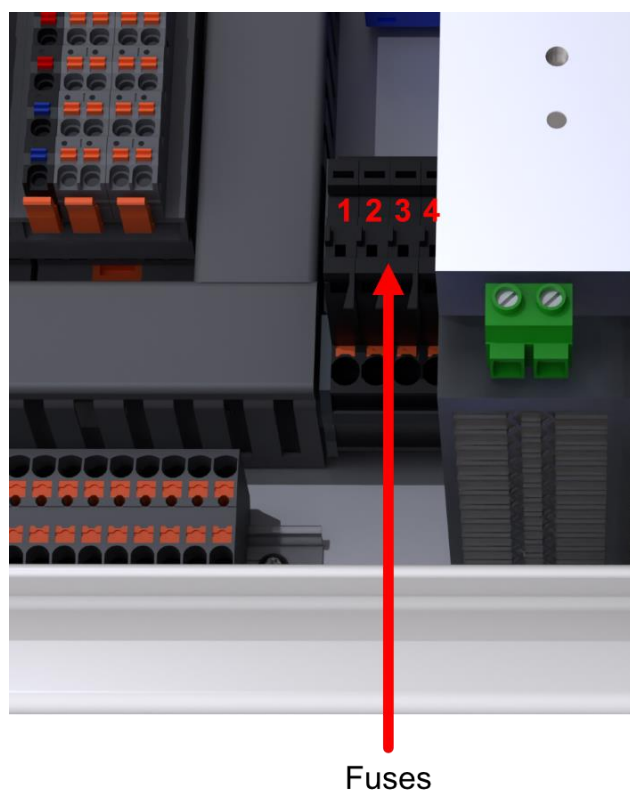


Figure 8 – Location of the fuses

Table 8 - Fuse table

Fuse number	Function	Fuse type	Description
1	Main supply in positive line.	MULTICOMP PRO MC000850	5mm × 20mm Ceramic Fast Blow Fuses. 6.3 A / 250 V
2	Main supply in negative line.	MULTICOMP PRO MC000850	5mm × 20mm Ceramic Fast Blow Fuses. 6.3 A / 250 V
3	Power supply 1	Schutter 0034.0909	Ultra-fast FUSE CERAMIC 6.3A 250VAC 5X20MM
4	Power supply 2	Schutter 0034.0909	Ultra-fast FUSE CERAMIC 6.3A 250VAC 5X20MM

7.4 Status indication

Table shows the status LED indication states and their meaning. There are three status LEDs: Run, Warning and Failure.

Table 9 - Status LED indication

Status Run LED state	Description
Off	System off and is not powered.
Short flash green	Searching for combinable BMSs on the CAN-bus network.
Blinking green slow	Waiting for start command.
Inverted Short flash green	System is pre-charging.
On Failure LED: Off	System in normal operation.

Status Warning LED state	Description
Off	System in normal operation.
On	System parameters out of boundaries, but still in operation.

Status Failure LED state	Description
Off	System in normal operation.
On	System in Failsafe. In any case when the Failure status LED is On the system is in Failsafe. Independent from state of other status LEDs.

8 INSTALLATION

Read the installation instructions in this chapter before commencing installation activities.



WARNING:

Before continuing make sure the following instructions are met:

- Ensure that the connection cables are provided with fuses and circuit breakers.
 - Never replace a protective device by a component of a different type. Refer to the ordering information sections of this manual or contact manufacturer for a correct replacement.
 - Before switching the device on, check whether the available DC bus voltage range conforms to the configuration of the product as described in the manual.
 - Ensure that the equipment is used under the correct operating conditions. Never operate it in a wet or dusty environment.
 - Ensure that there is always sufficient free space around the product.
 - Install the product in an environment that can sustain some heat. Ensure therefore that there are no chemicals, plastic parts, curtains or other textiles, etc. in the immediate vicinity of the equipment.
-



ELECTRICAL HAZARD:

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



NOTICE:

During installation a check form needs to be used to log the installation procedure. This log will be checked during commissioning.

8.1 Environment

The SmartLink PLC Box has an IP rating of IP54 and must be placed in a space that is moisture and dust free, non-condensing and protected against fluid (water, oil etc.) ingress from top and bottom.

8.2 Mounting

Mount the SmartLink PLC to a flat surface with the four mounting holes inside the box. The mounting hole diameter is 10 mm.

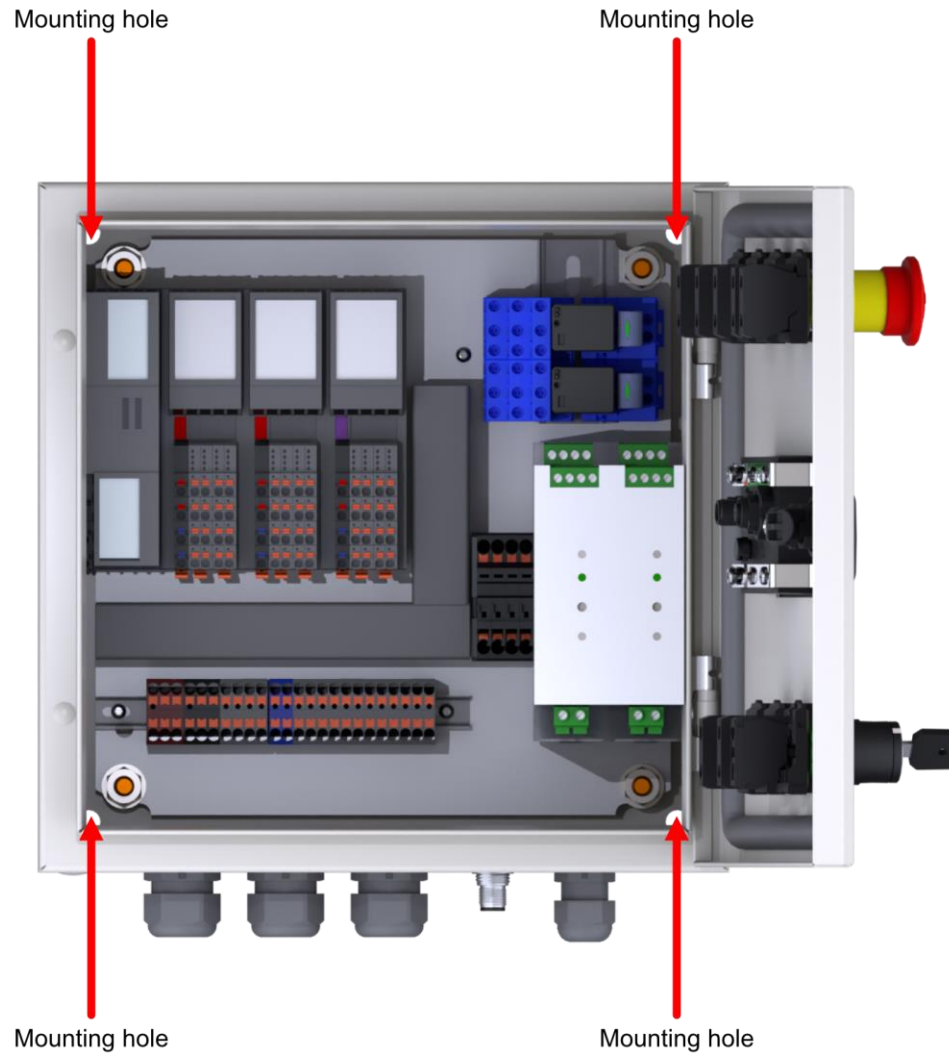


Figure 9 - Mounting hole locations

8.3 Connect the CAN-bus

The SmartLink PLC should be connected to the same CAN-bus network as the BMSs are connected to (Aux. CAN). This NMEA2000 CAN-bus should be connected to connector 'J' as shown in Figure 3.

If it is the last device in the bus, make sure to use a terminator to end the bus.

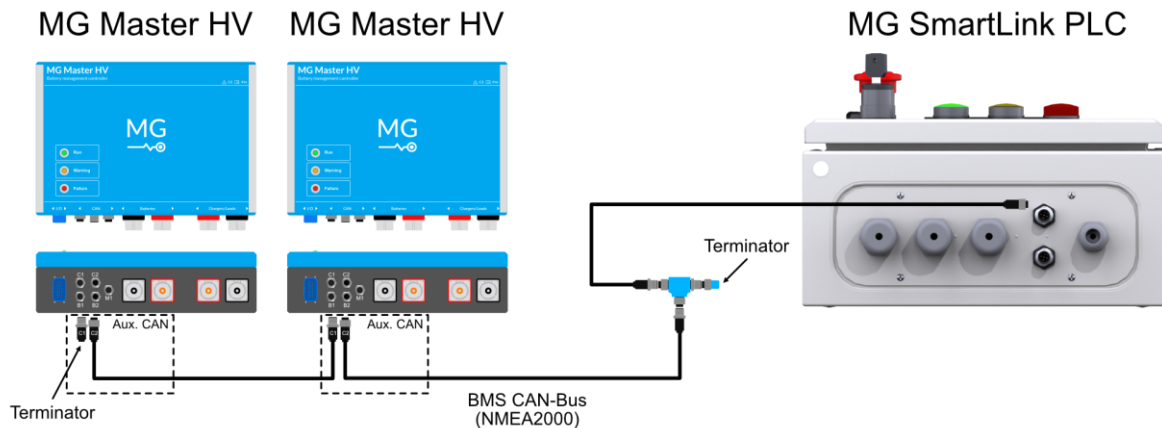


Figure 10 - CAN-Bus connection schematic overview

8.4 Connect the power supply

There are two power supply inputs on the SmartLink PLC Box. These inputs are the inputs of two DC-DC converters that are connected in parallel in the output. The intention is to have a redundant power supply to each of the inputs of the DC-DC converters. When one of the inputs is not powered a warning will be raised in the SmartLink PLC Box.

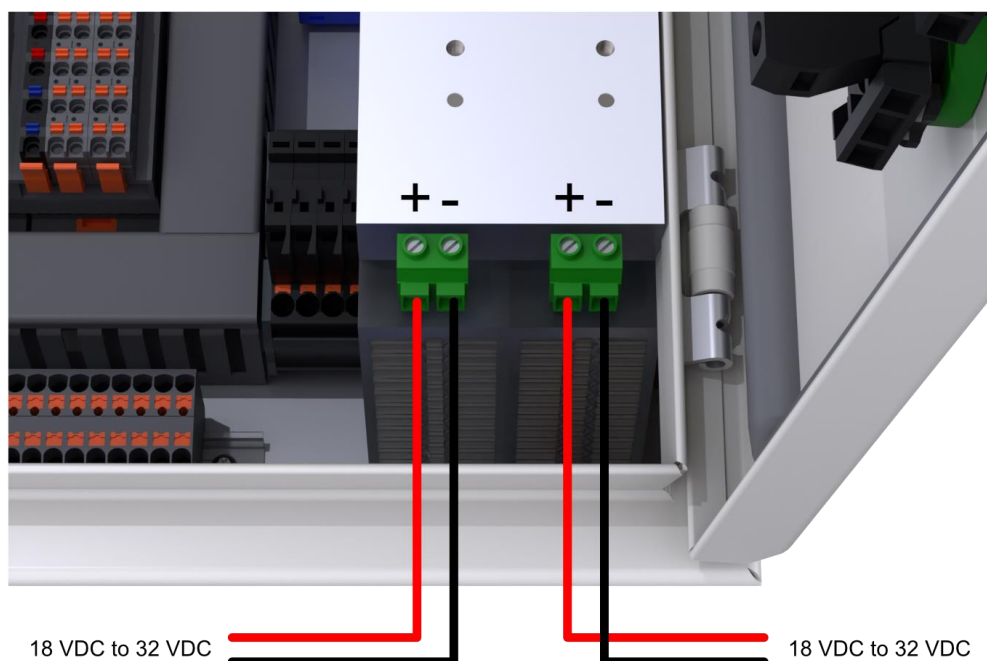


Figure 11 - Power supply connection

8.5 Connect a Master HV

The SmartLink PLC box is able to power one or more Master HVs depending on the model.

8.5.1 Connecting the emergency stop

The emergency stop of a Master HV can be connected to one of the Emergency output contacts inside the SmartLink PLC Box.

8.6 Connect an external Emergency Stop

A central external emergency stop can be connected to the SmartLink PLC with the same function as the integrated emergency stop. The schematic in Figure 12.

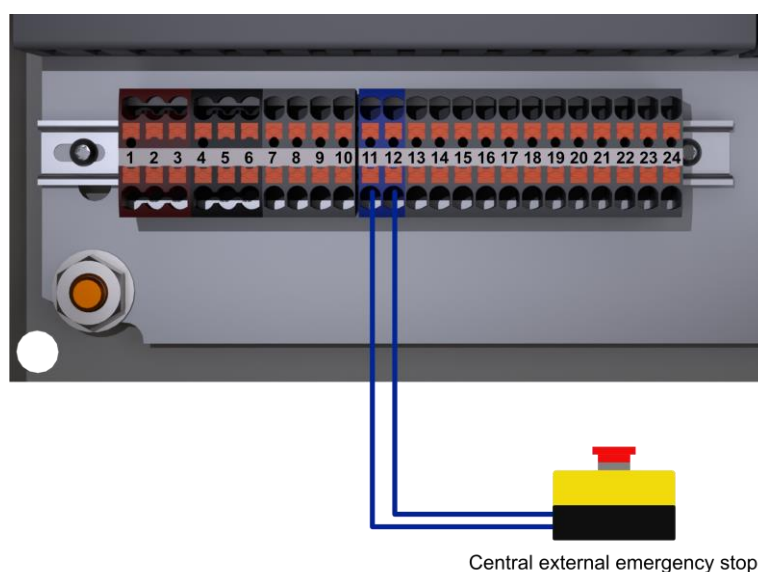


Figure 12 - Central external emergency stop schematic



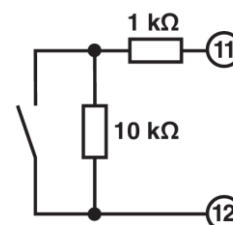
NOTICE:

There must be a loop wire installed between terminal 11 and 12 when there is no external emergency stop connected!



NOTICE:

If a MG SmartLink PLC Box Single BMS+ is used with an emergency stop monitor system, some additional resistors should be placed as close as possible to the emergency stop. The following diagram shows the correct way to integrate these resistors.



9 CONFIGURATION

Configuration is required before using the SmartLink PLC Box. Important is to configure the connected BMSs that they can be controlled by the SmartLink PLC Box. The procedures of how to configure this is explained in the following paragraphs.

9.1 Firmware and configuration

The SmartLink PLC Box is delivered with the latest firmware and preconfigured. Updates and configuration can only be performed by MG Energy Systems B.V.

9.2 Configure the MG Master BMSs

When a BMS (Master LV/HV) needs to be controlled and combined by the SmartLink PLC, a list of settings need to be changed in the BMS first. Before changing the settings, make sure the BMS firmware is the latest version. The following settings need to be changed:

- External CAN-bus protocol: **MG NMEA2000**
- Combined battery mode: **ENABLE**
- Wake up on charger detect: **NO** (only available for MG Master LV)

When these settings have been changed, a restart of the BMS(s) is needed first.

WARNING:

Before continuing make sure that:



- All other BMS's which do not need to be combined, and which are connected to the same CAN-bus, need to be disconnected or the following setting have to be applied:
 - Combined battery mode : DISABLE
 - It is not possible to run two separate combined systems on a single CAN-bus network.
-

9.3 Setting up the SmartLink PLC

The SmartLink PLC Box is pre-configured from the factory. To communicate to the PLC via Ethernet requires to set the IP-address to match the network that it is connected to.

9.3.1 IP-address

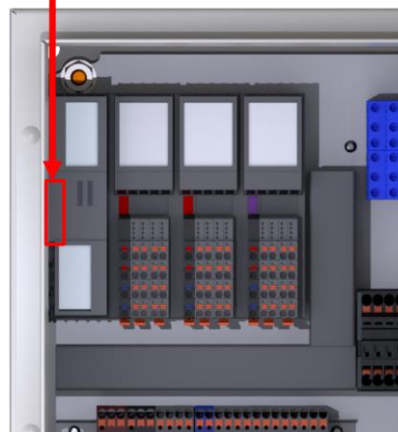
The default IP-address of the SmartLink PLC Box is *192.168.1.10*. This can be changed to user preferred network settings using the web interface of the SmartLink PLC. Therefore a Laptop needs to be connected to the Ethernet port of the SmartLink PLC.

1. Connect the Laptop with an RJ45 patch cable to the Ethernet port of the SmartLink PLC.
2. Configure the laptop to have a static IP-address in the range of the SmartLink PLC default IP-address.

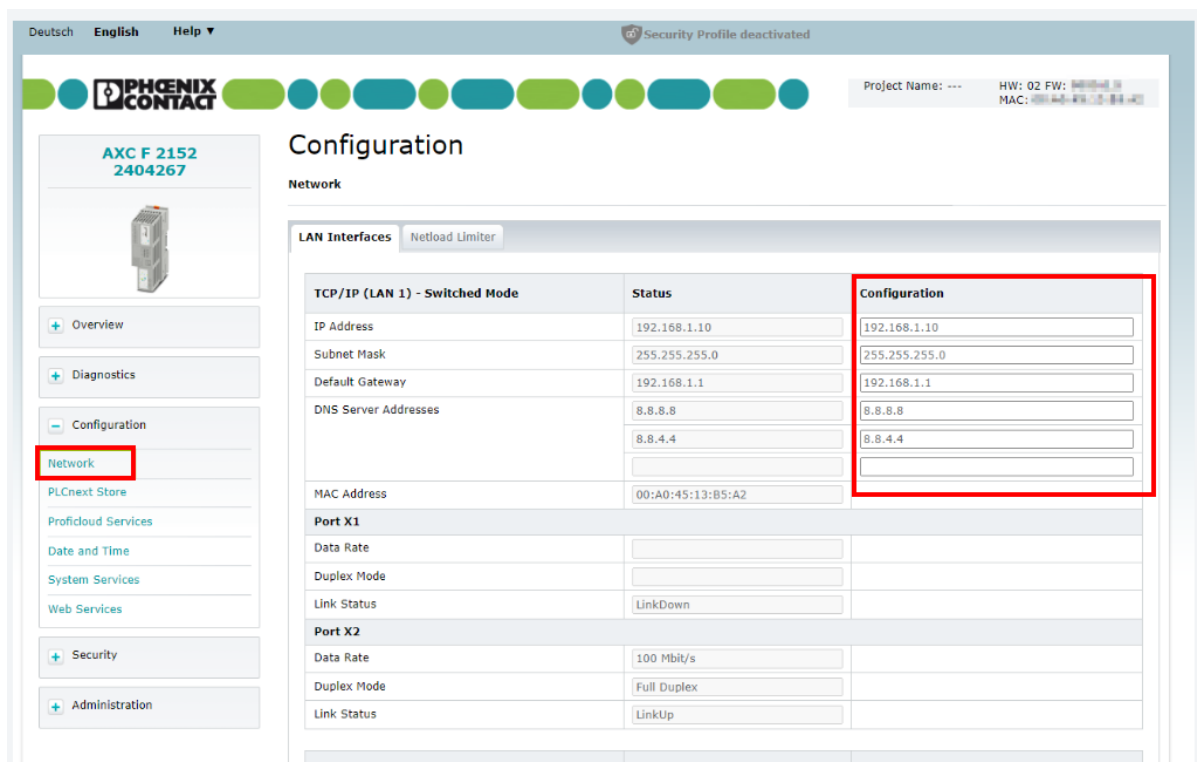
IP-address	192.168.1.20
Subnet Mask	255.255.255.0
Gateway	192.168.1.1

3. Open an internet browser and go to <http://192.168.1.10>
4. A login page shows. For the username fill in *admin*
5. For the password use the password printed on the enclosure of the PLC inside the SmartLink PLC Box.

Password location



6. Go to the menu *Network* under configuration and fill in the new network configuration settings as showed in the figure below.



More information about changing the IP-address and other settings can be found at the [manufactures website](#) of the PLC.

9.3.2 MOD-Bus TCP

For a guide into the MOD-Bus integration please refer to the dedicated [MOD-Bus integration manual](#) available in the MG Download Center.

10 OPERATION

The SmartLink PLC Box controls the connected Master BMSs by CAN-Bus. To control the complete battery system it is only necessary to control the SmartLink PLC with a limited set of commands. These command can be initiated by the buttons at the front of the SmartLink PLC or by MOD-Bus TCP. The following actions are possible:

- Start system
- Stop system
- Reset system

For MOD-Bus TCP control refer to chapter 9.3.2.

10.1 Power up Master BMSs

After applying the correct setting to all the BMSs, each of the BMSs needs to be powered up so the SmartLink PLC can detect and control them. The SmartLink PLC will automatically detect the state of the system.

10.2 Start system

To start the system, the start/stop button should be pressed for <1 second. The SmartLink PLC will choose one of the connected Master BMSs to start pre-charging the DC bus. After pre-charging the main safety contactors will be closed and the first BMS is in operation. The other connected BMSs will connect automatically to the DC-Bus when they sense the same voltage on the DC-Bus as the voltage of the string of batteries for 10 seconds.



NOTICE:

The system can only be started under the following conditions

- The Status indication of the SmartLink PLC is “Waiting for start command”
 - The minimum number of BMSs are able to start.
 - The safety switch must allow the start of the system
-

10.3 Stop system

To stop a running system, the start/stop button should be pressed for <1 second. All connected BMSs will open their contactor at the same time, and will automatically go to the standby state.

10.4 Reset system

10.4.1 One or more BMSs in failsafe

When there is one or more BMS's in failsafe, they can be restarted with the SmartLink PLC by a short push on the reset button.

10.4.2 SmartLink PLC in failsafe

When the SmartLink PLC is in failsafe, it can be reset in the same way as when BMSs are in failsafe. A short push on the reset button is needed to reset the device.

10.4.3 Restart the SmartLink PLC

The start/stop button should be pressed for more than 10 seconds to restart the device.

11 COMMISSIONING

Below describes the procedure for commissioning for the SmartLink PLC.



NOTICE:

Only commissioning of the SmartLink PLC is handled in this document. Make sure that the commissioning of the MG Master LV/HV is finished before starting this one.

11.1 Procedure

Use the following procedure to verify the systems functionality:

Check the firmware version of the MG Master LV or HV:

- ☐ The connected MG Master LV or HV firmware version is updated to the latest release.

Check MG Master LV or HV CAN-bus connections:

- ☐ All BMSs (AUX. CAN) are connected to the same NMEA2000 CAN-bus.

Check if the settings of the Master LV or HV are set correct:

- ☐ **External CAN bus protocol** is set to **MG NMEA2000**.
- ☐ **Combined battery mode** is set to **Enable**.
- ☐ **Start up when charger is detected** is set to **No** (only for MG master LV).
- ☐ A restart of all Master LV or HV's is done so the settings are activated.

Check SmartLink PLC connections:

- ☐ The SmartLink PLC is connected to the NMEA2000 CAN-bus of the Master BMSs.
- ☐ The SmartLink PLC is powered.

12 SERVICE

12.1 Maintenance

The device does not require specific maintenance. When any maintenance or user intervention is required, the user will be notified via status information send by the auxiliary CAN-bus or MOD-Bus TCP.



ELECTRICAL HAZARD:

Do not pour or spray water directly onto the device. When cleaning the device be aware that the connected battery string is a permanent energy source. Even when the device is turned off, the battery power connections might carry dangerous voltage levels.

12.1.1 Connections

It will suffice to check all connections once a year. Check if all connectors are mated correctly according the instructions given in sections of this manual.

12.1.2 Cleaning

Cleaning of the device is best done using a dry or slightly damp cloth. Limit the use of cleaning agents. If a cleaning agent is to be used, use an electrically non-conductive cleaning agent is advised.

It is important to keep the battery spaces clean and tidy in order to minimise the need for cleaning. Prevent the use of moisture, vaporizing agents, oil, grease, etc. in the vicinity of the device.

12.2 Disposal

Batteries marked with the recycling symbol must be processed via a recognized recycling agency. By agreement, they may be returned to the manufacturer. Batteries must not be mixed with domestic or industrial waste.

13 TECHNICAL SPECIFICATIONS

Technical specifications	SmartLink PLC Box Multi BMS
Power supply voltage range	18-32 VDC
Maximum current consumption	5 A
Active mode power consumption	~15 W
Maximum number of MG BMS's to combine	15
Communication	CAN-bus (NMEA2000), MOD-Bus TCP
IO	
Emergency contacts	6 emergency output contacts available
Power supply output	2.5A 24V power supply output
CAN-bus connection	M12
Enclosure	
Material	Powder coated steel
Dimensions	300 x 330 x 206 mm
Weight	7.7 Kg
Mounting	4x max Ø 10mm
Environmental	
Operating temperature range	-20 °C to 50°C
Humidity	Max. 95% (non-condensing)
Protection class	IP54

14 DIMENSIONS

The dimensions of this product can be downloaded from the MG Download Center.

<https://downloads.mgenergysystems.eu/smartlinkplc/drawings/smartlink-plc-box-drawing>

15 CONTACT DETAILS

For specific questions please feel free to contact us.

15.1 Sales

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

For specific sales questions, please contact our sales team:

MG Sales team

sales@mgenergysystems.eu

15.2 Technical support

For technical support, please follow the steps below:

1. Consult the Manual.
Manual can be found on the [MG Download Center](#).
2. Consult the [MG Support Center](#).
3. Watch the Installation Videos.
Videos can be found on [MG's You Tube channel](#).
4. 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](#).
5. Contact [MG Service Point](#).
6. Contact MG technical support.
Send an email with your technical questions to support@mgenergysystems.eu.