

48 V Standalone Battery Module

Installation Manual

About this manual

This manual describes how to install and use EM048063P3S and EM048126P3S series battery modules by LG Chem. Read this manual before you attempt to install the product, and follow the instructions throughout the installation process. If you are uncertain about any of the requirements, recommendations, or safety procedures described in this manual, contact LG Chem immediately for advice and clarification.

The information included in this manual is accurate at the time of publication. However, the product specifications are subject to change without prior notice. In addition, the illustrations in this manual are meant to help explain system configuration concepts and installation instructions. The illustrated items may differ from the actual items at the installation location.

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Chapter 1

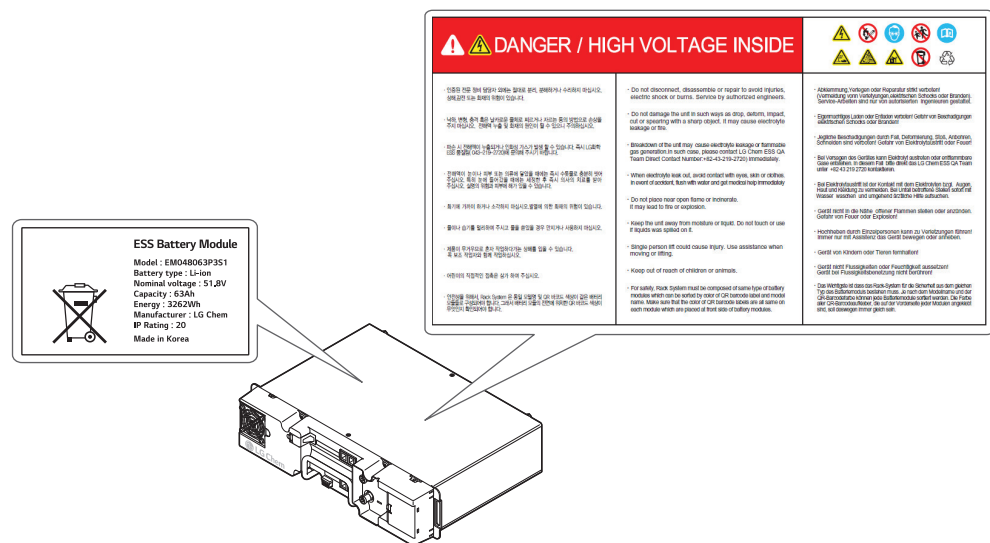
Safety

NOTE

To use rechargeable batteries, installers are required to comply with standard AS 4086.2 in Australia, VDE-AR-E2510-2 in Germany, and the domestic legislation in other countries.

1.1 Symbols on product labels

The nameplate and the warning label are attached to the top of the battery module.



The voltage of this battery module is strong enough to cause electric shock.



Keep the battery module away from open flame or ignition sources.



Wear appropriate personal protective equipment when dealing with the battery module.



Keep the battery module away from children.



Read the manual before installing and operating the battery module.



The battery module may leak corrosive electrolyte.



The battery module may explode.



The battery module is heavy enough to cause severe injury.



The battery module should not be disposed of with household waste at the end of its working life.



The battery module should be disposed of at a proper facility for environmentally safe recycling.

1.2 Safety instructions

For safety reasons, installers are responsible for familiarizing themselves with the contents of this manual and all warnings before performing installation.

1.2.1 General safety precautions

WARNING

Failure to observe the precautions described in this section can cause serious injury to persons or damage to property.

- Risks of explosion
 - Do not subject the battery module to strong impacts.
 - Do not crush or puncture the battery module.
 - Do not dispose of the battery module in a fire.
- Risks of fire
 - Do not expose the battery module to temperatures in excess of 60°C.
 - Do not place the battery module near a heat source, such as a fireplace.
 - Do not expose the battery module to direct sunlight.
 - Do not allow the battery connectors to touch conductive objects such as wires.
- Risks of electric shock
 - Do not disassemble the battery module.
 - Do not touch the battery module with wet hands.
 - Do not expose the battery module to moisture or liquids.
 - Keep the battery module away from children and animals.

- Risks of damage to the battery module
 - Do not allow the battery module to get in contact with liquids.
 - Do not subject the battery module to high pressures.
 - Do not place any objects on top of the battery module.

1.2.2 Battery handling guide

- Use the battery module only as directed.
- Do not use the battery module if it is defective, appears cracked, broken or otherwise damaged, or fails to operate.
- Do not attempt to open, disassemble, repair, tamper with, or modify the battery module. The battery module is not user serviceable.
- To protect the battery module and its components from damage when transporting, handle with care.
- Do not impact, pull, drag or step on the battery module. Do not subject it to any strong force.
- Do not insert foreign objects into any part of the battery module.
- Do not use cleaning solvents to clean the battery module.

1.3 Response to emergency situations

While the battery module comprises multiple battery cells that are designed to prevent hazards resulting from failures, LG Chem cannot guarantee their absolute safety.

1.3.1 Leaking batteries

If the battery module leaks electrolyte, avoid contact with the leaking liquid or gas. Electrolyte is corrosive and contact may cause skin irritation and chemical burns. If one is exposed to the leaked substance, do these actions:

Inhalation: Evacuate the contaminated area, and seek medical attention immediately.

Eye contact: Rinse eyes with flowing water for 15 minutes, and seek medical attention immediately.

Skin contact: Wash the affected area thoroughly with soap and water, and seek medical attention immediately.

Ingestion: Induce vomiting, and seek medical attention immediately.

1.3.2 Fire



In case of a fire, make sure that an ABC or carbon dioxide extinguisher is nearby.

⚠ WARNING

The battery module may catch fire when heated above 150°C.

If a fire breaks out where the battery module is installed, do these actions:

1. Extinguish the fire before the battery module catches fire.
2. If the battery module has caught fire, do not try to extinguish the fire. Evacuate people immediately.

⚠ WARNING

If the battery catches fire, it will produce noxious and poisonous gases. Do not approach.

1.3.3 Wet batteries

If the battery module is wet or submerged in water, do not try to access it. Contact LG Chem or your distributor for technical assistance.

1.3.4 Damaged batteries

Damaged batteries are dangerous and must be handled with extreme caution. They are not fit for use and may pose a danger to people or property. If the battery module seems to be damaged, pack it in its original container, and then return it to LG Chem or your distributor.

⚠ CAUTION

Damaged batteries may leak electrolyte or produce flammable gas. If you suspect such damage, immediately contact LG Chem for advice and information.

1.4 Qualified installers

This manual and the tasks and procedures described herein are intended for use by skilled workers only. A skilled worker is defined as a trained and qualified electrician or installer who has all of the following skills and experience:

- Knowledge of the functional principles and operation of on-grid systems.
- Knowledge of the dangers and risks associated with installing and using electrical devices and acceptable mitigation methods.
- Knowledge of the installation of electrical devices

- Knowledge of and adherence to this manual and all safety precautions and best practices.

1.5 Safety gear

Wear the following safety gear when dealing with the battery module. Installers must meet the relevant requirements of international standards, such as IEC 60364 or the domestic legislation.



Insulated gloves



Safety goggles



Safety shoes

1.6 Contact information

Use the contacts below for technical assistance. These phone numbers are available only during business hours on weekdays.

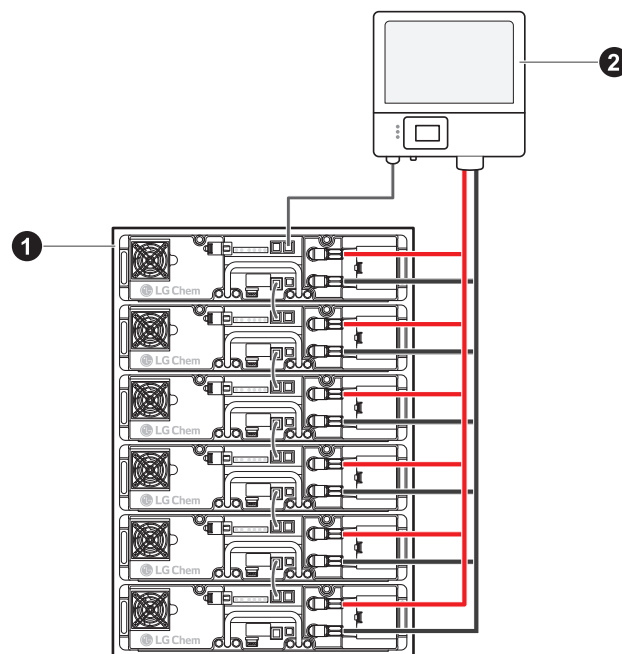
	Telephone	Email
Europe	+49 162 2970918	kalies@lgchem.com
USA	+1 888 375 8044	CSNorthAmericaESS@lgchem.com
Australia	+61 1300 178 064	m_AUservice@lgchem.com
Korea and other regions		essservice@lgchem.com

Chapter 2

Introduction

The EM048063P3S and EM048126P3S series battery modules are designed to be part of a small-scale electric energy storage system (ESS) for two purposes:

- Telecommunication system backup
- Residential photovoltaic system



1 ESS

2 Inverter or rectifier

NOTE

Hereafter in this manual, ESS refers to a set consisting of EM048063P3S or EM048126P3S series battery modules. Higher-level system refers to a rectifier or inverter that connects to the ESS to charge and discharge the ESS.

2.1 Features

The EM048063P3S and EM048126P3S series battery modules have the following features:

Built-in battery management system (BMS): A battery module's BMS monitors its operation and prevents the battery from operating outside design limitations. When a battery module enters an abnormal state, the BMS issues an alert and restricts or disables the battery's operation.

Hot-swap capability: Faulty battery modules can be replaced while the ESS remains in operation.

NOTE

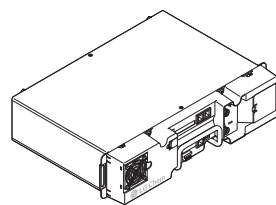
This feature is not supported with the residential models.

Scalability: An ESS can comprise up to 10 units connected in parallel. Battery modules can be arranged not only layer upon layer but also side by side.

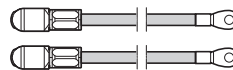
Power saving: When a battery voltage drops below the specified limit, it turns off. The battery module wakes up when a voltage higher than or equal to 33 V is applied.

2.2 System components

Aside from the battery modules, other items might be provided separately.



Battery module



Power cable



Intra-rack communication cable



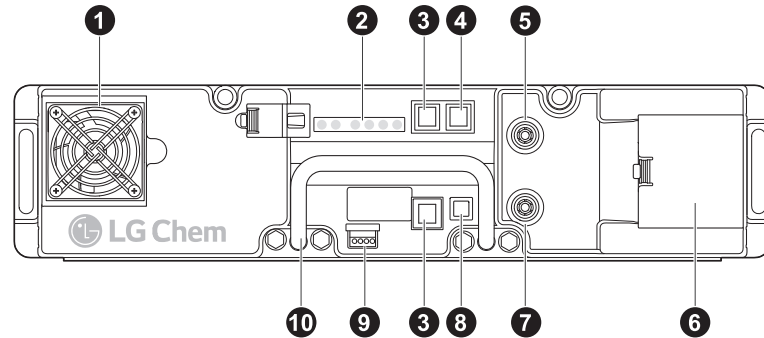
Higher-level communication cable

The table below lists the number of each component.

Battery module	As demanded (N)
Power cable	As many as the number of battery modules (N)
Intra-rack communication cable	One less than the number of battery modules (N-1)
Higher-level communication cable	1

2.3 Product overview

2.3.1 Appearance



- ❶ Fan
- ❷ Status indicators
- ❸ RJ48 port for intra-rack communication cable
- ❹ RJ48 port for higher-level communication cable
- ❺ Positive connector (+)
- ❻ Power terminal compartment
- ❼ Negative connector (-)
- ❽ On/Off button
- ❾ Dry contact
- ❿ Handle

2.3.2 Model lineup

There are four EM048063P3S series models and three EM048126P3S series models.

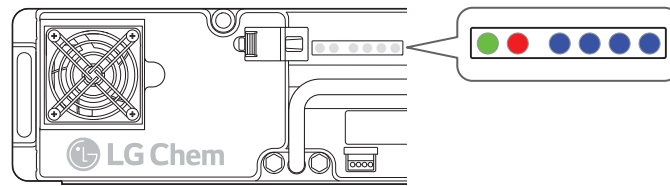
Model	Capacity	Protocol	Fan	Application
EM048063P3S1	63 A·h	Modbus 485	Equipped	Telecom.
EM048063P3S2	63 A·h	Modbus 485	Not Equipped	Residential
EM048063P3S4	63 A·h	CAN 2.0B	Not Equipped	Residential
EM048063P3S5	63 A·h	CAN 2.0B	Not Equipped	Residential
EM048126P3S6	126 A·h	Modbus 485	Not equipped	Telecom.
EM048126P3S7	126 A·h	CAN 2.0B	Not equipped	Residential
EM048126P3S8	126 A·h	Modbus 485	Not equipped	Residential

These models are the same in hardware but slightly different from each other in software.

NOTE

An ESS can consist of up to 10 units of the same battery module. Using different models of battery modules together is not permitted.

2.3.3 Status indicators



The indicators on the front of a battery module show its operating state.

						Normal
						SOC ≥ 75%
						SOC ≥ 50%
						SOC ≥ 25%
						SOC < 25%
						Voltage imbalance
						Warning
						Fault 1
						Fault 2

Green indicator: The first indicator on the left is on solid **GREEN** to show that the module is operating normally. While the module is initialized, only this indicator is on.



Blue indicators: In normal operation, the four indicators on the right show the module's state of charge (SOC). Each indicator represents 25% of a full charge. If the SOC value is 50%, the three rightmost indicators are on solid **BLUE**. The blue indicators of the slave modules look as below.



Whereas, the leftmost blue indicator on the master module flashes.



The blue indicators are also used to show the battery module's model number and ID. See **Identifying model number** on page 22 and **Commissioning the ESS** on page 28 for details.

Voltage imbalance: In the course of activating the ESS, the two leftmost indicators may turn on simultaneously temporarily due to voltage imbalance between the battery modules.



With the FET open, the module waits while the other modules charge. The red indicator turns off when all the modules reach the same voltage at around SOC of 93%.

Warning: When the module is in a warning state, the green indicator flashes *GREEN*. The blue indicators still shows the SOC.



Fault 1: When the module is in a low-level fault state, the green indicator turns off and the second indicator from the left flashes *RED*. Moreover, the blue indicators show the fault number in binary form.

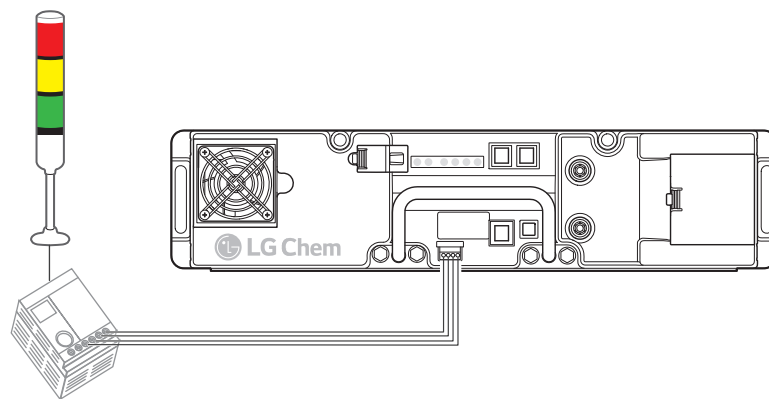


Fault 2: When the module is in a high-level fault state, the green indicator turns off and the second indicator from the left comes on solid *RED*. Moreover, the blue indicators show the fault number in binary form.

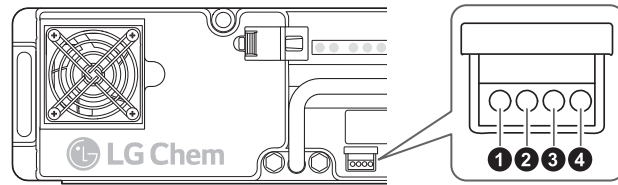


For details about warning and fault states, see the Service Manual.

2.3.4 Dry contact



There is a dry contact which can be used to signal to external devices, such as a stack light or a buzzer. Where appropriate, make connections to the dry contact of the master battery module. See **Master and slave modules** on page 16 for details about the master module.



When a battery module enters a warning or fault 1 state, the relay's terminal 1 and 2 become closed. When it enters a fault 2 state, terminal 3 and 4 become closed.

	Terminal ❶ and ❷	Terminal ❸ and ❹
Normal state	Open	Open
Warning or Fault 1 state	Closed	Open
Fault 2 state	Open	Closed

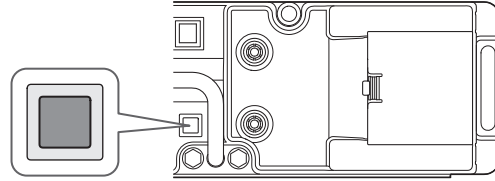
NOTE

The current through each terminal must not exceed 90 mA.

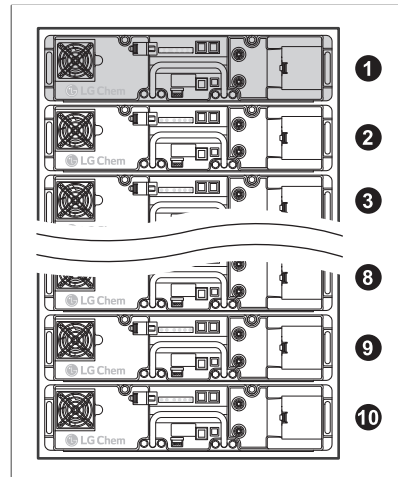
2.4 Master and slave modules

One of battery modules installed in the ESS acts as the master module, and the others act as slave modules. As the representative of the ESS, the master module communicates with the higher-level system.

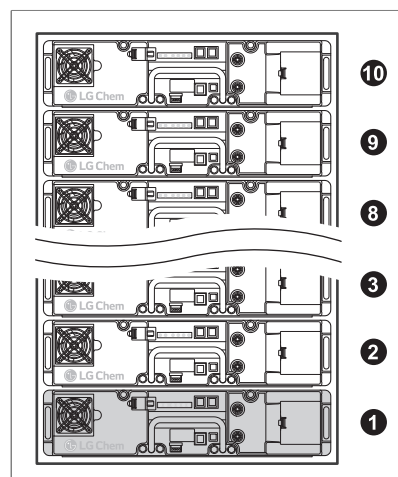
A module installed at the top or bottom of the rack must be the master module. Pressing the On/Off button on a module designates it as the master module and activates not only the master module but also the slave modules.



All of the battery modules are sequentially assigned IDs by the master module.



If the top module's On/Off button is pressed, the module becomes the master module and also the first module, as illustrated by this figure.



If the bottom module's On/Off button is pressed, the module becomes the master module and also the first module, as illustrated by this figure.

NOTE

This manual assumes that the top module is used as the master module.

Chapter 3

Installation Prerequisites

3.1 Installation location

Make sure that the installation location meets the following conditions:

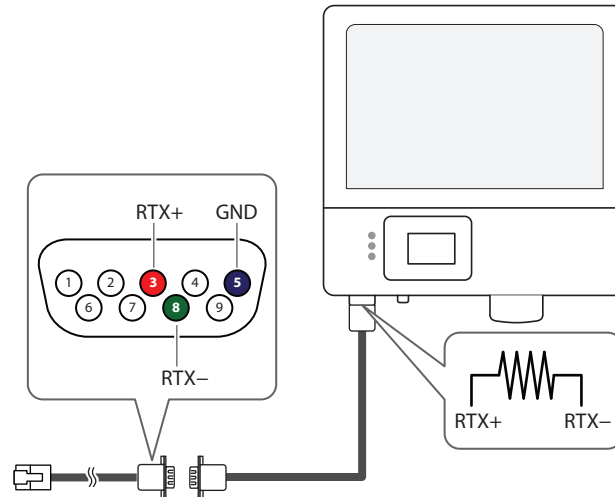
- Never stack battery modules directly on each other but use an appropriate rack.
- The building is designed to withstand earthquakes.
- The location is far away from the sea, to avoid salt water and humidity.
- The floor is flat and level.
- There are no flammable or explosive materials nearby.
- The ambient temperature should be within the range of -10 to 45°C .
- The temperature and humidity stays at a constant level.
- There is minimal dust and dirt in the area.
- There are no corrosive gases present, including ammonia and acid vapor.

NOTE

If the ambient temperature is outside the operating range, the battery module stops operating to protect itself. The optimal temperature range for the battery module to operate is 15°C to 30°C . Frequent exposure to harsh temperatures may deteriorate the performance and lifetime of the battery module.

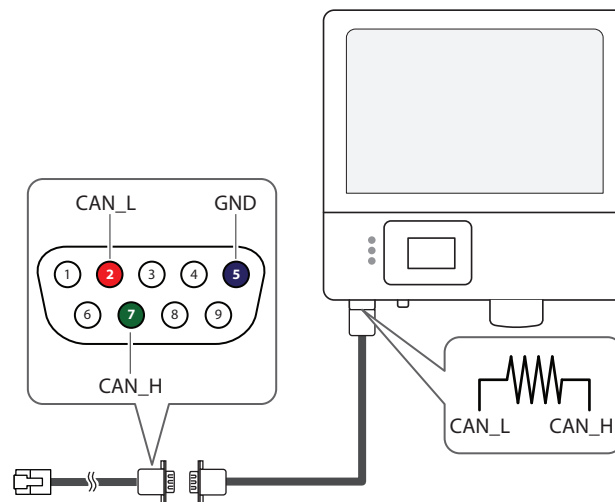
3.2 Resistor for the communication interface of the higher-level system

3.2.1 Modbus



If the Modbus protocol is used between the ESS and the higher-level system, make sure to install a 120 Ω resistor between the RTX+ and RTX- channels on the inside of the connector to or of the higher-level system.

3.2.2 CAN



If the CAN protocol is used between the ESS and the higher-level system, make sure to install a 120 Ω resistor between the CAN_L and CAN_H channels on the inside of the connector to or of the higher-level system.

3.3 Tools

These tools are required to install the battery module.



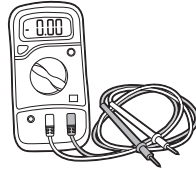
Phillips-head screwdriver



Torque screwdriver



Phillips-screwdriver bit



Voltmeter

Use properly insulated tools to prevent accidental electric shock or short circuits. Use adjustable tools and measuring instruments that are certified for precision and accuracy.

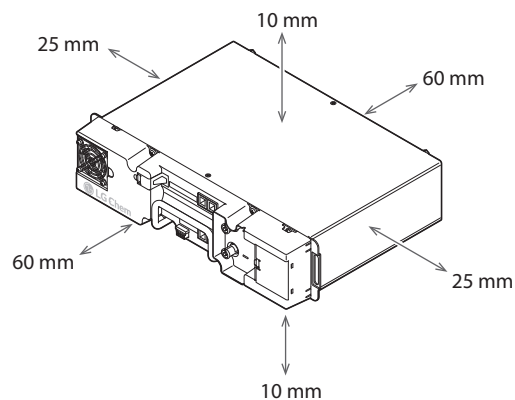
Chapter 4

Installation

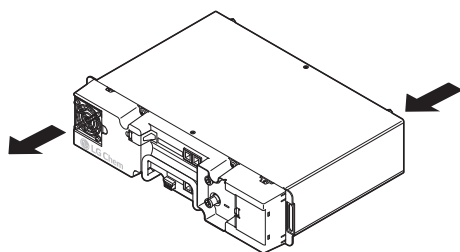
NOTE

Use 10 or fewer battery modules that are the same model to construct an ESS. Never use more than 10 units, nor use different models together.

4.1 Installation clearance



Make sure to leave a space as shown above around a battery module for proper cooling. If a battery module is entirely or partially covered or shielded, it may cause the battery module to stop operating.

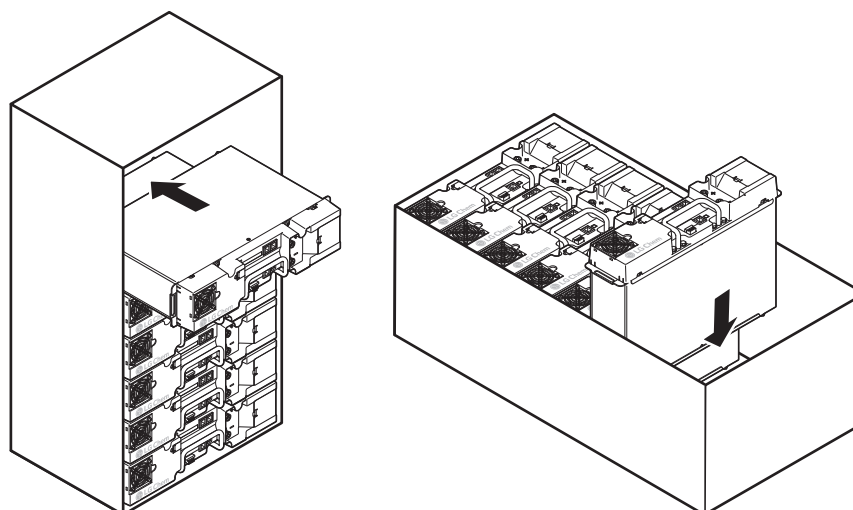


With the fan-equipped models, air is taken in at the rear and blown out the front by the fan. The flow rate of the fan is 30 m³/h.

4.2 Arranging battery modules

WARNING

A battery module weighs 26.5 kg or 44 kg. It is too heavy for a single person to carry. Make sure that two or more persons carry battery modules. Never stack battery modules directly on each other.

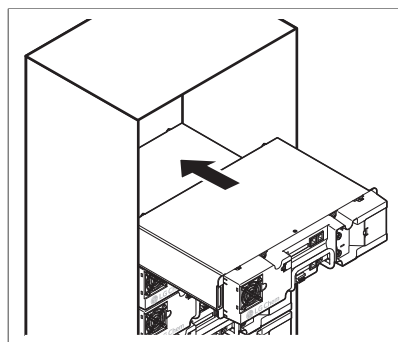


CAUTION

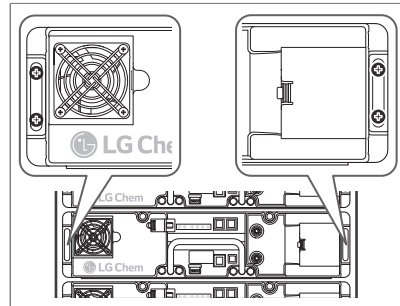
Make sure that battery modules are placed with the top up, or facing the same direction if they are arranged side by side, to prevent a short circuit due to wrong polarity connection.

Do not use the handle of the battery module for the purpose of carrying it. The handle cannot afford the battery module's weight. Use the handle only when installing the battery module.

Arrange battery modules layer upon layer or side by side in the rack.



1. Insert battery modules one by one into the rack's slots.
2. Check the battery modules to ensure that they are fit to be used. See **Pre-installation checks** on page 22.



3. On each battery module, fasten the brackets on both sides of the front using screws and cage nuts to secure it to the rack. Use a torque of 6 N·m.

NOTICE

The front brackets cannot afford the battery module's weight without any supporting structure. Make sure that each battery module is supported by something solid such as plates or rails.

4.3 Pre-installation checks

4.3.1 Identifying model number

Verify the model number of each battery module to ensure that they are all the same model.

1. Press the On/Off button on a battery module to activate it. The green indicator turns on first and then the rightmost blue indicator turns on a few seconds later.

NOTE

A battery module is charged less than 25% when being shipped. If the green indicator does not turn on, do not use the battery module.

2. Press and hold the On/Off button for longer than 5 seconds. While the button is pressed, the blue indicators show the last digit of the model number in binary form.

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	EM048063P3S 1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	EM048063P3S 2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	EM048063P3S 4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	EM048063P3S 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	EM048126P3S 6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	EM048126P3S 7
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	EM048126P3S 8

There are two more situations where the blue indicators show the model number.

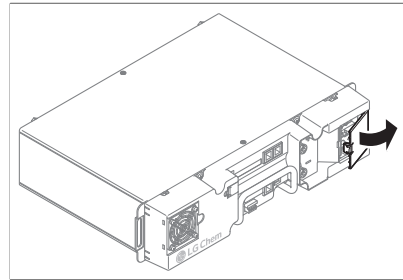
- When commissioning the ESS for the first time, if one or more different models are included, the master module's blue indicators show the model number of one

of them for 10 seconds.

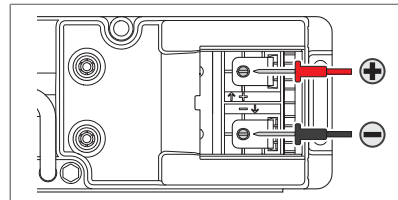
- When replacing faulty battery modules, if the new battery module is a different model, the battery module's blue indicators show the model number for 10 seconds.

4.3.2 Measuring battery voltage

Measure the voltage of each battery module.

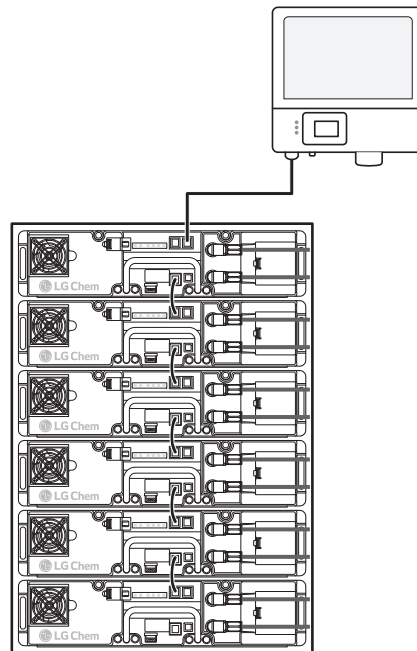


1. Pull the groove to remove the cover from the power terminal compartment.



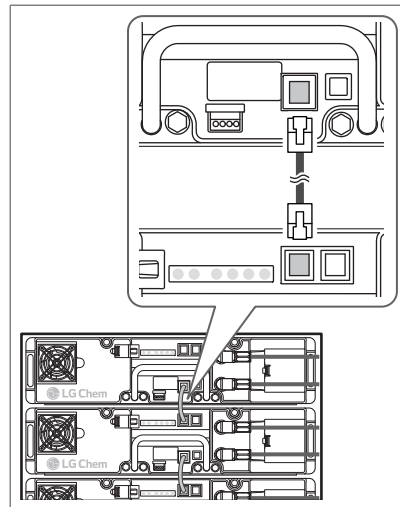
2. Measure the voltage at the terminal block using a voltmeter. If the voltage is lower than 42 V, do not use the battery module.
3. Replace the cover.

4.4 Connecting communication cables



To enable communication between the battery modules and between the master module and the higher-level system, connect them to one another using commu-

nication cables.

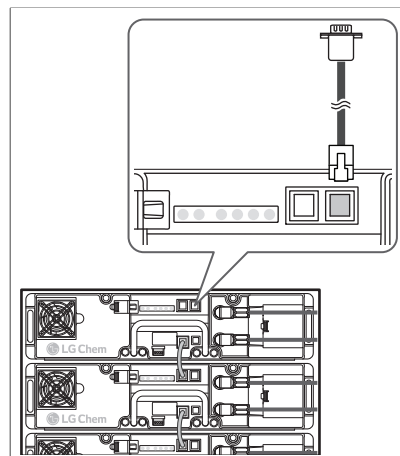


1. Connect each battery module to those adjacent to it using an intra-rack communication cable. Insert one end of the cable into the RJ48 port on the lower part of each battery module, and insert the other end of the cable into the RJ48 port on the upper part of the module positioned below it.

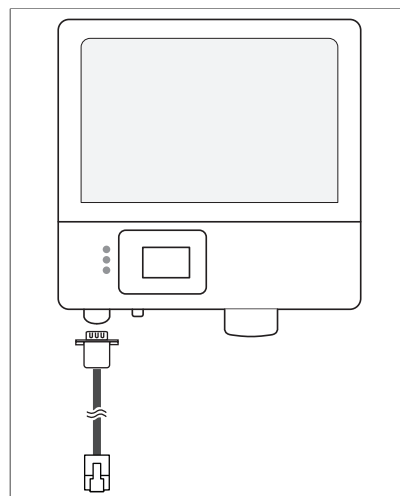
The port on the lower part of the last module should be left unconnected.

NOTE

There are two RJ48 ports on the upper part. Use the port on the left. The port on the right should be connected to the higher-level system.

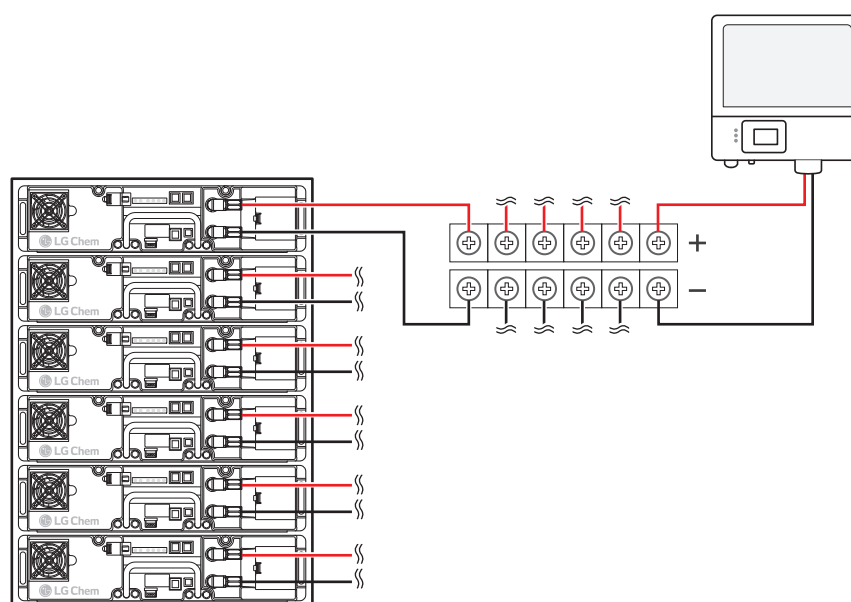


2. Connect the master module to the higher-level system using the higher-level communication cable. Insert the RJ48 connector of the cable into the RJ48 port on the master module.



3. Make sure that a resistor is properly installed on the Modbus or CAN interface of the higher-level system. See **Resistor for the communication interface of the higher-level system** on page 18.
4. Insert the D-sub connector at the other end of the cable into the corresponding connector on the higher-level system.

4.5 Connecting power cables



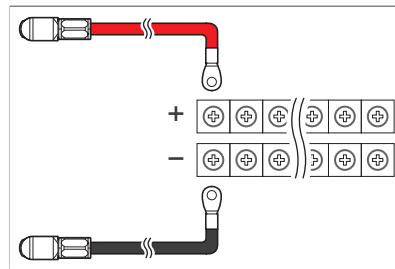
Connect power cables between the battery modules and the higher-level system via busbars.

CAUTION

When connecting power cables, pay attention to these precautions:

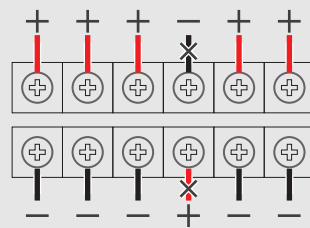
- Never connect battery modules in series. They must be connected in parallel.
- Make sure that the higher-level system is off before connecting power cables to it.
- Make sure that all the power cables are of equal length. If some cables are longer than others, the difference in length may cause different electrical resistances and consequently voltage imbalances between the battery modules.
- The total extension length of the power line from a battery module to the higher-level system must not exceed 5 m.
- Never short-circuit the busbars that connect the battery modules and the higher-level system.
- Make sure that the polarities are correctly connected.
- The power cable has a plug-in connector at its one end for connection to the battery module. The plug-in connector is designed to prevent reverse polarity. Connect the other end of the power cable to the busbar first, and then connect the plug-in connector to a battery module.

Repeat these steps for each battery module.



1. The positive cable (+) is red and the negative cable (-) is black. Connect the ring terminal of a positive cable to the positive busbar, and connect a negative cable to the negative busbar.

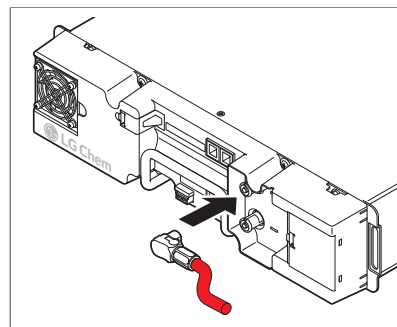
CAUTION



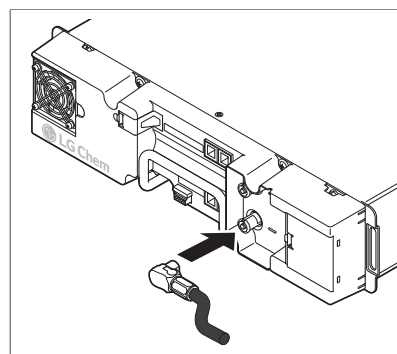
Pay attention not to reverse polarity. Connection with reversed polarity causes severe damage to the battery module.

NOTE

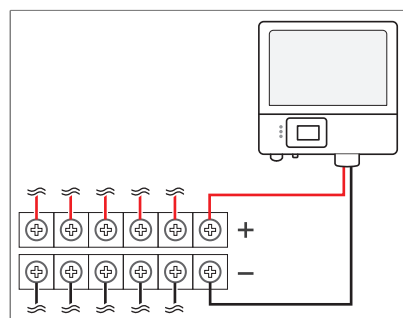
If the busbars cannot accommodate the ring terminal, modify the ring terminals to adapt them to the busbars.



2. Connect the connector of the positive cable to the positive connector of the battery module.



3. Connect the connector of the negative cable to the negative connector of the battery module.



4. Connect appropriate power cables between the busbars and the higher-level system.

Chapter 5

Commissioning

5.1 Commissioning the ESS

Follow the procedure described below to get the ESS ready for operation. If any step fails, see **Troubleshooting commissioning failure** on page 29 to solve the problem.

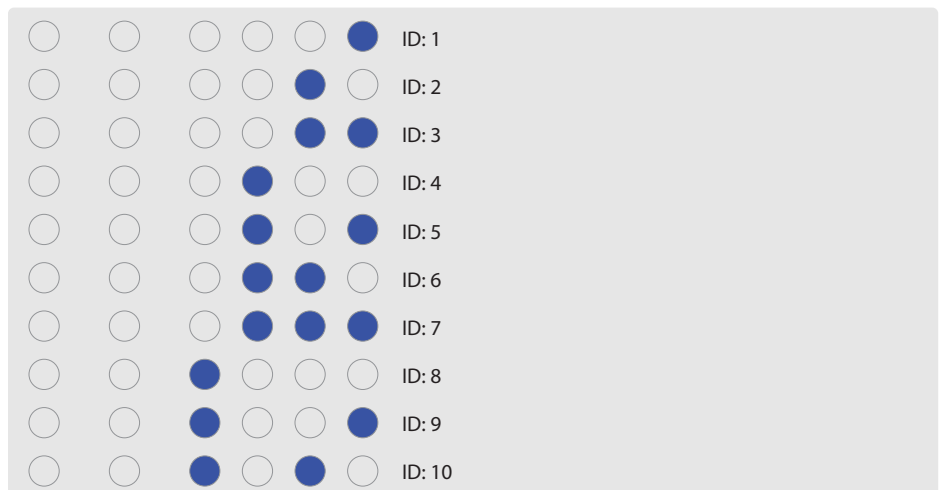
1. Press the On/Off button on the master battery module to activate the ESS. For each battery module, make sure that the green indicator is on.



NOTE

At the first activation, the ESS will abort activation if two modules are assigned with the same ID as master module.

2. On each battery module, the blue indicators turn on to show its ID in binary form. Make sure that all of the battery modules have correct IDs.



NOTE

The ESS will abort activation if a level 2 fault occurs on a module after ID assignment. The red indicator turns on as the module enters a fault 2 state. Before contacting LG Chem for technical assistance, check the indicators to identify the fault number, such as shown below.



3. On the higher-level system, set the maximum charge current to 63 A.
4. Let the higher-level system charge the ESS until every battery module is charged to at least 50% so that the two rightmost blue indicators are on. The red indicator may turn on temporarily until all the modules reach the same voltage.



5. Shut off the higher-level system, and set the maximum charge and discharge current properly in accordance with the number of the installed battery modules. The higher-level system maintains communication with the ESS to regulate the amount of current properly according to the battery status.
6. Commission the higher-level system to put the ESS in operation.

5.2 Deactivating the ESS

There are two methods to turn off the battery modules.

- To deactivate all the battery modules with their IDs kept, press the On/Off button of each battery module one by one.
- To deactivate the entire of the ESS, press and hold the On/Off button on the master module for longer than 5 seconds. This results in that the IDs assigned to the battery modules are removed so that the ESS becomes unable to wake up with a voltage applied by the higher-level system. It is needed to re-assign IDs to the battery modules.

The ESS shuts itself down if an error occurs in the course of commissioning. For example, if the On/Off button of any battery module positioned in the middle is pressed so that it is designated as the master module, every battery module is deactivated.

If the ESS seems to have failed to automatically deactivate itself in spite of an error, manually deactivate the ESS using either of the two methods described above.

5.3 Troubleshooting commissioning failure

The green indicator will not turn on

The battery module may be over-discharged or its On/Off button may be faulty. Replace the module with a new one.

The ESS will not be deactivated

While the initialization is in progress, you cannot deactivate the ESS. Wait until the blue indicators turn on to show the ID.

Slave modules are not activated

If the master module is normally activated but some slave modules are not activated, try these steps:

1. Shut off the higher-level system.
2. Deactivate the ESS.
3. Make sure that all the intra-rack communication cables are properly connected between the battery modules.
4. Re-activate the ESS.

If the problem persists, replace the communication cables with new ones.

Fault number 12



If the red indicator turned on together with the blue indicators showing fault number 12 in binary form, try these steps:

1. Make sure that the communication settings are properly configured on the higher level system.
 - CAN 2.0B: 500 kpbs
 - Modbus 485: 19200 bps
2. Make sure that the pin assignments match between the higher level system's Modbus or CAN interface and the higher-level communication cable. See **Resistor for the communication interface of the higher-level system** on page 18.
3. Make sure that a resistor is properly installed on the Modbus or CAN interface of the higher-level system. See **Resistor for the communication interface of the higher-level system** on page 18.
4. Make sure that the higher-level communication cable is properly connected between the master module and the higher-level system.
5. Re-activate the ESS.

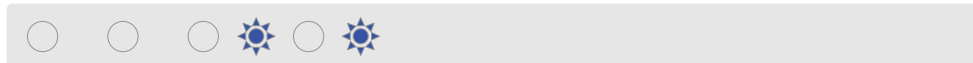
The green and red indicators are on simultaneously



The green and red indicators are on simultaneously as long as there is a voltage difference between any of the battery modules. Charge the ESS until all the modules

reach the same voltage and the red indicator turns off. The battery module with the lowest voltage charges first, and then the others charge one by one.

Some of the blue indicators flash



Among the battery modules, there are one or more different models. Remove all the communication cables from the battery modules to find different models. For details on how to identify a module's model number, see **Identifying model number** on page 22.

Appendix A

Warranty

LG Chem protects this product under warranty when it is installed and used as detailed in this manual. Violating the installation procedure or using the product in any way not described in this manual immediately voids all warranties on the product.

LG Chem does not provide warranty coverage or assume any liability for direct or indirect damages or defects that result from the following causes:

- Improper transportation or storage
- Incorrect installation, wiring or handling
- Non-compliance with LG Chem's installation manual
- Operating the product in an inappropriate environment
- Incorrect or inappropriate operation
- Insufficient ventilation
- Failure to adhere to safety warnings or instructions
- Repairs or modifications performed by unauthorized personnel
- Inverter failure or overcurrent.
- Force majeure events
- External influences, such as unusual physical or electrical stress.
- Use of an incompatible inverter

