Innovation in energy storage

Version 1.0 – 05-02-2024

Lithium-Ion 12 V LFP SmartConnect battery system

- Manual -

MGLFPSC120210 (MG LFP Battery 12.8V/210Ah/2700Wh SmartConnect)
MG2000112 (MG SmartLink Connect)

MG Energy Systems B.V.

TABLE OF CONTENTS

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

Rev.	Date	Changes	Revision author
1.0	05-02-2024	Initial document	FS/MS

1.2 Terms, abbreviations, and definition

Table 2 - Terms, abbreviations, and definitions

Battery cell	*Battery cell;* the smallest building block in a battery, a chemical unit. Cell is the bare Lithium-Ion battery cell.
Battery module	*Battery module;* is an assembly of submodules, BMS and outer enclosure.
Battery stack	*Battery stack;* is a set of multiple cells in cell cassettes constructed as one.
BMS	*Battery Management System;* The BMS is the electronics that monitors the battery cell parameters to keep it within the operation specifications.
CAN-Bus	*Controller Area Network bus;* CAN-Bus is a standard serial data-bus that provides data communication between two or more devices.
C-rate	*C-Rate;* the current (A) used to charge/discharge the battery system divided by the rated ampere-hours (Ah).
EMS	*Energy Management System;* The EMS controls all power sources and consumers in a system.
HVIL	*High Voltage Interlock Loop;* is a wire loop which is created for protection of pulling cables from the battery system while in operation. It shuts down the system when loop is not closed.
IC	*Integrated Circuit;* is a chip containing an electronics circuit;
MSDS	*Material Safety Data Sheet;* is a document that lists information relating to occupational safety and health for the use of various substances and products.
NMEA 2000	*National Marine Electronics Association's* NMEA 2000 is a plug-and-play communications standard used for connecting marine sensors and display units within ships and boats, standardised in the IEC 61162-1.
PCB	*Printed Circuit Board;* is a board containing an electronic circuit;
PCBA	*Printed Circuit Board Assembly;* is a board containing an electronic circuit including passive and active components;
SoC	*State-of-Charge;* is the remaining capacity in a battery cell or module in percent (%).
SoH	*State-of-Health;* is a figure of merit of the condition of a battery (or a cell, or a battery pack), compared to its ideal conditions.

1.3 This revision

This revision replaces all previous revisions of this document. MG Energy Systems B.V. has made every effort to ensure that this document is complete and accurate at the time of writing. In accordance with our policy of continuous product improvement, all data in this document is subject to change or correction without prior notice.

1.4 Scope

This product manual contains technical description, installation, safety and commissioning instructions and other relevant information for the MG LFP 12V SmartConnect battery in combination with the MG SmartLink Connect.

1.4.1 Document structure

This document is structured into two categories:

- System design: Guidelines and general recommendations for system integrators and designers.
- Installation, commissioning and maintenance: Procedures and instructions for installers and maintenance personnel.
- Operation: Instructions and procedures for general users.

1.5 Related documents

More related documents for the MG LFP 12V SmartConnect battery and MG SmartLink Connect can be found on our Download Center.

2 SAFETY INSTRUCTIONS

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.

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

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

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.

WARNING:
The Smart Connect battery has an internal switch. When installing the battery the module should be switched off. In case of a damaged battery module the state of the battery is unknown and the battery can be live.

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.
- There is a risk of electrocution and burns when working on higher voltage systems without proper protective gear and special training.

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 for:

- Defining the responsibilities and competency of all personnel working with this product and all relevant systems.
- Providing instruction and training.
- Ensuring that the contents of the operating and safety instructions have been fully understood by the personnel.
- Ensuring 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 the leakage of dangerous materials.
- Product damage.
- Property damage.
- Loss of all claims for damages.

2.2.4 Risk assessment

For every integration of the battery system it might be applicable, depending on the application, to perform a risk assessment.

Goal of the risk assessment is to identify the hazards and determine the corresponding risks for the particular application.

The following topics need to be addressed:

- Fire hazards (fire from the batteries, fire from external source etc.)
- Environmental hazards (moisture, water ingress, vibration, heat etc.)
- Electrical hazards (short-circuit, cable dimensioning, cable routing etc.)
- Installation and operational hazards (lifting, communication, power loss etc.)

2.2.5 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.

WARNING:
The MG LFP 12V SmartConnect battery modules may only be used in combination with a MG SmartLink Connect.

3 TRANSPORT, STORAGE, UNPACKING AND HANDLING

3.1 Transport

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

Notes on transport:

- Use original packaging materials.
- Lithium-Ion batteries are dangerous goods and must be transported according to the applicable rules.
- Transportation company and shipper must be qualified to transport and package dangerous goods.
- The SoC during transport must be ≤ 30%.

For details on transport of this battery module see the MSDS and general transport instructions.

CAUTION:
It is not allowed to transport, connect or operate a damaged battery.

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.

NOTICE:
The SoC of the battery as delivered from factory is ≤ 30%.

3.2 Storage

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

Notes on storage:

- Battery module must be stored in its original packaging.
- Store in a dry, clean, and conditioned location.
- Local regulations for storage of dangerous goods may be applicable.
- Recommended storage temperature of the battery module is between +10°C to +25°C.
- It is recommended to limit the battery charge between 50% and 70% SoC. This will limit calendric aging.

The battery module's SoC is decreasing 1% per year when not connected to any equipment, including MG SmartLink Connect. Recharging is required when the voltage is in the range of the cut-off voltage.

3.2.1 Storage of connected system

Special instructions need to be considered when storing a fully connected system. This means one or more MG SmartConnect battery modules in combination with the MG SmartLink Connect.
For longer periods of storage the battery module should be charged between 50% and 80% SoC.

The MG SmartConnect battery has an internal contactor that fully disables the output of the positive power terminal. This means that all power at the battery output is off. However inside the battery module a circuit to keep the MG SmartLink Connect in standby mode. This enables the user to turn on the system by Bluetooth or with the remote start/stop button.

Bluetooth can be turned on or off. This effects the standby power.

- Bluetooth off: standby current is 1.8mA.
  Battery @ 100% SOC -> 4860 days, 694 weeks, 13.5 years.
- Bluetooth on: Standby current is 3mA
  Battery @ 100% SOC -> 2916 days, 416 weeks, 8.1 years.

Calculations a based on a system with one MG SmartConnect battery module and one MG SmartLink Connect.

NOTICE:
Check the voltage of the stored battery module every year.
When the battery module voltage is < 12 VDC, recharging is required. Contact MG Energy Systems for specific instructions and tools if necessary.

3.3 Unpacking and handling

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 Lifting the battery module

Use the handles on the side of the battery module for lifting:

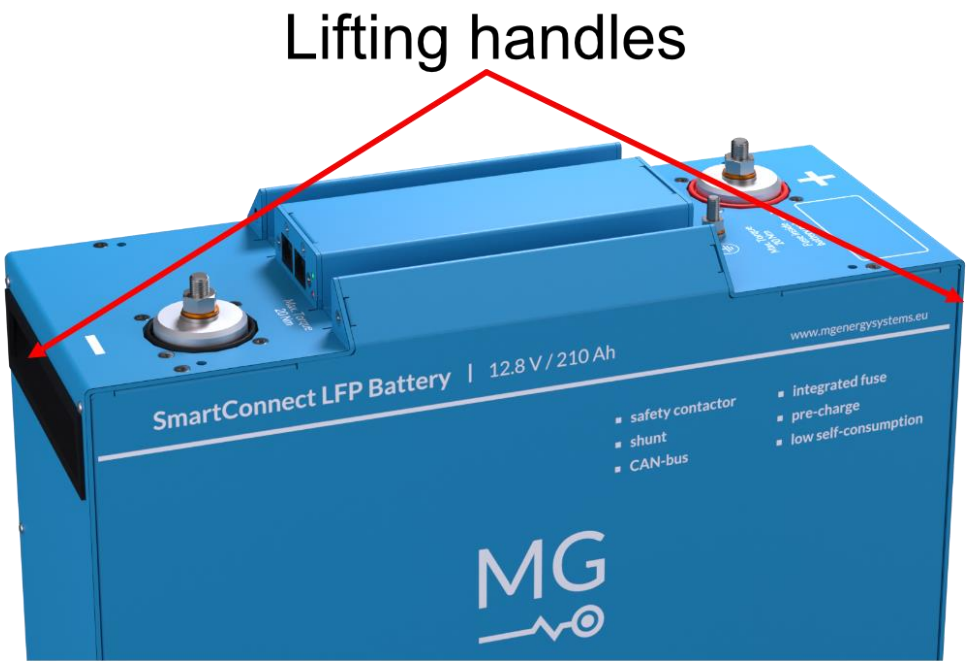


Figure 1 - LFP Lifting handles

CAUTION:
Always take the local applicable standards and regulations regarding the prevention of accidents into account when handling the product.

CAUTION:
Be aware of the total mass of the product and do not lift heavy objects unassisted.

3.3.2 Scope of delivery

The scope of delivery consists of two different products.

MG Battery module of type as described in chapter 5.1.:

- One or more MG LFP 12V SmartConnect battery modules.
- Quick installation guide: MG LFP 12V SmartConnect battery module

MG SmartLink Connect (MG2000112):

- One MG SmartLink Connect.
- Quick installation guide: MG SmartLink Connect

NOTICE:
Above products must be ordered separately!

NOTICE:

Not within the scope of delivery:

- Power cables and connectors (details can be found in chapter 6.1.2).
- Communication cables and connectors (details can be found in chapter 6.3.1).

4 GENERAL DESCRIPTION

The MG LFP 12V SmartConnect battery module in combination with the MG SmartLink Connect creates a battery system packed with features: Integrated BMS, built-in safety-contactor, pre-charge circuit, Bluetooth and sensors everywhere. The second generation LiFePO4 chemistry in combination with the SmartConnect technology makes this battery the ultimate choice.

WARNING:
This battery module can only be used in parallel!

WARNING:
The battery modules can only be used in combination with a MG SmartLink Connect.

4.1 Battery system components

The MG Energy Systems LFP SmartConnect battery system consists of the following components:

- One or more MG LFP 12 V SmartConnect battery modules of the same type;
- One SmartLink Connect battery management system;
- MG Energy Monitor (optional);

4.2 Functional description

Functional and safety features of the MG LFP SmartConnect battery system are:

- Robust LiFePO4 chemistry;
- Modular design;
- Low standby power;
- Plug and Play installation: Automatic configuration;
- Built in BMS;
- Internal Safety Contactor;
- DVCC and NMEA2000 Compatible;

4.3 Example systems

Different kind of battery system configurations can be created thanks to the modular design. The 12V Battery modules can be placed in parallel to create larger capacities.

4.3.1 System setup

The basic system are setup with one MG LFP 12V SmartConnect battery module and one MG SmartLink Connect. The example in Figure 2 is a simplified schematic showing the basic possibilities.

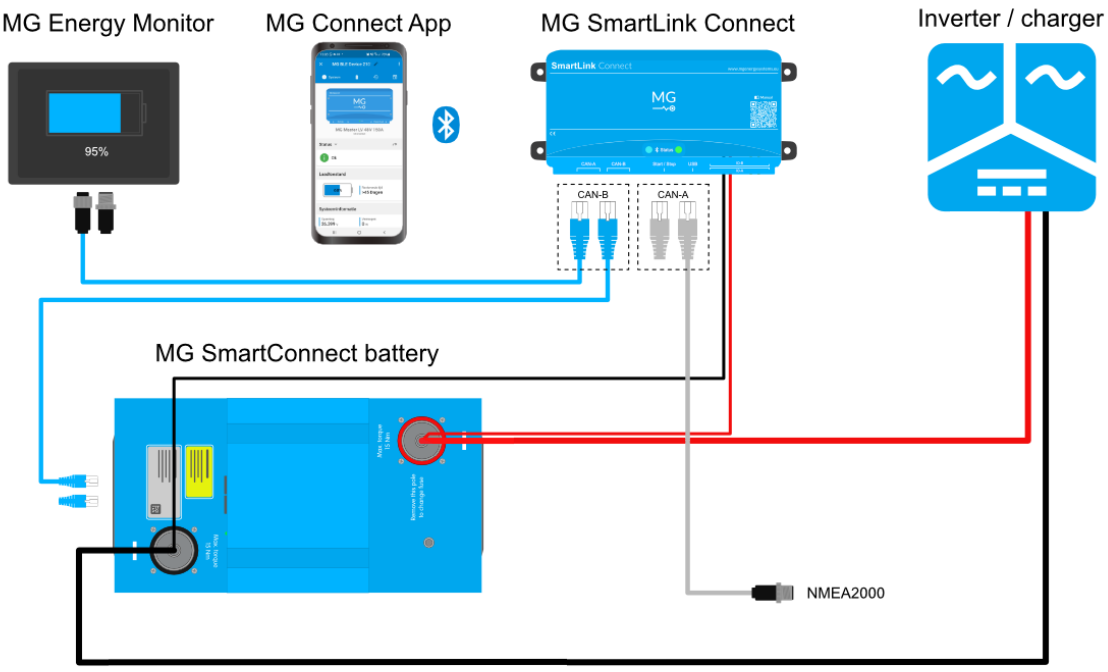


Figure 2 – SmartConnect 12 V battery system example

5 MODELS

5.1 MG Battery module models

The MG LFP 12V SmartConnect battery module is available in the following models:

Table 4 - Battery module models

Article number	Description	Remarks
MGLFPSC120210	MG LFP Battery 12.8V/210Ah/2700Wh SmartConnect	12 V installations only, RJ45 connectors

5.1.1 Battery designation

As per IEC 62620 it is required to state a standard designation per battery module configuration. For the LFP series lithium-ion battery these are given in table 5.

Table 5 - Battery module designation as per IEC 62620

Article number	Designation
MGLFPSC120210	IFpP/37/131/201/[2P4S]E/-10NA/95

5.1.2 Battery identification label

The identification label of the MG LFP battery module is located at the front of the enclosure.

Example identification label:

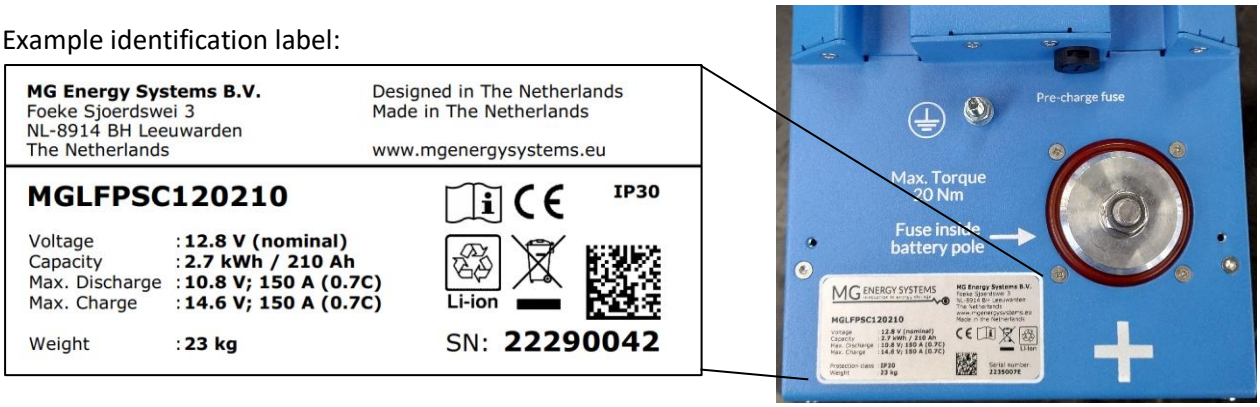


Figure 3 - Example identifications label

5.2 MG SmartLink Connect models

The MG SmartLink Connect is available in the following models:

Table 6 – SmartLink Connect models

Product	Article number
MG SmartLink Connect	MG2000112

5.2.1 MG SmartLink Connect identification

There are two identification labels located on the SmartLink Connect.
One of the Identification labels is located at the left side of the device.

Example identification label:

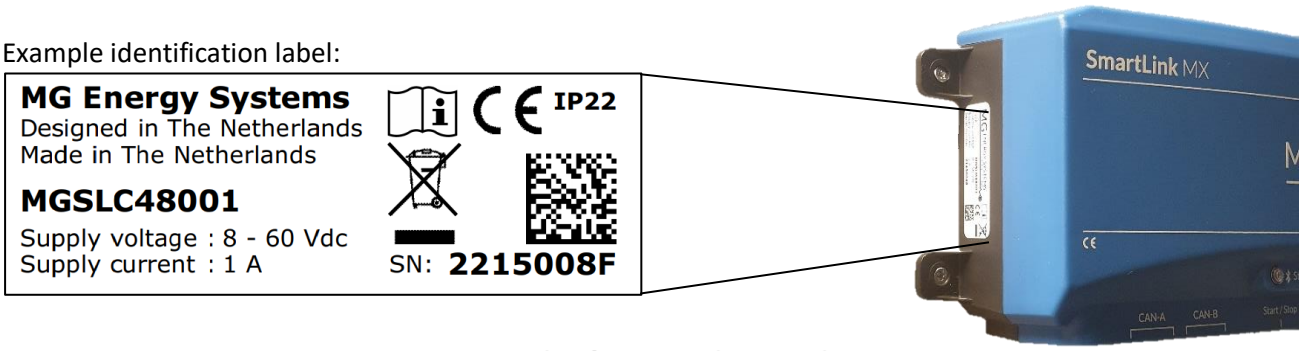
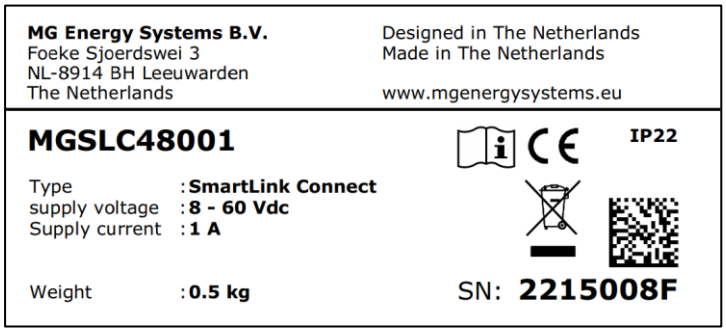


Figure 4 - identification number example

The other identification label of the SmartLink Connect is located at the bottom side of the device.



5.3 Identification label icons

The identifications label shown in figure 3 contains written information about the product. The explanation of the symbols used on the identification label is stated in table 7.

Table 7 - Identification lable logo explaination

CE	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 read before installation and use of the device.
	Device is treated according the Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU.
	GS1 data matrix type barcode containing detailed product information.

5.4 Approvals and standards

The MG LFP 12V battery system conforms to the following list of standards and tests.

- Declaration of Conformity
- Material safety datasheet

6 OVERVIEW

This chapter shows an overview of the 12V LFP Smart Connect battery and the SmartLink Connect.

6.1 12V LFP Smart Connect

Each battery module contains the following common parts:

- Negative battery pole connection;
- Positive battery pole connection;
- BMS CAN-Bus connection, RJ45;
- Status LEDs;

6.1.1 Connection overview

Figure 5 – LFP 210 Ah module overview

Table 8 - Module connection overview

Part	Description
A	Positive power connection (including fuse). M8 bolt connection.
B	Pre-Charge fuse
C	Equipotential bonding connection.
D	CAN-Bus communication, RJ45.
E	Negative power connection. M8 bolt connection.

6.1.2 Power connections

The power connections on the battery module consists of two M8 bolt connections. One is the positive battery pole and one is the negative battery pole.

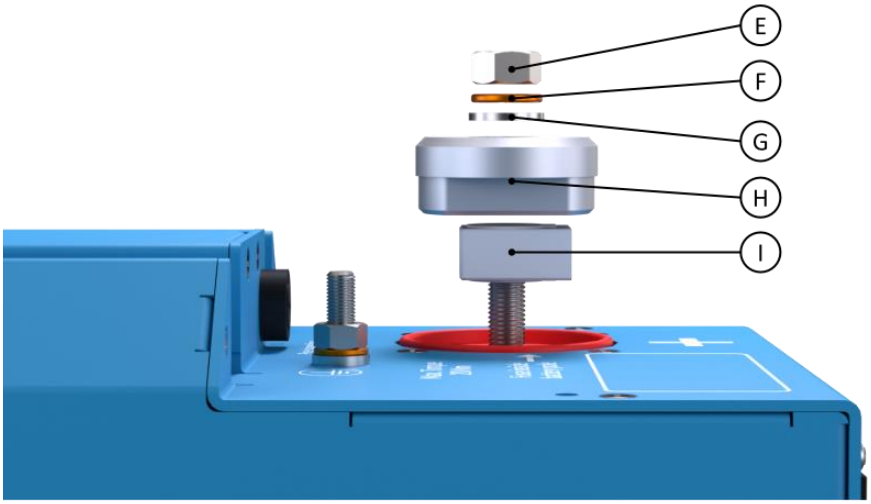


Figure 6 - Battery pole connection overview

Part	Description
E	Nut
F	Spring washer
G	Washer
H	Battery pole
I	Fuse (only positive battery pole)

6.1.2.1 Fuse

The positive battery pole contains a protection fuse. This fuse is a CF8 fuse. See chapter 8.5 for the replacement procedure.

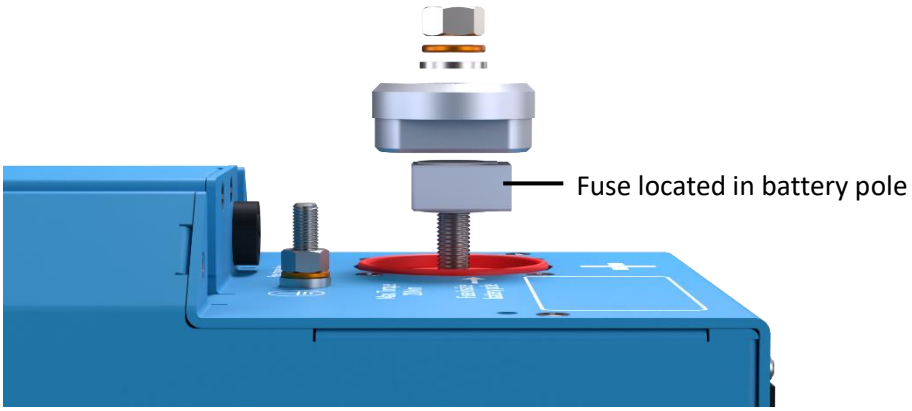


Figure 7 - Fuse location

Fuse types to use:

MG Fuse article number	Fuse current	Fuse manufacturer article number
MGFUSE1580150	150 A	Little fuse CF8 - 155.0892.6151
MGFUSE1580200	200 A	Little fuse CF8 - 155.0892.6201
MG4000034	-	Non-fused battery pole (negative battery pole)

See chapter 8.5 for the replacement procedure.

Default fuse types:

Battery type	Default fuse installed
MGLFPSC120210	200 A

NOTICE:

A broken fuse is indicated by measuring no voltage on the battery terminals. Before measuring the nut must be tightened first and the battery module must be turned on.

WARNING:

In some cases it is required to replace the fuse for a smaller one according to the cable size or can be fused elsewhere in the circuit.

6.1.3 Status indication

Figure 8 shows the location of the status indication LEDs. They are located next to the CAN-Bus connections.

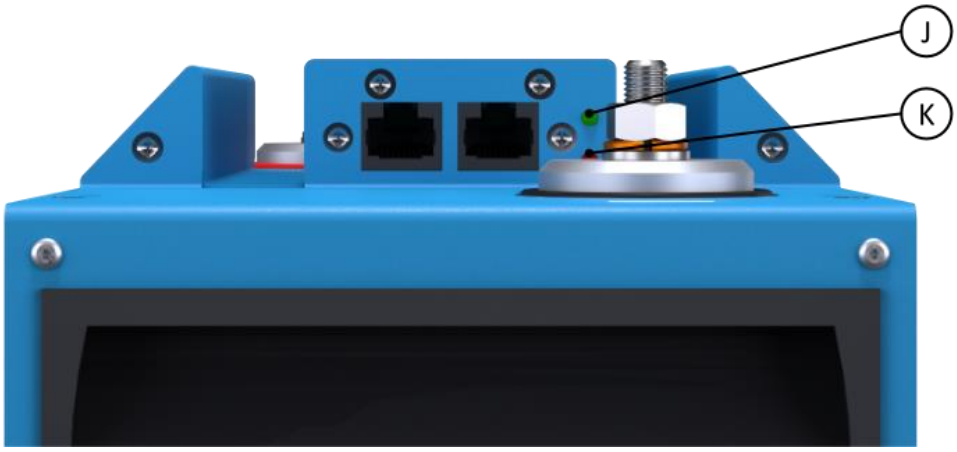


Figure 8 - Status LEDs overview

Part	Description
J	Green LED
K	Red LED

6.1.4 Indication

Table 9 shows the LED states and its meaning.

Table 9 - Status indication

Green LED	Red LED	Description
On	Off	Battery module is powered and internal BMS is operational.
On	On	Identification mode. The Red LED is turned on for a minute by the Diagnostic Tool to identify the battery.
Off	On	Battery module is in bootloader mode. Updating firmware is in progress.
Off	Off	Battery module is Off.

6.2 SmartLink Connect

This section shows the connection overview of the SmartLink Connect.

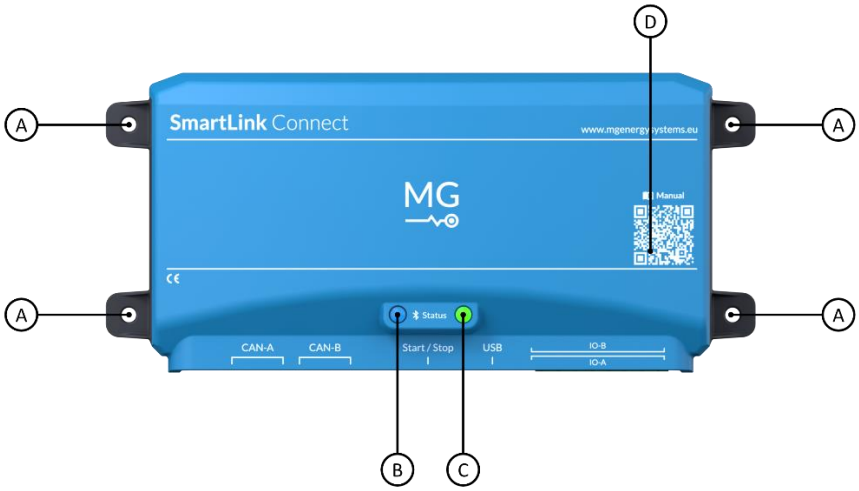


Figure 9 - SmartLink Connect overview front

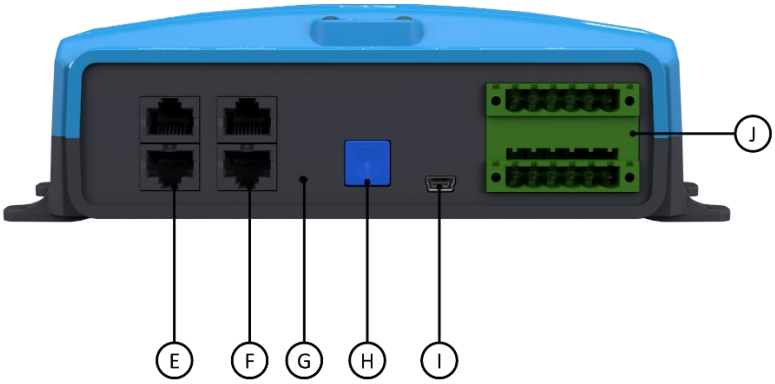


Figure 10 - SmartLink Connect connection overview

Part	Description
A	Mounting points:
B	Bluetooth LED
C	Status LED
D	QR-code for Manual
E	**CAN-A**: 2x RJ45: Public CAN-bus **(Isolated)**
F	**CAN-B**: 2x RJ45: Private CAN-bus
G	Internal reset button
H	Start/Stop/Reset Button
I	USB interface: Mini USB
J	IO connector **IO-A:** Power supply and digital IOs **IO-B:** Digital relay contact outputs

6.2.1 Connection details

This chapter describes the details of each IO connection of the MG SmartLink Connect.

6.2.2 I/O connectors

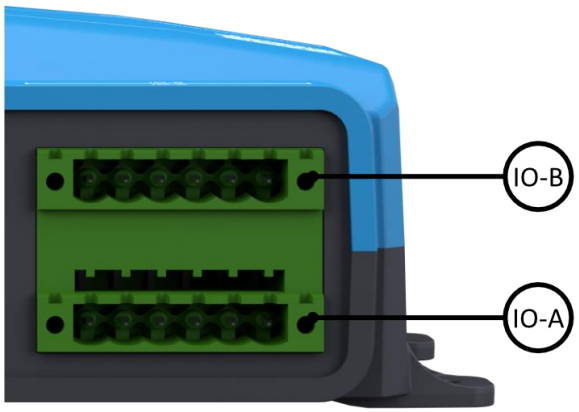


Figure 11 - IO connector pinout

Connector pins and specifications					
Conn.	**Pin**	**I/O**	**Voltage**	**Current**	**Purpose**
IO-A	1	In	60 V MAX	1 A	Power input
	2	Out			General IO, not implemented
	3	In			General IO, not implemented
	4	In			External start button
	5	Out	5 VDC	10 mA	External status output
	6	-			GND
IO-B	1	Out	Max. 60 VDC	0,8 A @ 60 VDC	Allow-to-charge
	2				
	3	Out	Max. 60 VDC	0,8 A @ 60 VDC	Allow-to-discharge
	4				
	5	Out	Max. 60 VDC	0,8 A @ 60 VDC	Programmable output 3
	6				

Table 10 - IO connector pinout

6.3 CANBus Connections details

Each battery module contains two CAN-Bus connectors to connect to the SmartLink Connect and to the next battery, if any.
This CAN-Bus connection is used for several functions:

- Data communication between battery module(s) and SmartLink Connect
- The battery module uses the V+ to enable the power of the internal BMS;

The LFP 12 V Series have the option for a RJ45 CAN-Bus connectors.

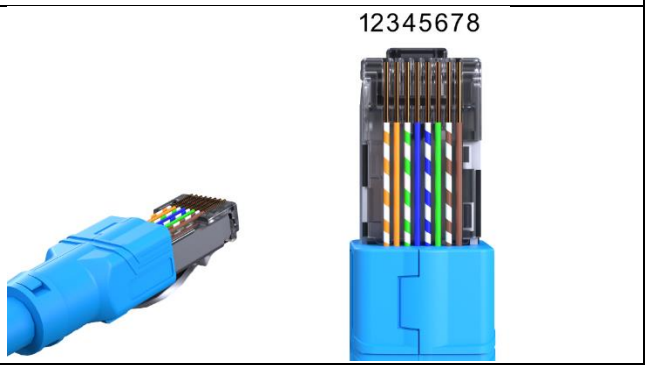
6.3.1 RJ45 CAN-Bus connector details

The standard connectors in the LFP Series are the RJ45 CAN-Bus connectors.

6.3.2 Connector details

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

Table 11 – RJ45 connector details

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

6.3.3 Smart Connect RJ45 details

The following table shows the pinout of the CANBus connection between the Smart Connect battery module and SmartLink Connect.

CAN-B: Private connector pins and specifications				
Pin	I/O	Voltage	Current	Purpose
1	-			
2	-			
3	-			GND
4	IN	10 V MAX		SP-Input **(Do not use)**
5	OUT	10 V MAX	100mA	SP-Feedback **(Do not use)**
6	IN	60 V MAX	1A	Optional power supply
7	CAN			CAN-H
8	CAN			CAN-L

NOTICE:

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

7 INTEGRATION

This chapter describes the necessary requirements and instructions for integration of the battery module into the application.

7.1 Risk assessment

Performing a risk assessment for the integration of the battery system is depending on the application for which specific rules might apply. For example in a Marine application, class register rules might apply or on other cases standard CE-marking might apply.

MG Energy Systems can supply the necessary basic documentation for risk assessment.

NOTICE:
Before integration design check the applicable rules for the application where the battery system will be integrated in.

7.2 Location

The location of the battery system needs special attention, since some regulatory body categorize Lithium-Ion battery systems as hazardous. Check for the local rules for the requirements of the battery system location in the used application.

General recommendations and requirements for the battery space with respect to the battery module are as following:

- Make sure the battery space is in accordance with the applicable rules.
- Ensure the battery space complies with the operating conditions of the batteries.
- Do not place the batteries next to a heat source.
- Accessibility for commissioning and service of battery modules must be maintained.
- Take into account the placement requirements in chapter 7.3.

7.2.1 Environment

The battery modules has an IP rating of IP30 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.

WARNING:
Moisture or water can damage the battery and its electronics. This might lead to dangerous situations.

7.2.2 Battery box

For some applications Local regulations or insurance companies may require additional safety measures. One of the solutions could be to place the battery modules in a steel box or sealed compartment with fire retardant properties. This will protect the battery modules from external environmental abuse such as water or moisture ingress and fire. It also protect the environment from a potential battery fire. The design and the requirement of using a battery box depends on the type of application and the outcome of the risk assessment.

Battery box options for additional safety measures:

- Preferred isolated for 60 minutes fire retardant (A60).
- Fluid and gas tight.
- Gas exhaust connection to outside (safe area).
- Manual or automatic flooding option of this battery box.
- Temperature and/or smoke sensor.
- No electrical switching equipment or junction boxes inside.
- Place the battery modules with at least 10 mm clearance from the floor/bottom.
- Accessibility for commissioning and service of battery modules must be maintained.

NOTICE:
Respect the thermal management notes of the battery module in chapter 7.2.2 when used in sealed spaces or compartments.

NOTICE:
Also find the guidelines for placement of batteries in a battery box on the MG Download Center

7.2.3 Thermal management

The LFP Series battery modules are air cooled. Therefore ambient temperature needs to be taken into account when selecting a space for the installation of the batteries.

- Make sure there is sufficient air flow in the battery space to dispose the heat rejected by the batteries and/or other equipment.
- The most optimized ambient temperature for the batteries is around 25 °C.

NOTICE:
Take into account the heat rejection of other equipment in the same space of the batteries.

NOTICE:
A significant decrease of cycle life will occur when the battery modules are used at high ambient temperatures.

If forced air ventilation is used for the battery room please make sure the environmental specifications are met. Temperature difference should in no way cause condensation on the battery module nor on other parts of the battery room.

7.2.3.1 Heat rejection

Table 12 shows the heat rejection versus charge and discharge rates for every LFP model.

Table 12 – Heat rejection versus charge/discharge rate.

Battery model	**LFP 210 Ah**
Nominal internal resistance	5 mOhm @ 25 °C

Cooling system	Passive air cooling (convection)
Heat rejection	0.5 C = 55 W 0.7 C = 110 W

7.3 Placement

This chapter will explain the design requirements for placement of the battery modules.

7.3.1 Positioning the battery

The battery module may only be placed upwards.

Figure 12 - Mounting positions of the LFP models

7.3.2 Mounting considerations

Mounting of the battery modules can be either done by straps or brackets.

NOTICE:
Mounting brackets or straps are not within the scope of delivery.

7.3.3 Battery module spacing requirements

Figure 13 shows the minimum spacing of the battery modules. It is mandatory to maintain a clearance of 10 mm from all sides of the battery module.

Figure 13 - Battery spacing requirements

7.4 Electrical

This chapter describes the installation and connections of the electrical wiring.

7.4.1 Power cables

Cable lengths need to be taken into account when designing a battery system.

NOTICE:

- Use the correct cable type for the applicable system voltage.
- Use the correct fuses for the applicable cable cross-section and voltage.
- We recommend to size the cables to limit voltage drop to 1% or less.

NOTICE:

Cable lug and battery must be cleaned before connection to ensure a low resistance connections. Check these power connections for excessive temperatures during a load test.

7.4.2 Parallel configuration

The battery module can set in parallel to create a larger system capacity. The SmartLink Connect can handle up to 6x LFP SC battery modules. Meaning that a 12 VDC system can have 6x LFP SC battery modules in parallel.

CAUTION:

Make sure the voltage of each battery module is equal in voltage/state of charge when connecting them in parallel. Excessive high uncontrolled currents can flow between battery modules when the voltage is not equal. This can damage the batteries and might lead to other damage or injury.

NOTICE:

The power cables of each battery module need to have matching lengths as good as possible when connecting battery modules in parallel.

There are two options when connecting more than four batteries in parallel.

1. Paralleling at the battery modules.
2. Paralleling using a custom bus bar connection system.

7.4.2.1 Paralleling at the battery modules

Paralleling at the battery modules makes it possible to connect more battery modules to a inverter/charger. Important is that the cable lengths of the battery modules must be as equal as possible to prevent too much differences during charging and discharging.

Figure 14 shows the connection of two paralleled battery modules. The two batteries in a group are connected crosswise. This is done to make sure the two batteries have the same total length of power cables and thus the same cable resistance.

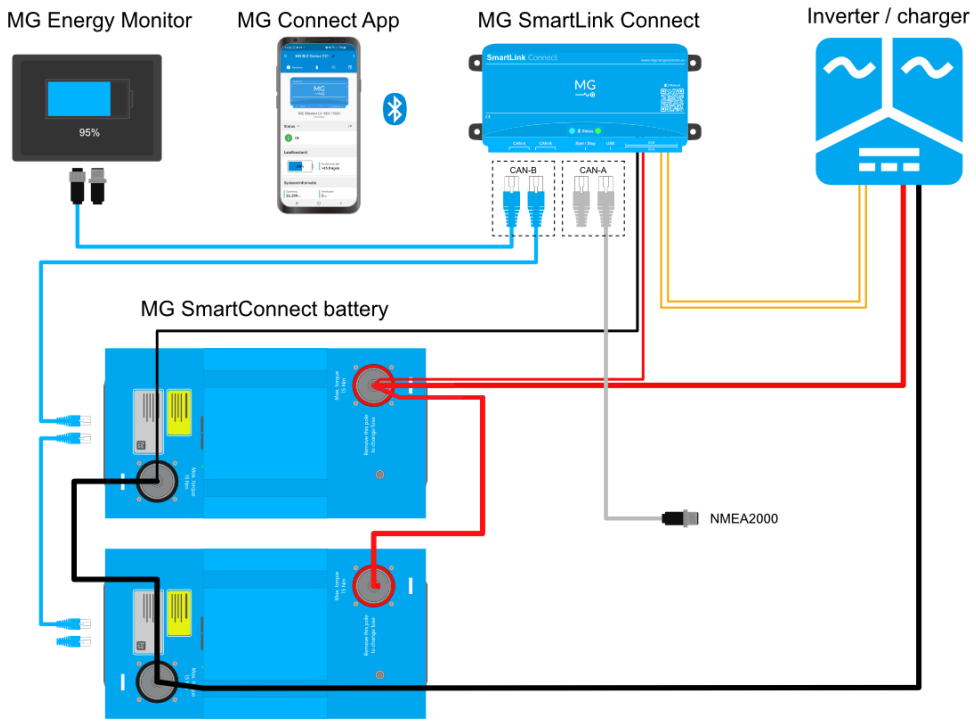


Figure 14 - Example of battery modules paralleled in groups

NOTICE:

- Do not create groups larger than six batteries;
- Only use this method in 12 V systems;

7.4.3 Charger

Any charger with constant voltage (CV) constant current (CC) charging can be connected to the MG battery system. The most important is that the charger can be stopped by the SmartLink Connect when the batteries are fully charged. Therefore the charger needs to have the ability to stop and start it remotely with a contact. There are also a number of chargers available that are digitally controlled by the SmartLink Connect.

7.4.3.1 Charger settings

Chargers that are controlled with a remote on/off need to use the following voltage settings.

Absorption voltage	14,1 VDC
Float voltage	13,2 VDC

8 INSTALLATION

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

Additional information for installation:

- Installation video: LFP 12 V SC
- Quick installation guide: LFP 12 V SC
- Technical drawings
- Application Notes

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. Therefore ensure 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.

8.1 Tooling

The required tools during installation are the following:

- Phillips screwdriver PH1 (insulated);
- Torque wrench M5 (8 mm) + M8 (13 mm) (insulated);

8.2 Installation procedures

Below the basic installation procedures at battery module level.

1. Mount the battery module: mounting procedure;
2. Equipotential bonding of the battery modules: equipotential bonding procedure;
3. Connect the battery module electrically: electrical connection procedure;

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

8.3 Mounting procedure

The battery module has no specific mounting points. Instead it can be mounted with brackets or straps as stated in chapter 7.3.2.

8.3.1 Mounting SmartLink Connect

Mount the SmartLink Connect to a flat surface with the 4 mounting holes on the side of the device. Make sure there is enough space to connect all interfaces and the Start-Button is reachable.

WARNING:
Countersunk screws should not be used. This can damage the mounting feet.

8.4 Electrical connection procedure

The battery module can be used in combination with other battery modules of the same type and always in combination with a SmartLink Connect.

Before any electrical connection can be performed, the top covers from the battery module must be removed.

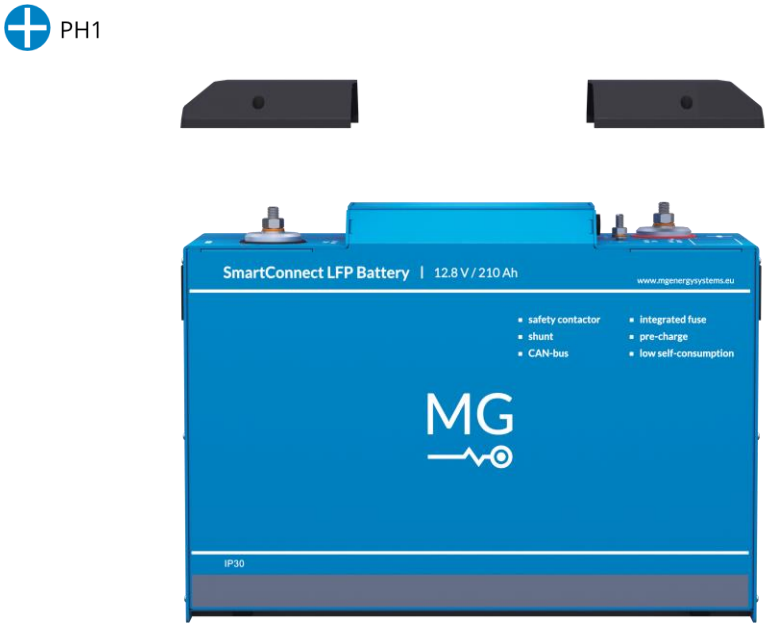


Figure 15 - Remove covers

ELECTRICAL HAZARD:
Before connecting the DC cables, make sure the other ends are protected or connected.

8.4.1 Equipotential bonding connection procedure

The equipotential bonding connection is located on top of the battery module next to the positive power connection as shown in chapter 6.1.1. Equipotential bonding connection scheme and the required wire cross-section depend on local standards and regulation. The typical used wire cross-section is 6 mm^2.

Connect a 6 mm^2 wire from the equipotential bonding point of each battery module in the system to a Protective Earth (PE). Tighten it with 4Nm.

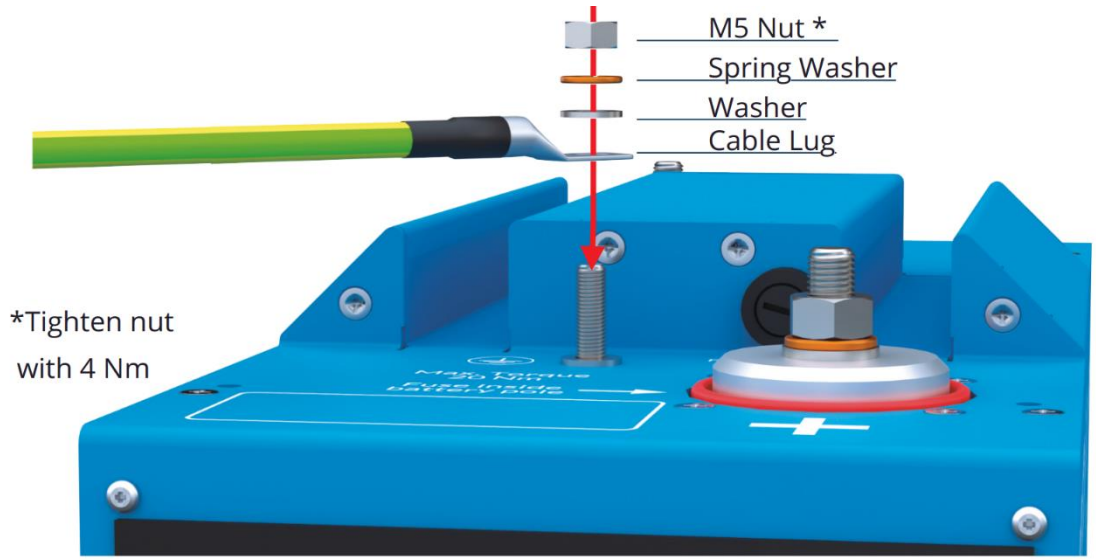


Figure 16 - Connection example of Equipotential bonding

ELECTRICAL HAZARD:
Make sure the equipotential bonding cable is routed with free clearance of the battery pole.

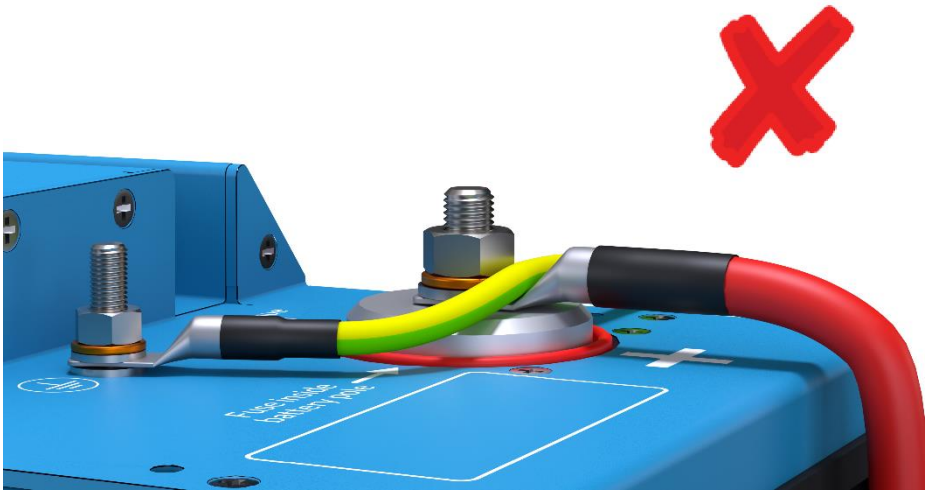


Figure 17 - Wrong routing of equipotential bonding wire

8.4.2 Positive and negative power connection procedure

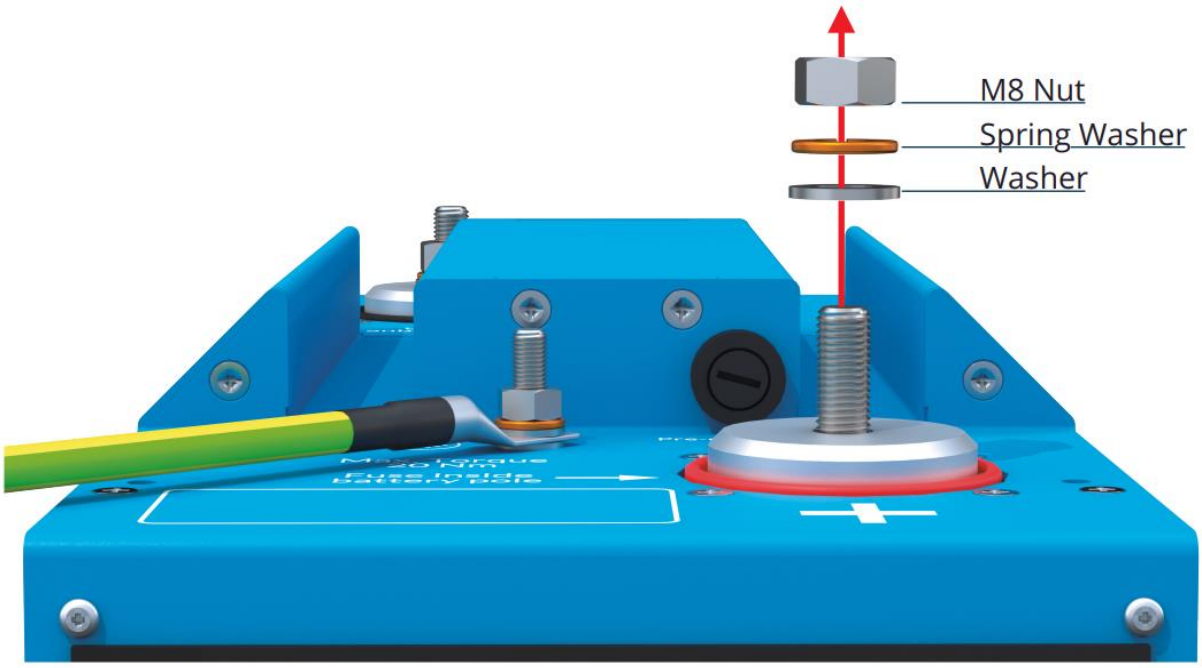
Before connecting any power cable make sure the routing of the power cables is made properly. Figure 18 shows a wrong connection of the power cable which will interfere with the CAN-Bus connectors and protection cover. Figure 19 shows a good connection of the power cable. Refer to chapter 0 for details about the power connections.

Figure 18 - Wrong connection of power cable

Figure 19 - Good connection of power cable

Below the procedure for connecting the power cables to the battery.

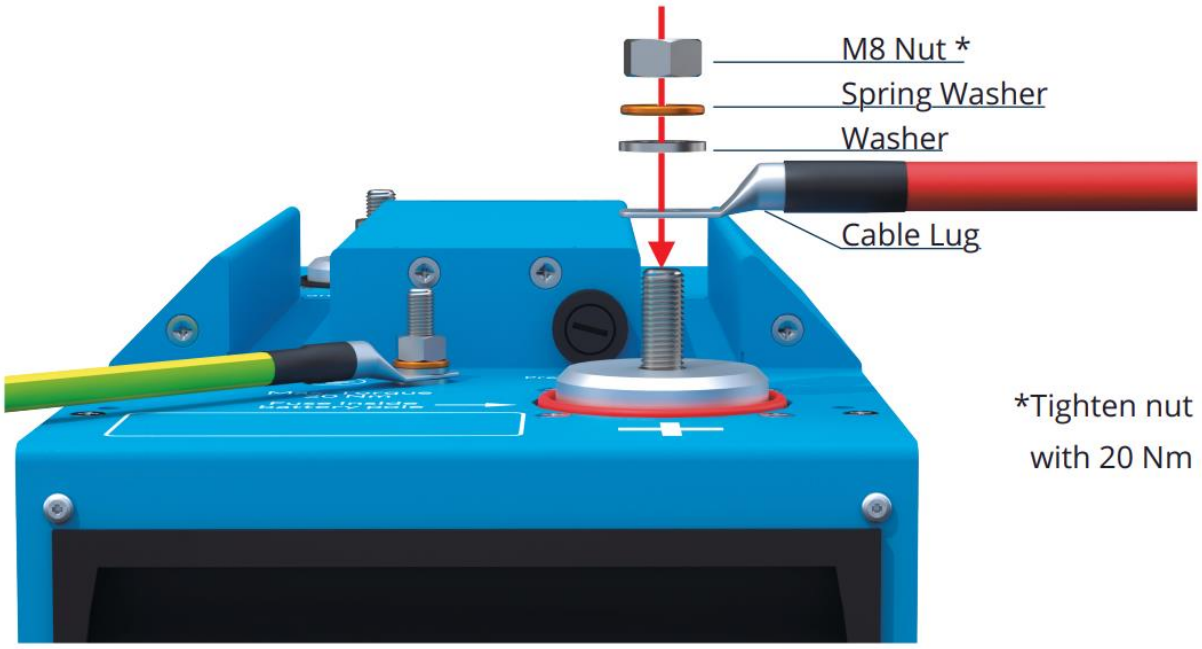
1. Remove the nut, spring washer and washer from the positive battery pole.



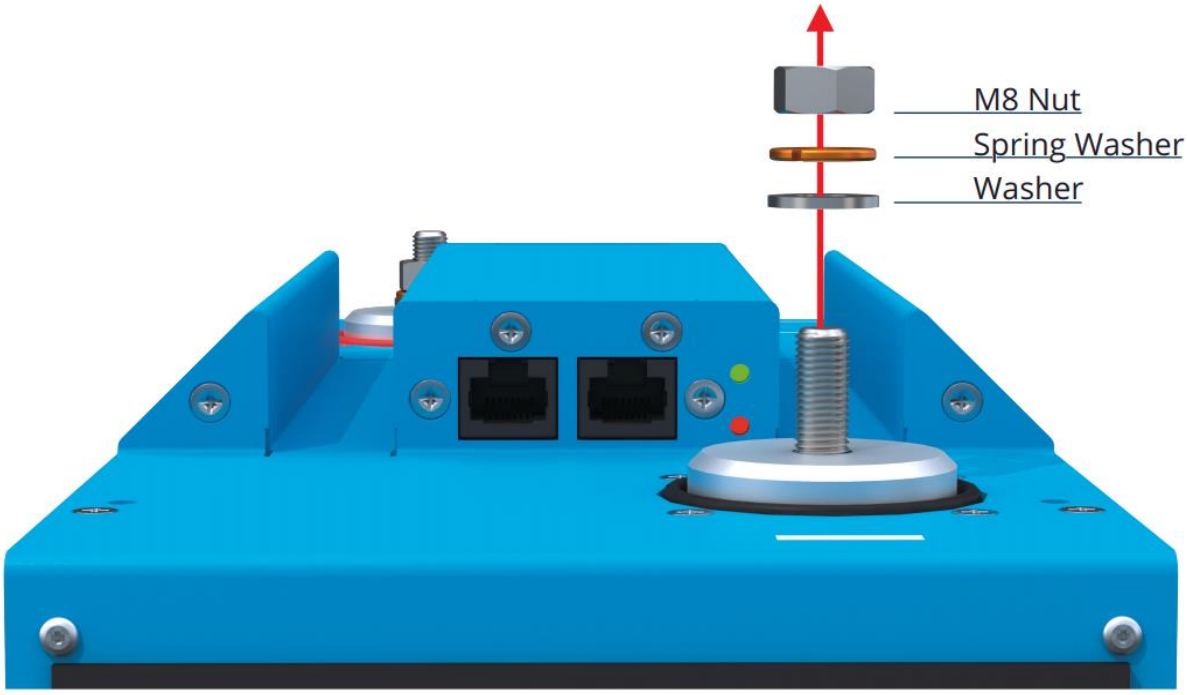
NOTICE:
When removing the nut and washers from the battery pole, it will become loose. This is normal. When the cable is connected and the nut and washers are back in place it will be tightened again.

2. Clean the battery pole and the cable lug's contact surfaces for a low resistance connection.

3. Connect the positive power cable with M8 cable lug to the M8 bolt as shown and place back the washer, spring washer and nut. Tighten the nut with a torque of 20 Nm.

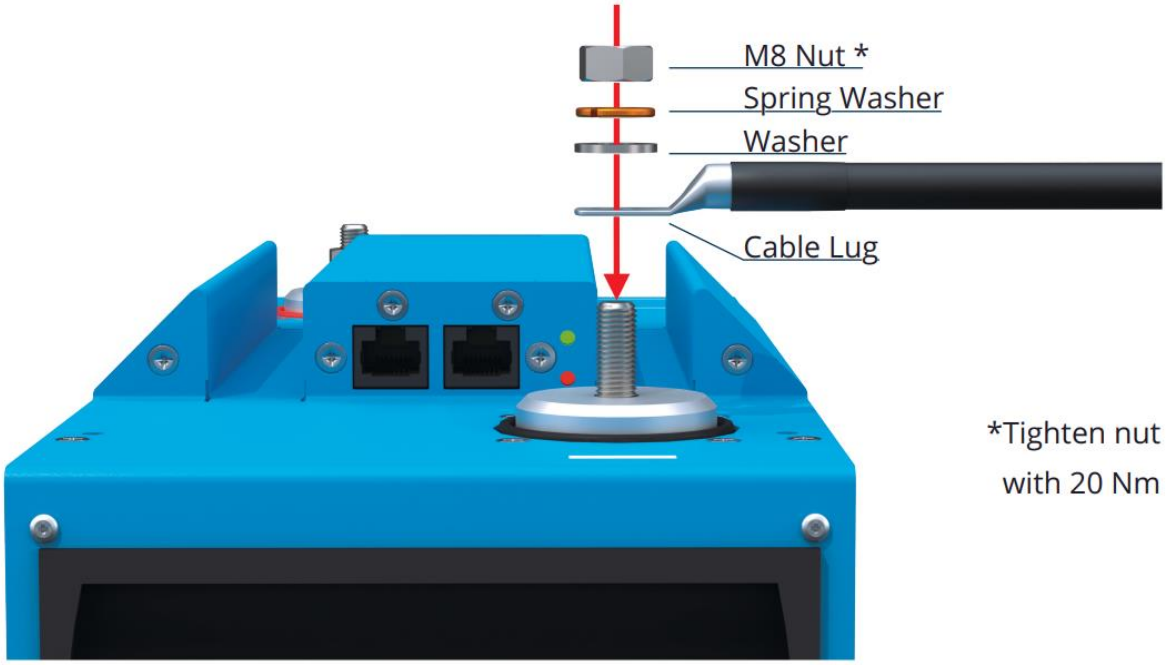


4. Remove the nut, spring washer and washer from the negative battery pole.



5. Clean the battery pole and the cable lug's contact surfaces for a low resistance connection.

6. Connect the negative power cable with M8 cable lug to the M8 bolt as shown and place back the washer, spring washer and nut. Tighten the nut with a torque of 20 Nm.



WARNING:
Make sure the cable lug is directly mounted to the battery pole without any washers or nuts in between.

WARNING:
Stacking of multiple cable lugs is possible however we strongly advise against it. Connection resistance increases which, in time, might lead to excessive heat generation.

ELECTRICAL HAZARD:
Make sure power cables are routed properly to avoid sharp edges and other possible causes of a short-circuit. It is recommended to protect the cables with a conduit system.

8.4.3 CAN-Bus connection procedure

The battery modules communicated with a CAN-Bus system to the SmartLink Connect. This connection is a RJ45 connector on the battery. For more information about the CAN-Bus communication connection possibilities, refer to section 6.3.

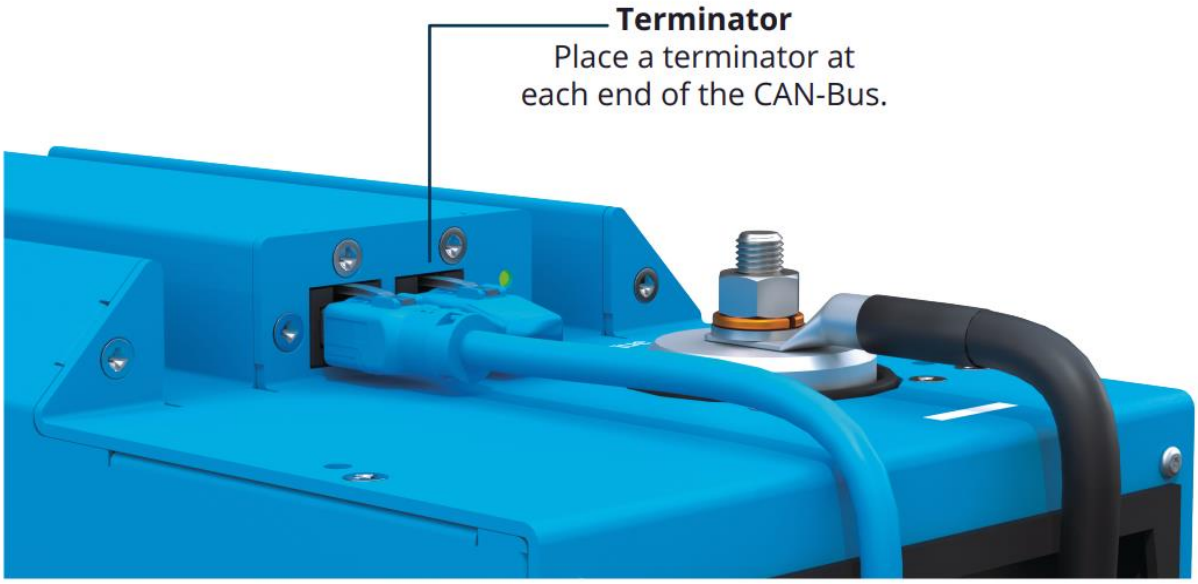


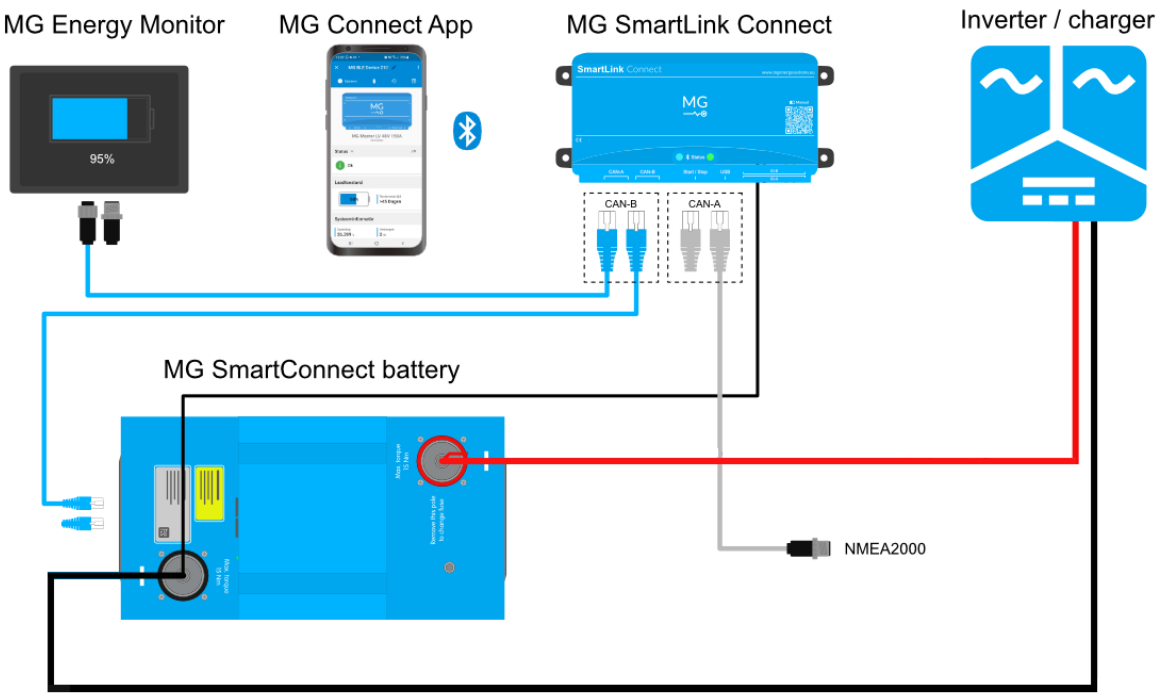
Figure 20 - RJ45 battery connection

8.4.3.1 Basic connection

The most basic connection of a SmartConnect battery module and a SmartLink Connect is as following:

1. Start with a CAN-Bus cable at the SmartLink Connect, the Battery CAN-Bus, and go to the first battery.
2. Connect from the first to the second battery. Repeat this until the last battery module.
3. Place a termination resistor at the end and begin of the CAN-Bus network.
4. Connect the negative side of one battery module to the SmartLink Connect IO-A connector pin 6 (GND) with a 1mm^2 wire
5. Connect the battery module to the inverter trough the main positive and negative connections
6. Make the implementation complete by connecting the CANBus NMEA 2000 or implement the ATC and ATD contacts form the SmartLink Connect

RJ45 connection:



WARNING:
Use the termination resistors delivered with the SmartLink Connect.
3rd party termination resistors could damage the devices, because pinning could be different.

8.5 Fuse replacing procedure

Replacement of the fuse requires the battery system to shut down. The fuse can be replaced with a new fuse or with a non-fused battery pole.

WARNING:

- When replacing the fuse with a non-fused battery pole, the fuse for the string of batteries needs to be installed separately in the system.
- Do not use the battery unfused.

8.5.1 Non-fused battery pole

The non-fused battery pole is actually a regular negative battery pole. Figure 21 shows the difference between the two.

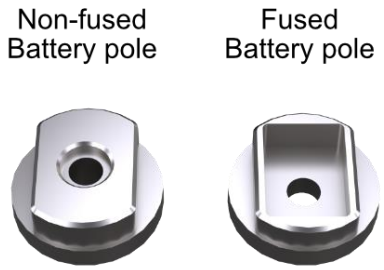
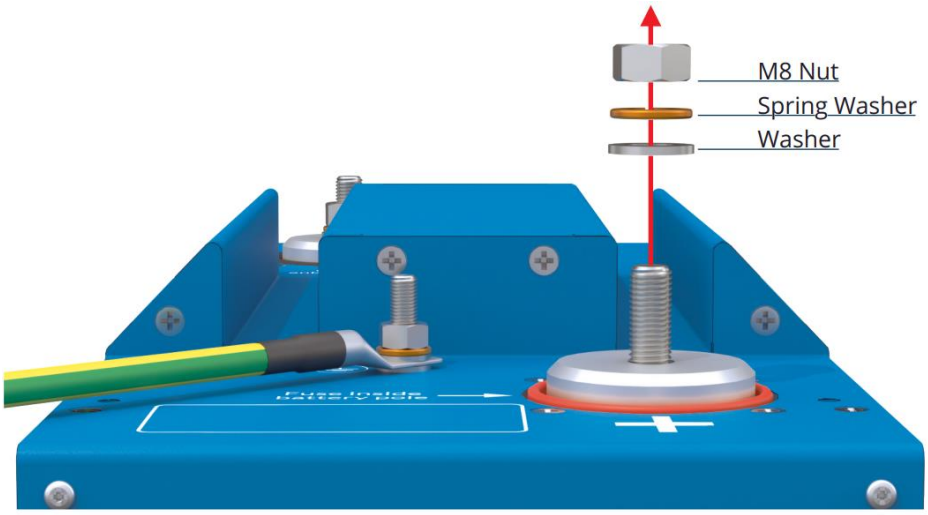


Figure 21 - Overview of negative and positive battery pole.

8.5.2 Replacement instructions

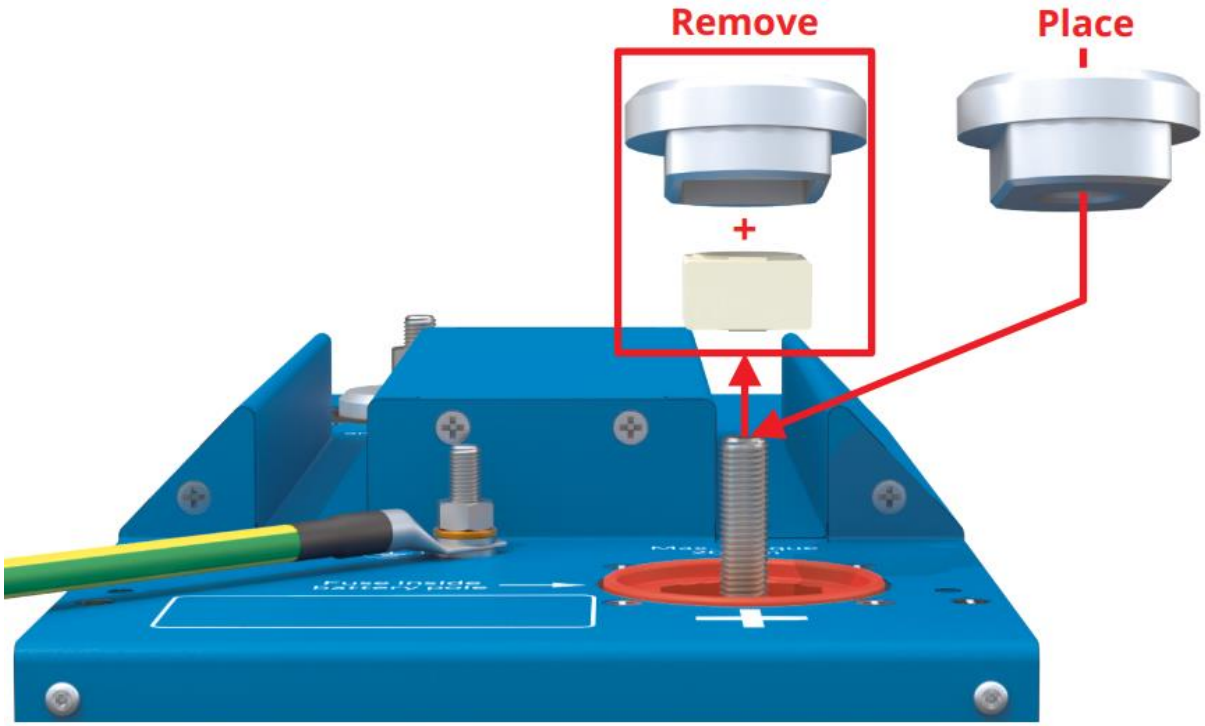
1. Remove the nut, spring washer and washer from the positive battery pole.



NOTICE:

When removing the nut and washers from the battery pole, it will become loose. This is normal. When the cable is connected and the nut and washers are back in place it will be tightened again.

2. Remove positive battery pole and fuse.



3. Now the fuse can be checked and replaced with a new one or it can be replaced with a non-fused battery pole. If the fuse is replaced with a non-fused battery pole then clean the battery pole with a fine sanding block (scotch-brite). Recommended is to add an electrical joint compound for better conduction.

4. Before connecting the power cable, the voltage of the battery module needs to be measured to check if it is the same as the parallel connected batteries. If not then charge/discharge the batteries separately to the same level.

5. Connect the power cables with the instructions of chapter 8.4.2.

9 OPERATION

This chapter will describe the user operation of the battery system. The basic user actions are as following:

- Start system;
- Stop system;
- Reset system;

9.1 States of operation

The SmartLink Connect has several states where it can operate in.

- **Normal operation**: The battery system is running. The main safety contactor of the Smart Connect Battery module is closed and charging and discharge is possible;
- **Standby**: The battery system is off.
- **Failsafe**: In this state the Status indicator is blinking red and beeping. The main safety contactor is opened and no power can be charged or discharged;

9.2 Starting the battery system

The start/stop button should be pressed for at least 2 seconds to start the battery system. The SmartConnect battery module begins to pre-charge the DC bus until the voltage has reached a safe level to close the main safety contactor. After closing the main safety contactor the chargers and loads are activated if possible. The system is now in **Normal operation**.

9.3 Stopping the battery system

The start/stop button should be pressed for at least 2 seconds to stop the battery system. The SmartLink Connect first stops all chargers and loads if possible and then opens the main safety contactor of each battery module. The system is now in **Standby**.

9.4 Resetting from failsafe

If the SmartLink Connect is in failsafe state, there are two possibilities: Stop the system or reset the system.

- To stop the system press the start/stop button for at least 2 seconds;
- To reset the system press the start/stop button shortly. No longer than **1 second.**

NOTICE:
The failsafe is only active for 10 minutes. After this time the SmartLink Connect will go to Standby automatically to save energy.

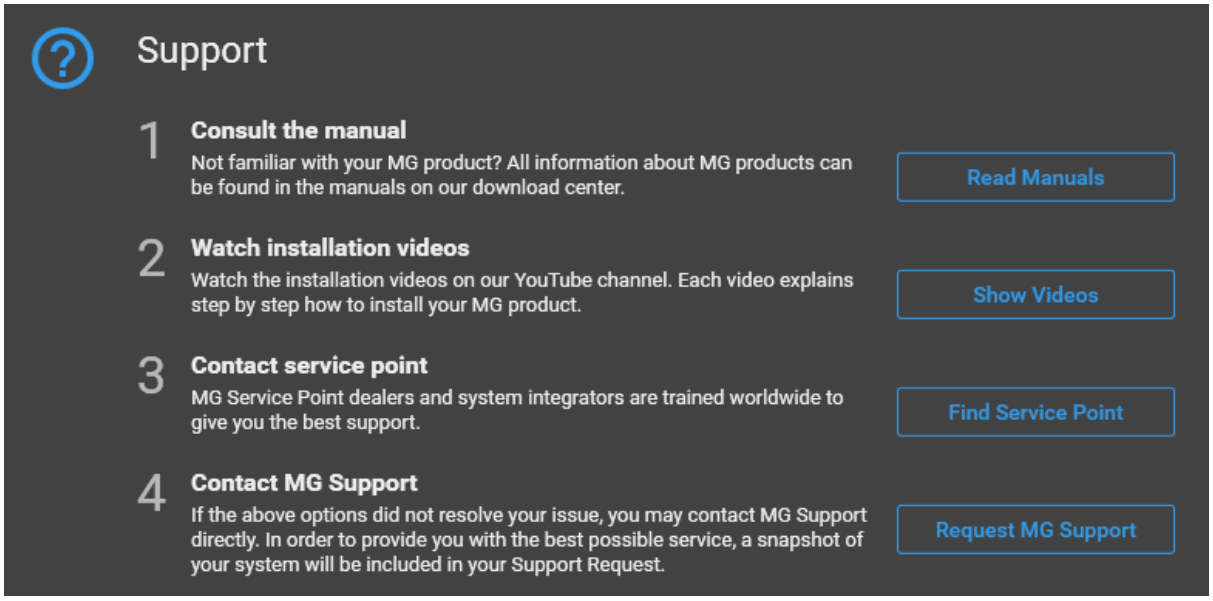
10 DIAGNOSTICS AND TROUBLESHOOTING

Diagnostic and troubleshooting can be achieved in several ways.

- Connecting the MG Diagnostic Tool;
- Connecting the MG Connect App;
- Looking/listening at the Status indicator;

10.1 Troubleshooting procedure

The below troubleshooting procedure will help you finding and solving the issue with the system.



10.2 Status indicator

Table 13 shows the meaning of the status LED and buzzer.

Table 13 - Status indication reference

Status LED state	Description
Off	System is in standby mode. Press Start button to start up the system.
On	Running.
Blinking red / no beep	In Secondary Bootloader
Blinking green/red fast	Updating firmware of connected batteries.
Flashing/beeping 2 times	Battery communication error (check BMS CAN-Bus cables).
Flashing/beeping 3 times	Under or overvoltage detected (check charger or load settings).
Flashing/beeping 4 times	Under or over temperature detected (check battery temperatures).
Flashing/beeping 5 times	Pre-charge time out occurred (check if pre-charge current is below 10A).
Flashing/beeping 6 times	Pre-charge fuse broken (check the pre-charge fuse). *Or* Overcurrent detected
Flashing/beeping 7 times	Battery configuration failure (check BMS CAN-Bus cables).
Flashing/beeping 8 times	Interlock loop open (check interlock loop configuration in Diagnostic Tool).
Flashing/beeping 9 times	Battery firmware updating failure (check BMS CAN-Bus cables and then contact manufacturer).
Flashing/beeping 10 times	Main safety contactor failure (contact manufacturer).
Flashing/beeping 11 times	Internal measurement failure (contact manufacturer).
Flashing/beeping 12 times	System instability problem detected (contact manufacturer).
Flashing/beeping 13 times	No appropriate firmware found for connected battery (contact manufacturer).

11 SERVICE

11.1 Maintenance

Maintenance attention mainly concerns the battery module, the SmartLink Connect does not need maintenance. For maintenance of the battery module it will be sufficient to inspect the following points once a year:

- Check the electrical connections on torque.
- Check if all communication connections are mated.
- Check for traces of water, oil, moisture, any other fluids or dust.
- Check for signs of corrosion.
- Clean the device.
- Check status with the MG Diagnostic Tool, MG Connect App (Apple or Android) or MG Energy Portal.

ELECTRICAL HAZARD:

Do not poor 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.

11.1.1 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 of 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.

11.2 End-of-life

The battery module is considered end-of-life if the SOH is decreased to 70 %. After this period it is strongly advised to replace the battery module to ensure safety.

11.3 Disposal

Batteries marked with the recycling symbol must be processed locally via a recognized recycling agency. By agreement, they may be returned to the manufacturer. Batteries must not be mixed with domestic or industrial waste. Before disposal it is recommended to discharge the battery module to 0 VDC.

12 BOUNDARY LIMITS

The boundary limits that are used by the SmartLick Connect for the battery modules are listed in this chapter. A level will be triggered when a boundary condition is true for a defined period of time.

Battery thresholds are compatible with the following master BMS firmware versions or higher:

- SmartLink Connect 1.1 or higher

12.1 Limits

Boundary limits are defined to keep the battery within manufacturer's specifications.

The tables with the boundary limits consist of:

- Name, description of the situation;
- Action, action on respond of the boundary, set/clear or failsafe;
- Boundary condition, contains a value that is needed for an action in combination with the time;
- Time that the boundary condition has to be present before it will be triggered. Times indicated with "+" start counting if the previous boundary condition above is set.

12.1.1 Cell voltage

Name	Action	Boundary condition	Time
Almost charged	Set	>= 3440 mV	10 sec.
	Clear	< 3390 mV	10 sec.
Charged	Set	>= 3520 mV	+10 sec.
	Clear	< 3440 mV	10 sec.
Over voltage warning	Set	>= 3600 mV	+20 sec.
	Clear	< 3520 mV	20 sec.
Over voltage critical	Failsafe	>= 3650 mV	+5 sec.
Almost discharged	Set	<= 3100 mV	10 sec.
	Clear	> 3150 mV	10 sec.
Discharged	Set	<= 3000 mV	+10 sec.
	Clear	> 3100 mV	10 sec.
Under voltage warning	Set	<= 2900 mV	+20 sec.
	Clear	> 3000 mV	20 sec.
Under voltage critical	Failsafe	<= 2850 mV	+5 sec.

12.1.2 Cell temperature charging

Name	Action	Boundary condition	Time
Over temperature alert	Set	>= 43 °C	5 sec.
	Clear	< 42 °C	5 sec.
Over temperature	Set	>= 45 °C	+20 sec.
	Clear	< 43 °C	20 sec.
Over temperature critical	Failsafe	>= 50 °C and charge current > 5% battery capacity	+60 sec.
Under temperature alert	Set	<= 1 °C	5 sec.
	Clear	> 2 °C	5 sec.
Under temperature	Set	<= 0 °C	+20 sec.
	Clear	> 1 °C	20 sec.
Under temperature critical	Failsafe	<= -5 °C and charge current > 5% battery capacity	+60 sec.

12.1.3 Cell temperature discharging

Name	Action	Boundary condition	Time
Over temperature alert	Set	>= 53 °C	5 sec.
	Clear	< 52 °C	5 sec.
Over temperature	Set	>= 55 °C	+20 sec.
	Clear	< 53 °C	20 sec.
Over temperature critical	Failsafe	>= 60 °C	+60 sec.
Under temperature alert	Set	<= -19 °C	5 sec.
	Clear	> -18 °C	5 sec.
Under temperature	Set	<= -20 °C	+20 sec.
	Clear	> -19 °C	20 sec.
Under temperature critical	Failsafe	<= -25 °C and discharge current > 10% battery capacity	+60 sec.
Invalid value warning	Set	-	10 sec.

12.1.4 Power terminal temperature

Name	Action	Boundary condition	Time
Over temperature alert	Set	>= 60 °C	5 sec.
	Clear	< 59 °C	5 sec.
Over temperature	Set	>= 70 °C	+20 sec.
	Clear	< 60 °C	20 sec.
Over temperature critical	Failsafe	>= 80 °C	+60 sec.
Invalid value warning	Set	-	10 sec.

12.1.5 Current per SmartConnect battery module

Name	Action	Boundary condition	Time
Over current warning	Set	> 0.75C	10 sec.
	Clear	<= 0.65C	10 sec.
Over current critical	Failsafe	> 1.0C	+50 sec.
Over current critical 2	Failsafe	> 1.2C	+25 sec.

12.1.6 SmartConnect system current

Name	Action	Boundary condition	Time
Over current warning	Set	> 1.0C or 600A	10 sec.
	Clear	<= 1.0C or 600A	10 sec.
Charging over current critical	Failsafe	> 2.4C	+20 sec.

12.1.7 Balancing

Name		Boundary condition	Time
Offset cell voltage		> 50 mV	5 min.
Balancing cell voltage		>= 3350 mV	5 min.
Battery pack current		current within ±5% battery capacity	5 min.

12.1.8 Contactor temperature

Name	Action	Boundary condition	Time
Over temperature alert	Set	>= 55 °C	5 sec.
	Clear	< 54 °C	5 sec.
Over temperature	Set	>= 58 °C	+20 sec.
	Clear	< 55 °C	20 sec.
Over temperature critical	Failsafe	>= 60 °C	+60 sec.
Invalid value warning	Set	= invalid	10 sec.

12.1.9 Hardware failure

When SmartConnect battery module has hardware failure of any kind.

Name	Level	Boundary condition	Time
Hardware failure warning	Set	= invalid	20 sec.
	Clear	= valid	20 sec.

12.1.10 PCBA Smart Connect battery temperature

Name	Level	Boundary condition	Time
Hardware failure warning	Set	= invalid	30 sec.
	Clear	= valid	30 sec.
Over temperature master warning	Set	>= 90,0 °C	30 sec.
	Clear	< 90,0 °C	30 sec.

12.1.11 Private CAN-bus communication timeout

Name	Level	Boundary condition	Time
Private CAN-bus communication timeout warning	Set	= not received all required data	10 sec.
	Clear	= received all required data	0 sec.
Private CAN-bus communication timeout critical	Fail-safe	= not received all required data	30 sec.

12.1.12 Private CANBus power supply

Name	Level	Boundary condition	Time
Hardware failure warning	Set	= invalid	30 sec.
	Clear	= valid	30 sec.
Hardware failure critical	Failsafe	= invalid	+10 sec.
Under voltage warning	Set	>= 9 V	10 sec.
	Clear	< 9 V	10 sec.
Under voltage critical	Fail-safe	>= 7 V	+50 sec.

13 TECHNICAL SPECIFICATIONS

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

https://downloads.mgenergysystems.eu/smartconnect/documents/technical-specification-en

14 DIMENSIONS

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

https://downloads.mgenergysystems.eu/smartconnect/drawings

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. 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. Contact MG Service Point.
5. Contact MG technical support.
   Send an email with your technical questions to support@mgenergysystems.eu.