INSTRUCTION MANUAL

Electrical Energy Storage, Ferroamp RACK & CABINET

21-0003 - 21-0015

THIS INSTRUCTION MANUAL IS AN ORIGINAL
Document ID: 73-H010 / Version: 2.0

Thank you for purchasing a Nilar product! It is required to read and understand these instructions carefully for a safer installation and operation, as well as optimum performance and a longer service life.

Keep this manual in a safe place for future reference.

This manual may be modified and updated without prior notice. Contact Nilar for validation.

Colors used in illustrations of e.g. cables are only illustrative and might deviate from the actual color.

Without written permission from Nilar this manual is not to be copied or transferred for other purposes, neither in its entirety nor parts of it.

The product described in this manual is manufactured in compliance with the Low Voltage Directive (LVD) 2014/35/EU, the Electromagnetic Compatibility (EMC) Directive 2014/30/EU and the restrictions of certain hazardous substances according to RoHS Directive 2011/65/EU.

The product contains metal hydride battery packs that follow the EU-directive 2006/66/EG ('Battery Directive'). The battery packs do not contain the heavy metals lead, mercury or cadmium.

The product adheres to the Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU. This means that the manufacturer/importer has a responsibility that the manufactured products are collected, taken care of and recycled after they have reached the end of their lifespan.

Nilar products are in compliance with Regulation (EC) No. 1907/2006 concerning the **R**egistration, **E**valuation, **A**uthorization and the restriction of **Ch**emicals (REACH). We check that our suppliers comply with REACH requirements for all the materials and components they deliver to us.

The product described is intended to be used in conjunction with Ferroamp products, including but not limited to Ferroamp EnergyHub and Ferroamp ESO (Energy Storage Optimizer).

Document identification: *73-H010*

Version	Status	Date
1.0	Previous release	2020-08-03
1.1	Internal revision	2020-09-02
2.0	Released revision	2020-09-11

This manual will give you as a reader all the necessary instructions for a more professional and safer handling of the product. Read the manual carefully in order to avoid mistakes and risks. The manual is divided into the following chapters:

Below follows an explanation which facilitates the understanding of abbreviations used throughout the manual.

Abbreviation	Signification
AC	Alternating Current
AAC	Ampere of Alternating Current
ADC	Ampere of Direct Current
BMS	Battery Management System
CAN	Controller Area Network
CCI	Customer Connection Interface
DC	Direct Current
EDS	Electronic Data Sheet
EES	Electrical Energy Storage
EMC	ElectroMagnetic Compatibility
EMS	Energy Management System
ESO	Energy Storage Optimizer
HMI	Human Machine Interface
IMD	Insulation Monitoring Device
IMU	Integrated Monitoring Unit
IPC	Industrial Personal Computer
LED	Light Emitting Diode
LVD	Low Voltage Directive
MCB	Miniature Circuit Breaker
MSDS	Material Safety Data Sheet
NiMH	Nickel Metal Hydride
PLC	Programmable Logic Controller
PPE	Personal Protective Equipment
PSN	Proper Shipping Name
RCD	Residual-Current Device
REACH	Registration, Evaluation, Authorization and the restriction of CHemicals
RoHS	Restrictions of Hazardous Substances
RTU	Remote Terminal Unit
SoC	State of Charge
TCP	Transmission Control Protocol
VAC	Volt of Alternating Current
VDC	Volt of Direct Current
WAN	Wide Area Network
WEEE	Waste Electrical and Electronic Equipment

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1. Safety Information

This chapter contains general safety information that is applicable to the Nilar Electrical Energy Storage (EES).

To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing installation, operation, maintenance and decommissioning. For more detailed information, contact Nilar and request the Material Safety Data Sheet (MSDS).

1.1 Safety markings in this instruction

WARNING!

The exclamation mark within an equilateral triangle is intended to alert the user that negligence of this information can be life threatening.

CAUTION!

The exclamation mark within a circle is intended to alert the user that negligence of this information can be associated with bodily injury and/or damage to the product.

1.2 General warnings and cautions

WARNING! This product contains powerful battery packs (NiMH) and is supplied by multiple hazardous electrical sources. Beware of stored and residual energies.

WARNING! Obey local regulations for live working when casing/door is open.

WARNING! Wear electrically insulated gloves when handling battery packs. Battery pack surfaces may carry hazardous voltage due to lowered insulation resistance. Do not place battery packs on conductive surfaces.

WARNING! Risk for electric shock and arcing if product is used incorrectly.

WARNING! The battery packs cannot be switched off. Please note:

- Work only with one battery pack terminal at the time.
- Rupture disc may release electrolyte during. abnormal use. We therefore recommend wearing safety glasses.

WARNING! Risk for electrical hazards if product is exposed to rain or moisture

WARNING! Do not operate the product with suspected failures. If you suspect that the product is damaged, have it inspected by qualified service personnel.

WARNING! Do not block or cover the rupture disc outlet on the battery packs.

WARNING! If a fire occurs, it can be extinguished by using CO_2. Ensure that fire extinguishers are available.

CAUTION! If the battery pack(s) is damaged mechanically, the following may occur:

- High heat generation on the surface of the battery cells.
- Electrolyte may escape.
- Eventual smoke from the battery packs can irritate the skin, eyes and respiratory system.

Therefore, follow these guidelines:

- Do not open the battery packs.
- Do not modify or mechanically damage the battery packs.
- Operate the EES only within the allowed operating range.
- Do not short-circuit the battery packs.
- Do not continue to use the battery packs after identified as faulty.

CAUTION! To avoid potential hazards, use this product only as specified.

CAUTION! Do not operate the product with covers removed. If covers are removed during e.g. repair, do not touch any exposed connections.

CAUTION! The product shall not be exposed to liquids (not even dripping or splashing) and objects filled with liquids must not be placed on or close to the product.

CAUTION! Remove personal metal items such as rings, bracelets, necklaces, and watches when physically handling the product since it can result in a short-circuit current causing severe burn.

CAUTION! Keep product surfaces clean and dry.

2. TECHNICAL SUPPORT AND WARRANTY

2. Technical support and warranty

CAUTION!

Please make sure to always have the serial number of your product(s) available for warranty and technical support matters.

Regarding technical support, please contact your authorized local Nilar representative and have the serial number available.

The serial number can be found in two (2) different locations of the rack/cabinet, on the inside of the door / front lid (left door on the rack) ① and on the right side of the casing ②.

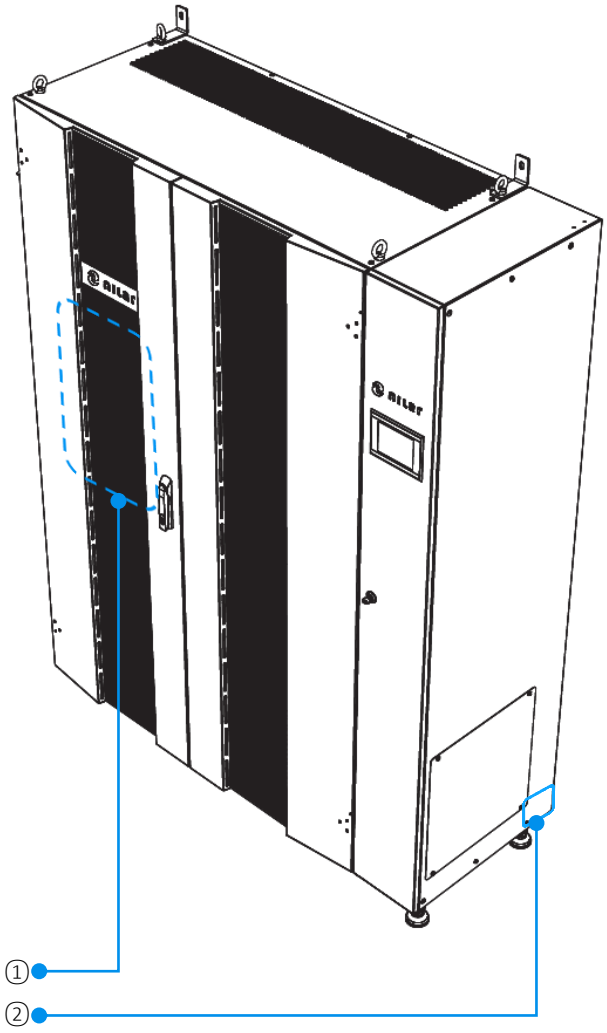


Figure 1: Indication of Serial number sticker on the EES Rack

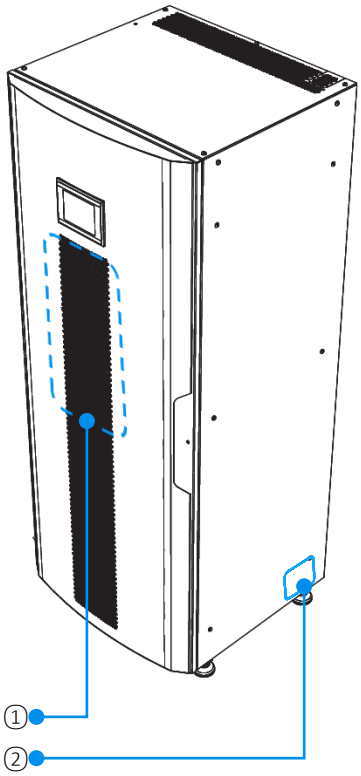


Figure 2: Indication of Serial number sticker on the EES Cabinet

Regarding the warranty conditions, please contact your authorized local Nilar representative.

3. ENVIRONMENT

3. Environment

This chapter will inform about the composition of Nilar products and hence give the user valuable information on partly how to treat the product and partly how it is recycled the day it has reached the end of its lifecycle.

Please contact Nilar in order to find your closest representative.

3.1 Compliance

Nilar products are compliant with the following directives and regulations:

- EU-directive 2006/66/EC ('Battery Directive'). The battery packs do not contain the heavy metals lead, mercury or cadmium.
- Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU.
- Restrictions of certain hazardous substances according to RoHS Directive 2011/65/EU.
- Nilar products are in compliance with Regulation (EC) No. 1907/2006 concerning the Registration, Evaluation, Authorization and the Restriction of Chemicals (REACH).

3.2 Rack/Cabinet

The racks and cabinets consist of steel which can be recycled completely (with the exception of the paint).

3.3 Battery Management System (BMS)

The BMS consists of three (3) various material types. The main part is its platform which, just like the rack/cabinet, is made out of carbon steel and is recycled as such.

The second part is electronics. The electronic components are recycled as electronic waste.

Lastly it consists of various types of plastics and hence recycled as such.

3.4 Battery pack

When the Nilar battery pack has reached its end of life, Nilar takes the full responsibility for the recycling process by accepting the complete battery packs back. The recycling process used ensures that most of the materials are reused or recycled appropriately. The main components in the battery packs consist of: Plastic, aluminum, Ni-plated steel, carbon steel and active materials. Contact your authorized local Nilar representative for a more detailed composition specification.

3.5 Integrated Monitoring Unit (IMU)

The IMU can be divided into two categories of materials. First there is the outer shell which is made of plastic and has to be recycled as such. Secondly it consists of a circuit board and this has to be recycled as electronic waste.

4. FUNCTION DESCRIPTION

4. Function description

Nilar Electrical Energy Storage (EES) is a solution for grid connected energy storage. The EES can accept electrical energy from various energy sources, store the energy and provide energy when required. Between Nilar EES and the grid it is required to connect the Ferroamp[1] EnergyHub which converts AC to DC and vice versa. The operation is fully automated and monitored externally via the Ferroamp EnergyHub Cloud tool.

The EES consists of innovative and environmentally friendly Nilar Hydride® batteries (NiMH) that are based on a bipolar modular battery solution. The modules, in turn, can be assembled into battery packs of different voltages (VDC) in a simple stacking operation. These battery packs can be series connected to form a battery string, where each battery string is controlled and isolated by fuses and contactors in a TN-grounding system installation.

To optimize performance, the Nilar EES is equipped with a BMS. The BMS monitors the status of the battery packs and can manage the operation of the EES in order to optimize performance.

The BMS communicates with the Ferroamp EnergyHub via a CANopen communication protocol. Amongst others, information about maximum allowed charge and discharge current, State of Charge (SoC), warnings and alarms are exchanged.

Figure 3: Battery pack 144VDC (12 modules)

Figure 4: Rack solution 57,6 kWh incl. battery packs and integrated BMS

Figure 5: Cabinet solutions 11,5 – 28,8 kWh incl. battery packs and integrated BMS

[1] Svenska Ferroamp Elektronik AB, hereinafter referred to as Ferroamp only

4. FUNCTION DESCRIPTION

4.1 General schematic overview

The energy flow in and out of Nilar EES is controlled by the Ferroamp EnergyHub by effecting the Energy Storage Optimizer (ESO) power.

The Nilar BMS monitors the battery energy flow and provides this data to the Ferroamp EnergyHub.

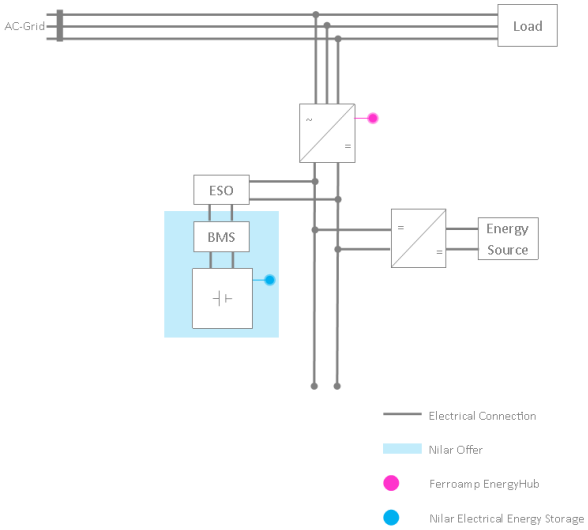


Figure 6: General schematic overview

4.2 System specification

Table 1: Specification for one (1) 576VDC Rack

	Rack	
Rated energy	57,6	*kWh*
Nominal system voltage	576	*VDC*
System voltage range	480 - 768	*VDC*
Nominal BMS voltage supply	760	*VDC*
Max. continuous charging power	57,6	*kW*
Max. continuous discharging power	57,6	*kW*
Dimensions (HxDxW)	1996 x 615 x 1534	*mm*
approx. **Weight (EES in operation)**	1731	*kg*
approx. **Weight (rack, empty)**	371	*kg*
Protection class	IP20	*IP*
Max. allowed relative humidity (without condensation)	90	*%*
Ambient operating temperature range	-20 to +40	*°C*
Pollution degree	2	*Class*
Overvoltage category	II	*Category*
EMC	EN 61000-6-2:2005 (Immunity) EN 61000-6-3:2007 (Emission)	*IEC*
Maximum installation altitude	2000	*m*

4. FUNCTION DESCRIPTION

Table 2: Specification for 576VDC Cabinet with 2, 3, 4 and 5 battery strings

	2	**3**	**4**	**5**	
Rated energy	11,5	17,2	23,0	28,8	*kWh*
Nominal system voltage	760	760	760	760	*VDC*
Battery string voltage range	480-768	480-768	480-768	480-768	*VDC*
Max. continuous charging power	12	18	24	30	*kW*
Max. continuous discharging power	12	18	24	30	*kW*
Dimensions (HxDxW)	1160x 660x 701	1510x 660x 701	1970x 660x 701	2320x 660x 701	*mm*
approx. **Weight (EES in operation)**	377	550	723	896	*kg*
approx. **Weight (cabinet, empty)**	95	132	169	206	*kg*
Protection class	IP20	IP20	IP20	IP20	*IP*
Max. allowed relative humidity (without condensation)	90	90	90	90	*%*
Ambient operating temperature range	-20 to +40	-20 to +40	-20 to +40	-20 to +40	*°C*
Pollution degree	2	2	2	2	*Class*
Overvoltage category	II	II	II	II	*Category*
EMC	EN 61000-6-2:2005 (Immunity) EN 61000-6-3:2007 (Emission)				*IEC*
Maximum installation altitude	2000	2000	2000	2000	*m*

4.3 Energy Management System (EMS)

The EMS is the application energy management system that the Nilar EES system is connected to by a field bus. In this case the EMS consists of Ferroamp EnergyHub Cloud tool.

The Ferroamp EnergyHub Cloud tool manages various system functions such as power management and inverter management.

The Nilar EES and the Ferroamp EnergyHub Cloud tool communicate via a CANopen communication protocol.

4.4 Battery Management System (BMS)

The EES is controlled by the BMS that protects and controls the batteries to optimize performance. Each battery has its IMU that communicates via a CANopen communication bus to the Programmable Logic Controller (PLC) system.

4. FUNCTION DESCRIPTION

4.4.1 PLC

The EES is equipped with a PLC (Pigeon RB300-CM3). The PLC monitors data from the IMUs, controls the switching on and off of each battery string, enables operation and monitoring of system status on site.

It also manages alarms, presents the actual status of the EES and, in applicable cases, interfaces with the auxiliary systems/equipment.

Table 3: Specification of PLC

	Value	Unit
CPU	1,2	*GHz*
RAM memory:	1	*GB*
Flash memory:	4	*GB*
Output types:	Open drain/analog	-
Input types:	Digital/dry/analog	
Output voltage:	0-10	*VDC*
Input voltage:	0-28	*VDC*
Power supply:	15-28	*VDC*
Output channels:	10	-
Input channels:	16	-
Open drain outputs:	500	*mA*
5V output DC	1	*A*
EMC:	EN 55011 group 1 class A & B	-
EU standard:	EN 61326-1:2013	-
Operating temperature:	0-50	*°C*
Operating relative humidity:	5-95	*%*
Protection class:	20	*IP*

4.5 Rack

A rack solution serves as the casing for the battery packs and the integrated BMS in Nilar's larger configurations. Within the rack, the BMS is integrated on the right side as an extendable drawer.

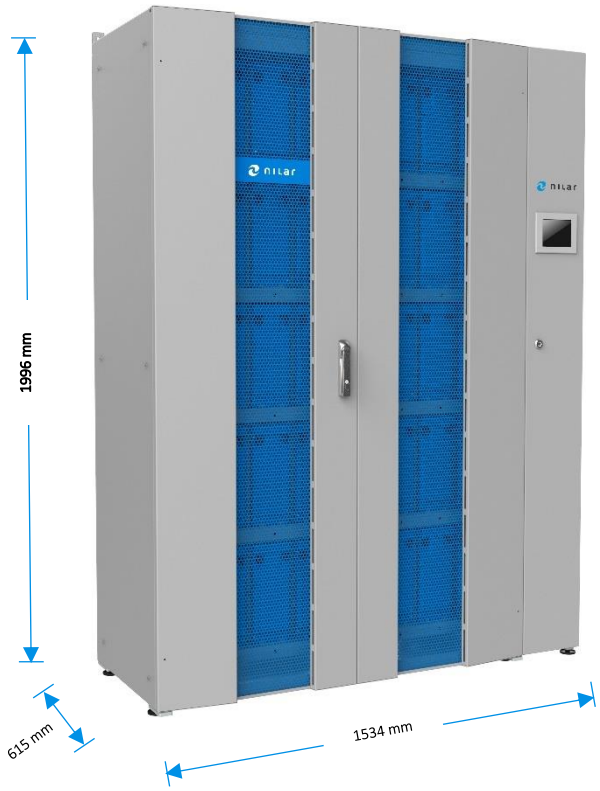


Figure 7: Rack incl. measurements

4. FUNCTION DESCRIPTION

4.6 Cabinet

For smaller energy solutions (<30kWh), the battery packs and the BMS are fully integrated in a cabinet which comes in four (4) different heights (2, 3, 4 and 5 battery strings) depending on the energy. The BMS is integrated in the upper part of the cabinet.

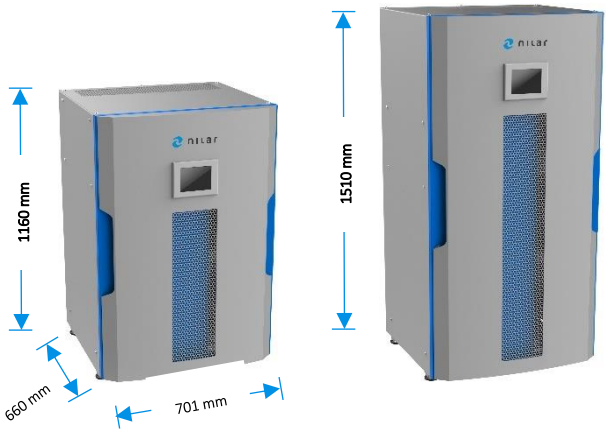


Figure 8: Cabinet size 2 (left) and size 3 (right) incl. measurements

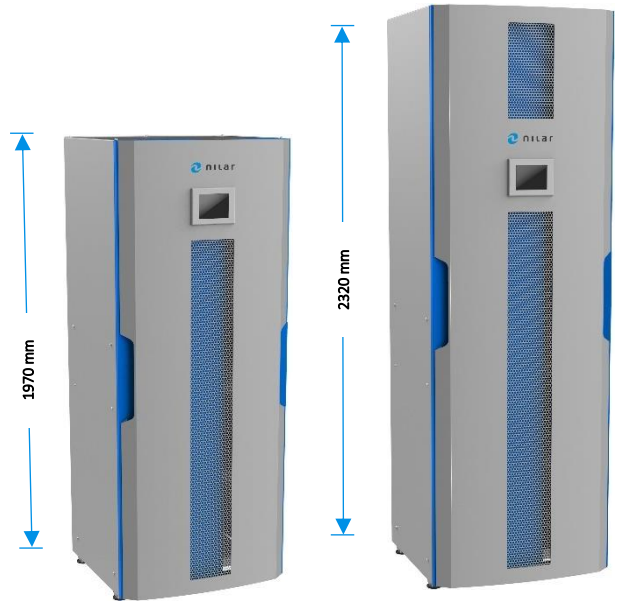


Figure 9: Cabinet size 4 (left) and size 5 (right) incl. measurements

4.7 Contactors

The contactors are used to open and close a battery string and are controlled by signals from the BMS. On the positive side (+), each battery string has its own dedicated contactor whereas on the negative (-) side, all battery strings share one contactor.

4.8 Fans

Fans are placed on the back of the rack/cabinet in order to cool the battery packs and are controlled by the IMUs. The fans are activated when a certain target temperature is surpassed. The speed is continuous and the settings are defined in the BMS.

4.9 Battery string

Each EES contains several battery strings with battery packs connected in series to match the required system voltage. To meet the required energy content, battery strings are connected in parallel. Strings are fitted with contactors and fuses on both sides of the string and one current sensor for monitoring of charge and discharge currents. The following components are found in a battery string:

- Battery packs with IMU's 4 pcs
- Current sensor 1 pc
- Fan units 4 pcs
- CANopen cables (in/out) 2 pcs
- CANopen cables (interpack) 3 pcs
- 24VDC power cable[2] 1 pc
- String power cables 2 pcs
- Interpack cables 3 pcs

[2] In a rack, two (2) battery strings share one 24VDC power cable

4. FUNCTION DESCRIPTION

4.10 Battery pack specification and build-up

A battery pack can contain between 1 and 12 modules (12VDC per module). In the context of an EES, the battery packs usually contain 12 modules.

The maximum battery voltage is obtained during charging, namely when the battery pack is fully charged.

For more detailed information regarding the battery pack, please refer to the battery pack manual (doc.id 73-H001).

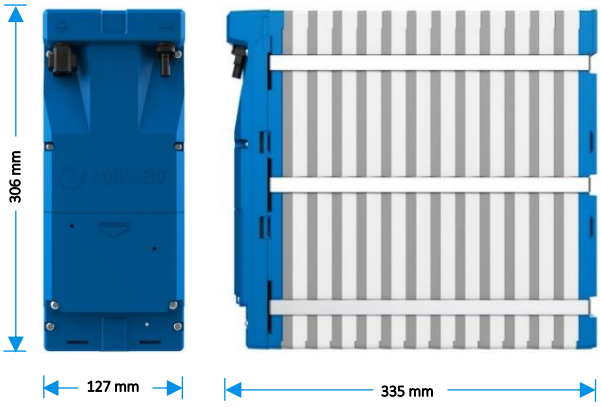


Figure 10: Measurement illustration of 144V battery pack

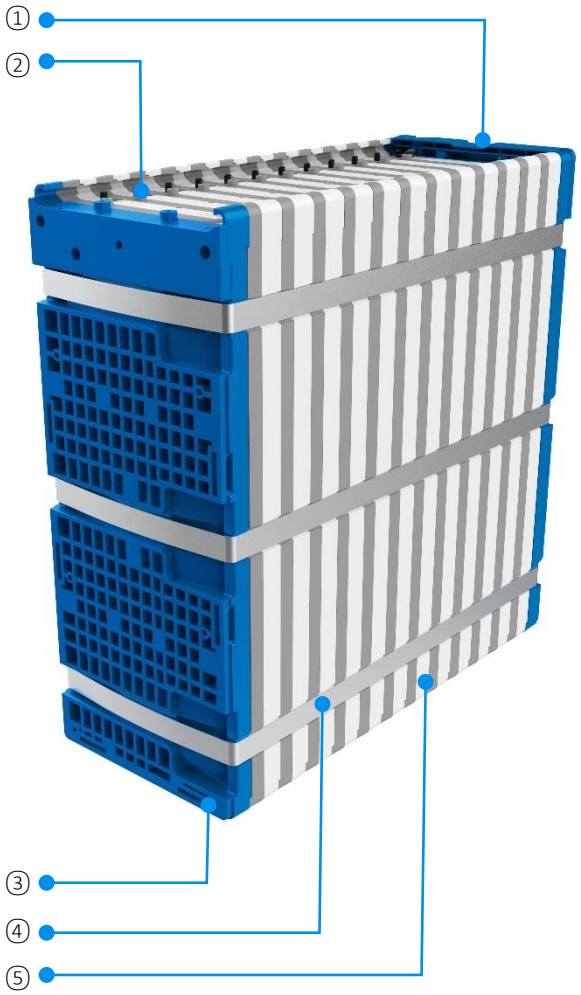


Figure 11: Parts of 144V Battery pack excl. IMU

4.10.1 Rupture disc (①, not displayed)

The Nilar battery pack is fitted with a rupture disc that is activated at a pressure of 6 bar. The rupture disc is located on the rear side of the battery pack. The rupture disc is only activated under abusive conditions.

4.10.2 Module voltage terminals (②)

Each module provides the integrated monitoring unit (IMU; see section 4.11) with its actual voltage through the module voltage terminals. Also, the cables to the main terminals of the battery pack are connected to the first and the last module in a battery pack.

4.10.3 End pieces (③, blue ●)

There is one end piece on each side of the battery pack to assure the required compression of the battery pack.

4. FUNCTION DESCRIPTION

4.10.4 Steel strapping bands (④, steel grey ●)

The battery pack is bound together by three (3) insulated steel strapping bands. Their function is both to hold the modules together as well as assuring the right compression for the battery pack.

4.10.5 Module (⑤, light and medium grey ●●)

The 12V module is the building block for all Nilar battery packs. 10 battery cells are connected in series to create modules with a rated capacity of 10Ah and a nominal voltage of 12VDC.

4.11 Integrated Monitoring Unit (IMU)

The IMU is attached on the front of the battery pack, one IMU per battery pack. The IMU is monitoring the battery pack status and controls the battery pack fan. It communicates via a CANopen interface.

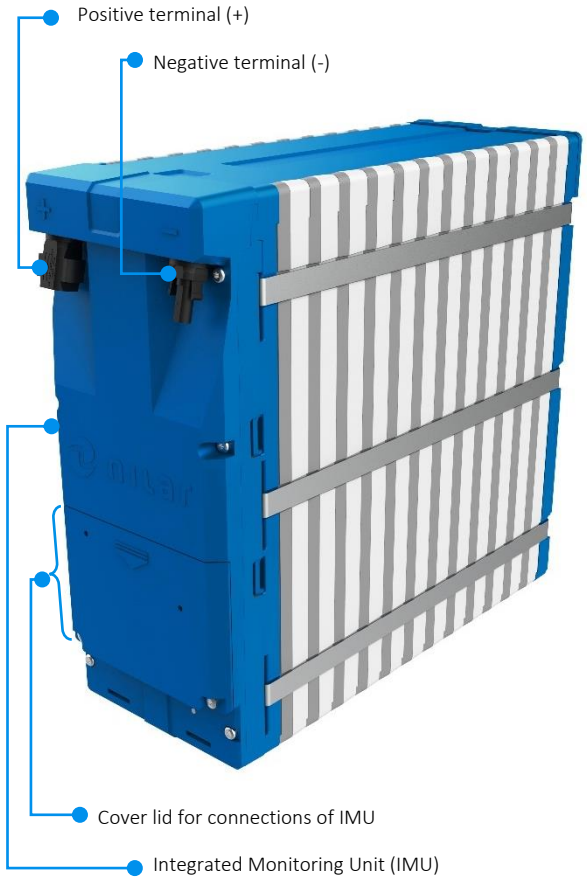


Figure 12: 144VDC Battery pack with IMU on front

Data monitored by the IMU:

- Module voltages *(up to 12 modules per battery pack).*
- Battery pack voltage.
- Battery pack temperature *(1 sensor per battery pack).*
- Battery pack pressure *(1 sensor per battery pack).*
- Ambient temperature sensor *(1 sensor per rack/cabinet).*
- String current *(1 sensor per battery string).*

For a more detailed description of the IMU, please refer to the CAN interface description (doc. Id: SPN-170063-88-H001).

4. FUNCTION DESCRIPTION

4.11.1 Positive (+) and negative (-) terminals

WARNING!

Never detach the assembled male and female connection under load.

The terminal posts are located on the upper side of the IMU. The connections are of the type ‘Phoenix Sunclix PV, chassis connector’. The cables to connect the battery packs have a connection of the type ‘Phoenix Sunclix PV, cable connector’.

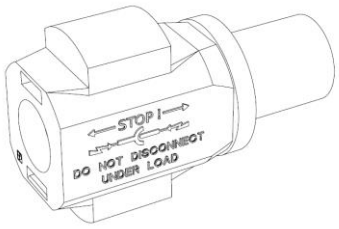


Figure 13: Design, positive (+) chassis connector, type Phoenix 1805180

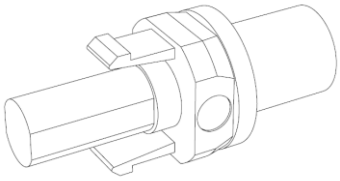


Figure 14: Design, negative (-) chassis connector, type Phoenix 1805177

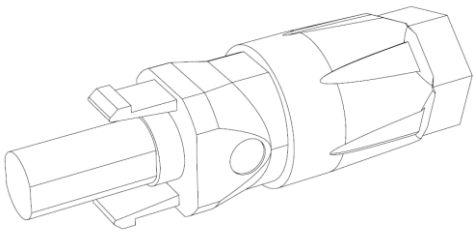


Figure 15: Design, positive (+) cable connector, type Phoenix 1774674

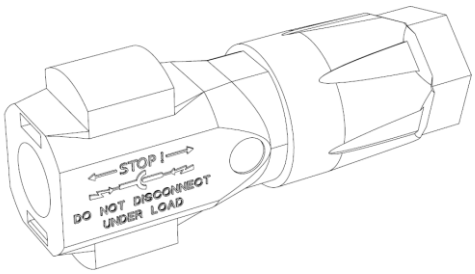


Figure 16: Design, negative (-) cable connector, type Phoenix 1774687

In order to detach the assembled male and female connection a flat screwdriver is needed.

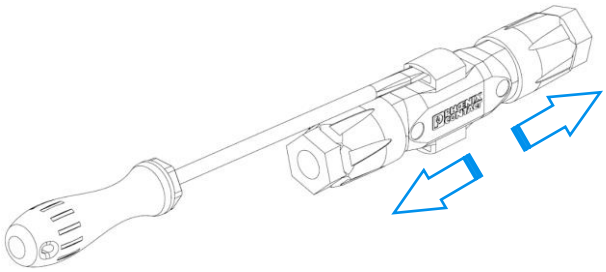


Figure 17: Disconnection of cable connectors

4. FUNCTION DESCRIPTION

4.12 Connections IMU

All connections for the IMU are found under the cover lid.

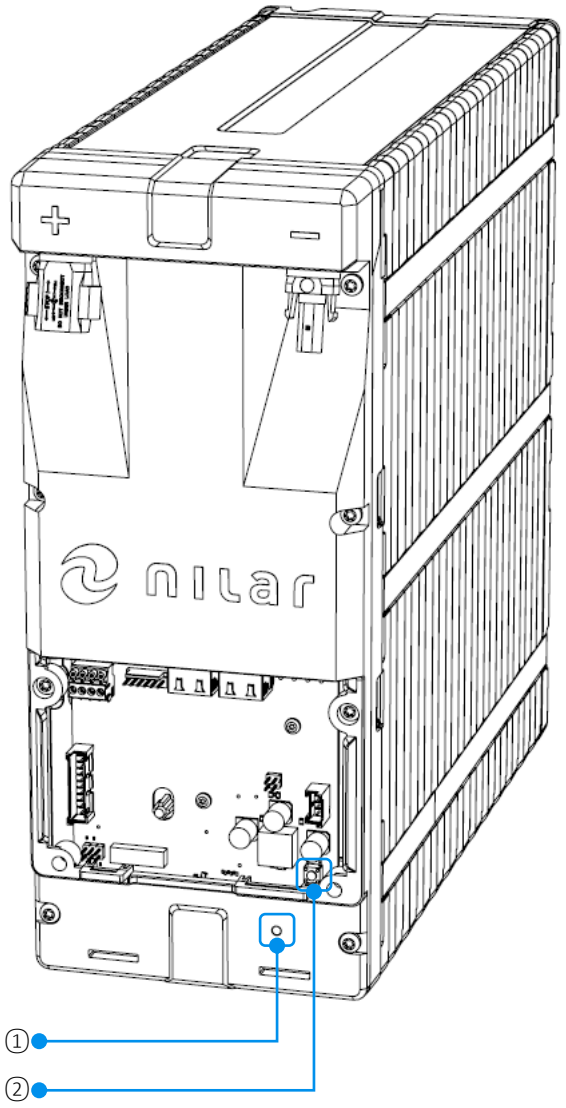


Figure 18: Overview of IMU with cover lid removed

4.12.1 Operation LED (①)

The operation LED indicates the status of the IMU as displayed in the following table.

Table 4: Description of visual signals

Visual signal	State
● *Green*	*Normal mode (system measuring is active)*
● *Red*	*Active alarm*
● *Blue*	*Power save mode (voltage measuring disabled)*
● *Yellow*	*Start-up sequence (IMU requests settings input from superior control system)*

An IMU that is running in normal mode will flash:

Green → *off* → Green → *off* etc.

An IMU that is running in normal mode during start-up sequence will flash:

Green → Yellow → Green → Yellow etc.

An IMU in power save mode with no alarm will flash:

Green → Blue → Green → Blue etc.

An IMU with an active alarm will replace the green signal and hence flash:

Red → *off* → Red → *off* etc.

An IMU in the start-up sequence with an active alarm will flash:

Red → Yellow → Red → Yellow etc.

An IMU in power save mode with an active alarm will flash:

Red → Blue → Red → Blue etc.

4.12.2 Reset button (②)

By pushing the Reset button, the IMU will be manually restarted.

4. FUNCTION DESCRIPTION

4.12.3 Overview - connections

The following connections and switch are available on the IMU and their function is explained in the subsequent sections.

Note! The indication numbers in the following figure correlate to various headings of chapter 4.12.

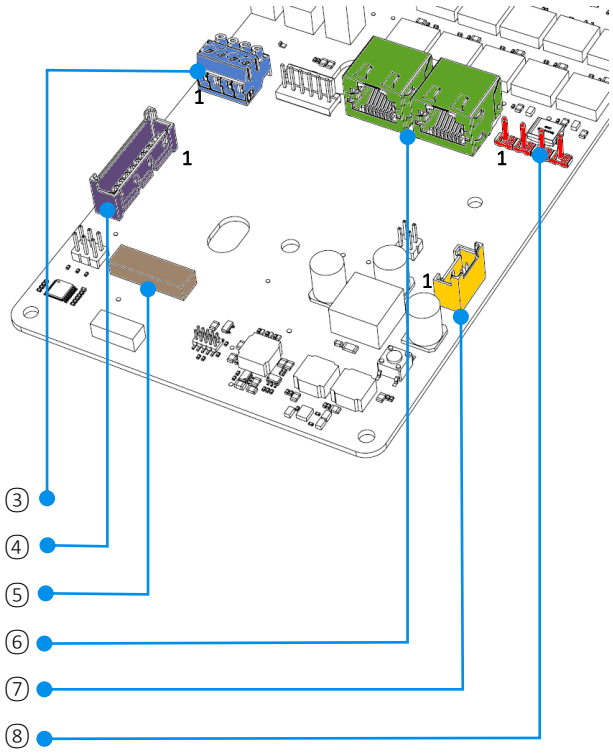


Figure 19: Indicated connection points of IMU. '1' indicates pin 1 of connection

4.12.4 Current (③, blue●)

This connection is for the current sensor which monitors the charge/discharge current.

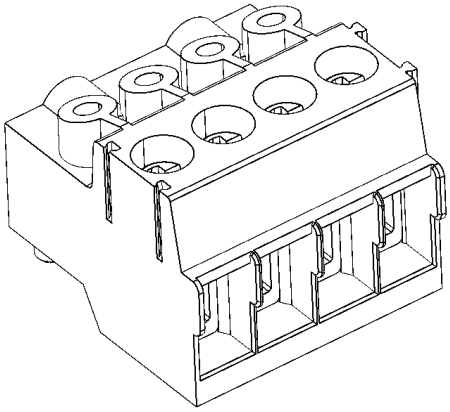


Figure 20: Design Current connector, type Phoenix 1984031. With front-/outside visible (screws on top)

The IMU is designed for use with a Hall effect current sensor from LEM (DHAB S/151).

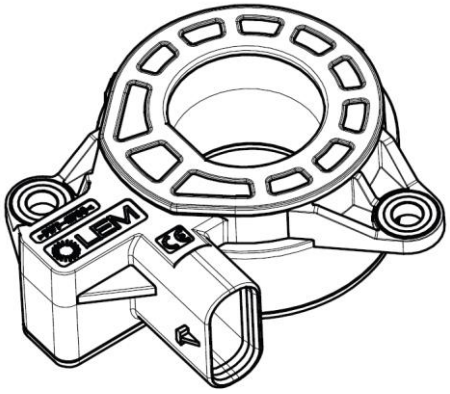


Figure 21: Design, Current sensor type LEM DHAB S/151

4. FUNCTION DESCRIPTION

4.12.5 Ambient temperature sensor (④, purple ●)

This connection is used for the external ambient temperature sensor that provides the BMS with necessary temperature data. One sensor is used per rack/cabinet.

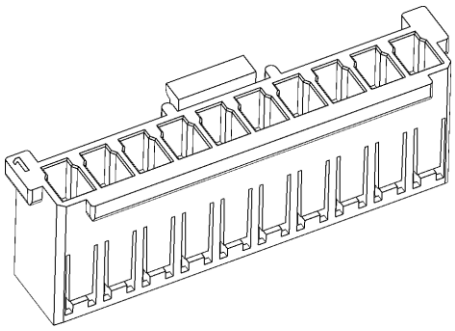


Figure 22: Design, Ambient temperature sensor connector, type Molex 51103

4.12.6 Address setting (⑤, brown ●)

When connecting several battery packs to a string or system solution, every battery pack/IMU requires a unique identification (address). This identification is set by the DIP-switch.

Note! The switch setting is already made by Nilar prior to delivery.

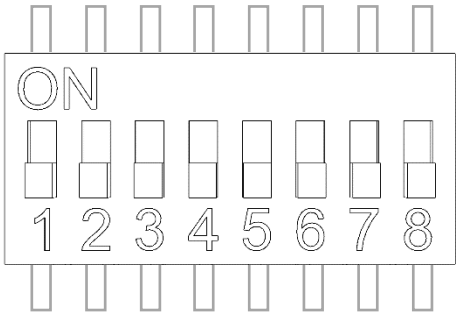


Figure 23: DIP-switch for address setting

4.12.7 CAN1 and CAN2 (⑥, green ●)[3]

The CANopen connections (type: RJ45/8P8C) are used as input and output per battery pack in order to connect the battery string for communicating with the IMU as described in the section *4.13 Signals IMU.*

CANopen is a serial bus which must have a CANopen termination of 120Ω at each end (installed during assembly at the production facility).

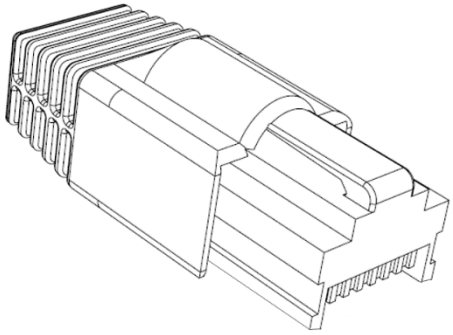


Figure 24: Design, CANopen connector, Shielded RJ45

[3] The two (2) CAN ports are interchangeable

4.12.8 Fan (⑦, yellow ●)

This connection is used to power the cooling fan for each battery pack.

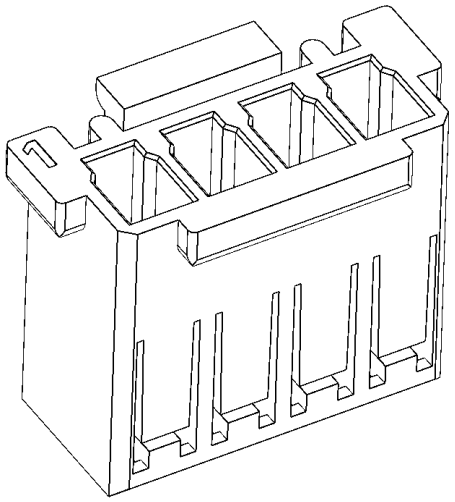


Figure 25: Design, Fan connector, type Molex 51103-0400

4.12.9 Power In (⑧, red ●)

The 24VDC power supply that powers the IMU is connected to the connection marked 'Power In'.

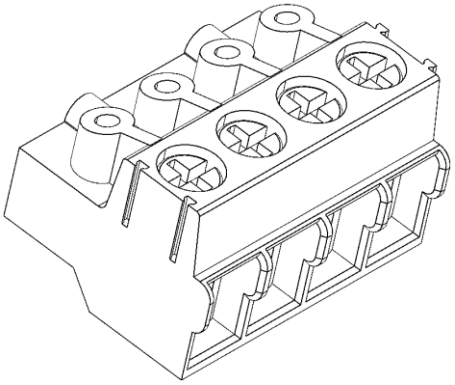


Figure 26: Design, Power in connector, type Phoenix 1934887. With front-/outside visible (screws on top)

4.13 Signals IMU

The following signals are monitored by the IMU.

4.13.1 Voltages

The voltage monitors measure the voltage of each module. If the actual voltage is out of the defined range it will be communicated to the BMS which in turn triggers an alarm.

In addition to the module voltages, the combined voltage of the battery pack is also measured and presented as a total battery pack voltage value.

4.13.2 Current sensor

The current sensor gives information about the current flow direction and value. If the current is out of the defined range it will be communicated to the BMS which in turn triggers an alarm.

4.13.3 Pressure sensor

An internal battery pressure sensor measures the relative pressure in each battery pack. Due to the common gas space in the Nilar bipolar battery pack design, all the cells in the battery pack have the same pressure. If the pressure is out of the defined range it will be communicated to the BMS which in turn triggers an alarm.

4.13.4 Battery temperature

There is one temperature sensor in each battery pack that measures the temperature. If the temperature is out of the defined range it will be communicated to the BMS which in turn triggers an alarm to prevent the battery pack from overheating.

The temperature data is also used to detect when a full charge cycle is completed.

Additionally, the ambient temperature is measured by the IMU via an externally connected sensor per 1 (one) EES unit.

For a more detailed description of what actions the triggered alarms will result in, see Appendix 2 in the Appendices chapter.

For a more detailed description of the IMU, please refer to the CAN interface description (doc. Id: SPN-170063-88-H001).

5. Transportation, lifting and storage

This chapter deals with the conditions that Nilar products require when being transported, moved, lifted, and stored.

WARNING!

Battery pack surfaces may carry hazardous voltage due to lowered insulation resistance. Always transport and/or store the battery packs on insulating (non-conductive) surfaces.

CAUTION!

Please make sure that the battery packs are positioned in the correct way during transportation and storage.

CAUTION!

Always wear PPE (Personal Protective Equipment) when handling battery packs. At minimum this includes:

Safety glasses, safety shoes with steel toe and electrically insulated gloves.

The battery packs must always be placed in an upright position (with the terminals in upper position) during transportation and storage:

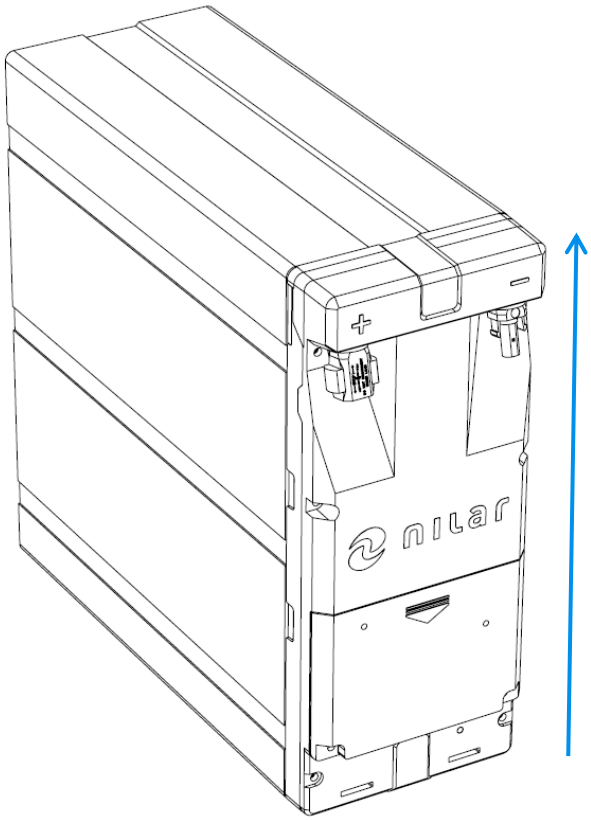


Figure 27: Orientation of battery pack

5. TRANSPORTATION, LIFTING AND STORAGE

5.1 Transportation

When transporting Nilar products, some preparations and precautions must be taken which will be described in this part of the chapter.

5.1.1 Packaging and outside conditions

CAUTION!

When performing the visual inspection, it is important not to remove the battery packs from their original Nilar sealed plastic packaging.

CAUTION!

It is important to always pack the battery packs in their original Nilar sealed plastic packaging with moisture absorbent bags, if being transported.

Nilar products are delivered well-protected in their original packaging. Nevertheless, transport damages can occur. Therefore, always check for any visible damage and signs of electrolyte leakage (especially at the rupture disc outlet).

If any transport damage is discovered:

- Document the damage.
- Report the damage to the responsible logistic company.
- Contact your authorized local Nilar representative.

If undamaged, we advise to keep the original packaging for further and future transportation. If this is not possible, please contact your authorized local Nilar representative.

Transport conditions range between the temperatures −30°C and +60°C and a relative humidity up to 90% (without condensation).

Note! The relation between temperature and the recommended maximum storage time as described in section 5.3 is also applicable for longer transportation durations.

5.1.2 Transportation of Battery packs

Nilar battery packs do not require UN approved packaging or marking when transported by sea, road, rail or air.

No dangerous goods documentation is required when transporting Nilar battery packs by road or rail.

A dangerous goods declaration is required if battery packs are transported by sea in quantities of over 100 kg in one transport unit. Nilar battery packs are then defined as dangerous goods, class 9. UN number and Proper Shipping Name (PSN) are UN 3496 and Batteries, Nickel Metal Hydride, respectively.

An Air Waybill or similar is required if battery packs are transported by air. Nilar battery packs are not classified as dangerous goods and belong to the entry *Batteries, dry* in the list of dangerous goods in IATA (no UN number). If an Air Waybill is used, the words 'Not Restricted' and the Special Provision number (A123) must be included in the description of the substance on the Air Waybill, according to IATA-DGR.

The battery packs must be separated from each other to prevent short-circuits and be securely packed to prevent movement that could lead to short-circuits; Nilar's original packaging ensures that this cannot occur.

Please observe that special regulations apply for defective or damaged battery packs that have the potential of leading to a hazardous event during transportation. Please contact local expertise or Nilar for advice regarding transport of damaged or defective battery packs.

5.1.3 Transportation of Cabinets/Racks incl. BMS

In regard to the Cabinet/Rack unit, no special preparations or precautions are needed other than described in section *5.1.1 Packaging and outside conditions.*

5. TRANSPORTATION, LIFTING AND STORAGE

5.2 Moving and lifting

WARNING!

Never stay, work or walk under suspended objects such as a lifted rack.

WARNING!

Never perform any lifts by attaching lifting slings or chains on any other parts of the product other than the designated eye bolts.

WARNING!

The rack/cabinet with integrated BMS must always be emptied of its battery packs and disconnected from any power sources before any lift/moving can be performed.

WARNING!

Be careful when moving the rack/cabinet not to make hasty movements, move over uneven and/or slanting surfaces, since this increases the rollover risk.

CAUTION!

Please note that the doors / front lid must be open or detached in order to fit the pallet loader.

Do not forget to fixate the opened doors / front lid in order to reduce rollover risk and possible crushing injuries.

CAUTION!

Be careful when lifting the battery pack. In its larger configurations, it weighs more than 25 kg. We therefore recommend using lifting aids, safety shoes with steel toe and electrically insulated gloves.

CAUTION!

Always use **both** straps when lifting and/or carrying the battery pack.

5.2.1 Battery packs

The battery packs are equipped with two detachable and durable straps on each side of the battery pack. It is advised to always carry the battery packs using these lifting straps.

Figure 28: Battery pack incl. lifting straps

5. TRANSPORTATION, LIFTING AND STORAGE

5.2.2 Racks – horizontal displacement

For horizontal displacements, a pallet loader or a fork lift is suitable. Other devices can be used for horizontal displacement as long as they fulfil the safety requirements as described in section 5.2.

When moving the rack, it is important to find the right balance points. The following illustrations indicate the approximate lifting points for the pallet loader; the exact location can deviate a bit from the illustrations.

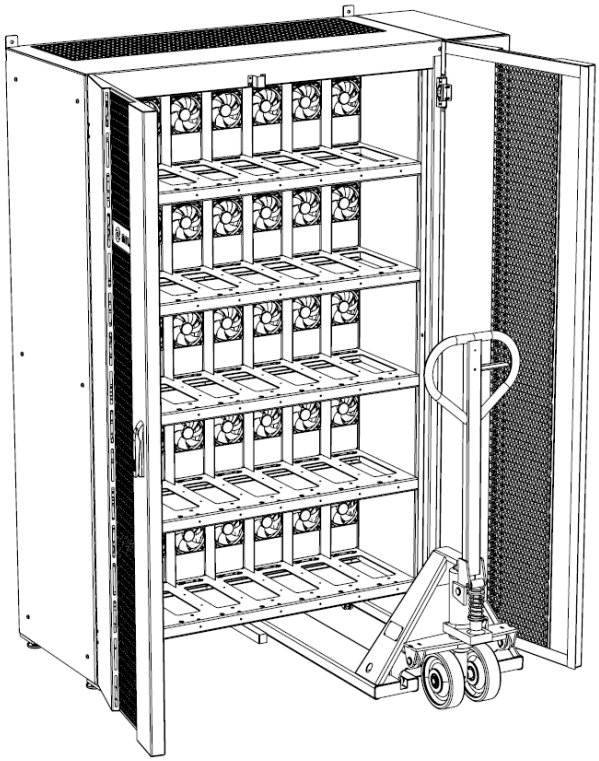


Figure 29: Rack and pallet loader during horizontal moving

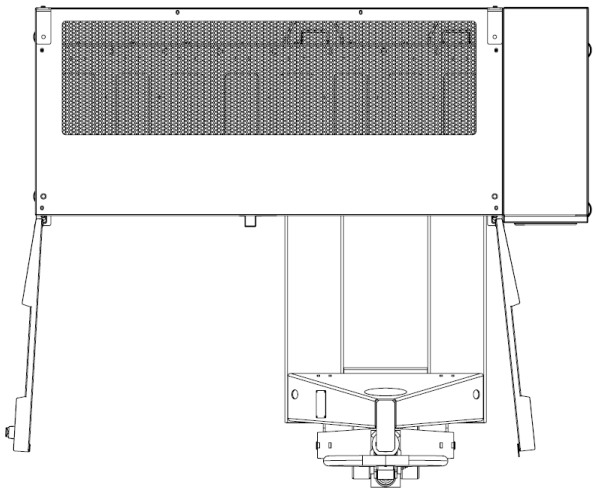


Figure 30: Top view of rack and pallet loader, indicating approximate lifting points

5.2.3 Racks – vertical displacement

For vertical displacements an overhead crane/hoist can be used.

Prior to any lifting, the provided eye bolts need to be mounted (included as standard equipment with every EES).

Attach the eye bolts (①) by screwing them clockwise until tightened into the designated four (4) holes located on top of the rack.

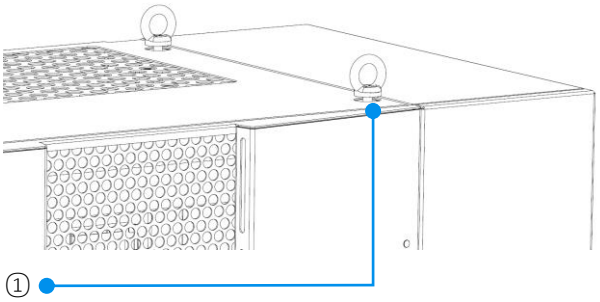


Figure 31: Detail view of attached eye bolts

5. TRANSPORTATION, LIFTING AND STORAGE

Attach the lifting slings or chains securely on the eye bolts of the rack as well as the lifting aid (crane, hoist etc.).

The minimum distance between the top cover of the rack and the upper connection point of the lifting slings must be at least 650mm. This is in order to avoid overly sharp angles of the lifting slings.

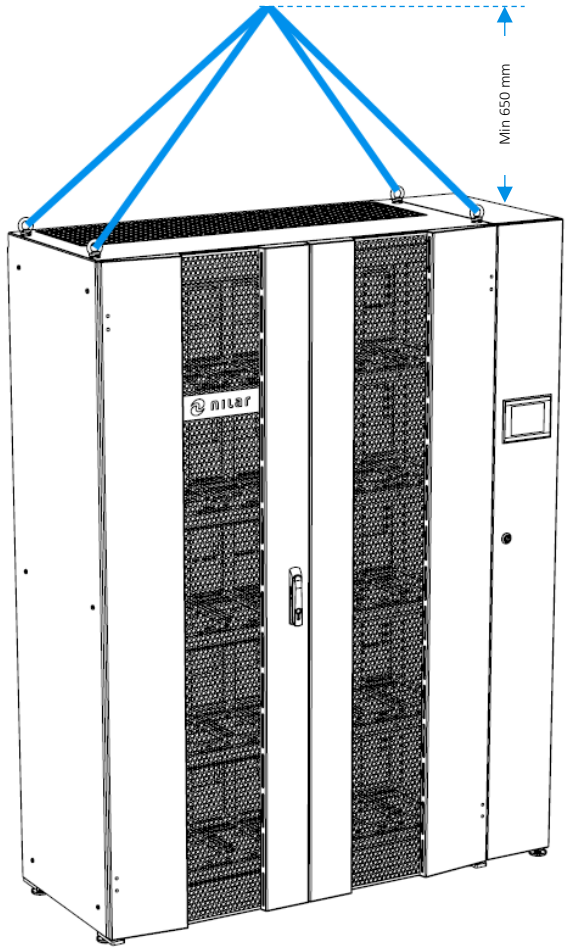


Figure 32: Rack with attached lifting slings

5.2.4 Cabinet – horizontal displacement

For horizontal displacements, a pallet loader or a fork lift is suitable. Other devices can be used for horizontal displacement as long as they fulfil the safety requirements as described in section 5.2.

When moving the cabinet, it is important to find the right balance points. Normally, the balance point equals the middle of the cabinet (weight of front lid excluded).

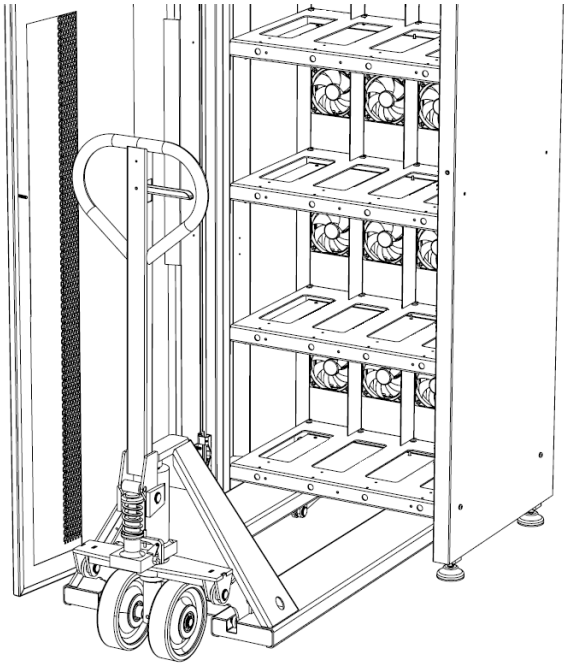


Figure 33: Cabinet and pallet loader during horizontal moving

5.2.5 Cabinet – vertical displacement

Nilar does not recommend lifting the cabinet vertically with lifting slings, chains or any other lifting devices. Hence the cabinet is not equipped with eye bolts.

5. TRANSPORTATION, LIFTING AND STORAGE

5.3 Storage

CAUTION!

Moist conditions can create irreversible damage on Nilar EES including but not limited to electrical failure and corrosion.

It is important to always keep the battery packs in their original Nilar sealed plastic packaging with moisture absorbent bags during storage.

Nilar battery packs can be stored long periods without loss of performance. Battery packs and rack/cabinet with integrated BMS must be stored in dry (< 90% relative humidity and without condensation) and preferably cold conditions. The following table displays the relation between temperature and the recommended maximum storage time at 75% SoC initial capacity and without intervention.

Table 5: Relation between temperature and the recommended maximum storage time at 75% SoC initial capacity

Temperature [°C]	Time [years]
-30 to +10	7
+11 to +30	5
+31 to +40	1,5
+41 to +60	28 days

Note! The specified years as displayed in the table refer to disconnected individual battery packs in their original packaging and not battery packs connected in a complete EES.

6. INSTALLATION

6. Installation

This chapter does, amongst others, explain under which circumstances a safe installation can take place and also provides guidance through the installation of the product, step-by-step.

WARNING!

The complete EES system (incl. peripheral equipment such as the inverter) may still provide hazardous voltage and energy, including residual or stored energy, although it is switched off or may appear switched off.

The Nilar battery packs cannot be switched off.

WARNING!

Always install a type B or B+ Residual Current Device (RCD), not supplied by Nilar. If an RCD of another classification (type AC, A or F) is already installed, it needs to be replaced with a type B or B+ RCD.

For more information regarding the RCD-installation and RCD-types, see Appendix 5 in the Appendices chapter.

WARNING!

The electrical installation must fulfil national/local legislations, regulations, suitable standards and applicable demands from recognized organizations etc.

CAUTION!

Always wear PPE (Personal Protective Equipment) when handling battery packs. At minimum this includes:

Safety glasses, safety shoes with steel toe and electrically insulated gloves.

CAUTION!

Do not work alone - in the event of an emergency, another person's presence may be essential!

CAUTION!

It is required that a smoke alarm, preferably with connected surveillance function, is installed in close and strategical connection with the Nilar product.

Furthermore, the installation of a gas alarm that warns in case of high levels of hydrogen is recommended.

6. INSTALLATION

6.1 General conditions on site

WARNING!

Pollution degree II- Do not install the EES in areas that are subject to contamination, such as high levels of airborne dust, metal particles or flammable materials/gases. Do not install where liquids, or any other foreign objects or substances may enter the EES.

CAUTION!

Make sure to allow space for emergency evacuation at all times.

The minimum distance can vary in different markets and must always be in accordance with national/local legislation.

CAUTION!

When choosing the location for the EES, a stable, fairly flat and vibration free surface must be considered.

The location must be well-ventilated and the installation altitude shall not exceed 2000 meters above sea level.

CAUTION!

Do not cover the EES! It is of especially great importance not to block any ventilation openings.

Arrange the rack/cabinet in such manner that all the access points are easily accessible for start-up, operation, maintenance and cleaning (see section 6.3).

Do not allow direct sunlight on the system. The relative humidity should be kept below 90% (without condensation).

6.2 Scope of supply

The scope of supply varies depending on the specific EES solution selected. The necessary quantity of each item per EES solution is listed in Appendix 1. In addition to the items shown, there is optional auxiliary equipment that can be provided by Nilar, such as the back-to-back assembly set featured in section 6.4.1.

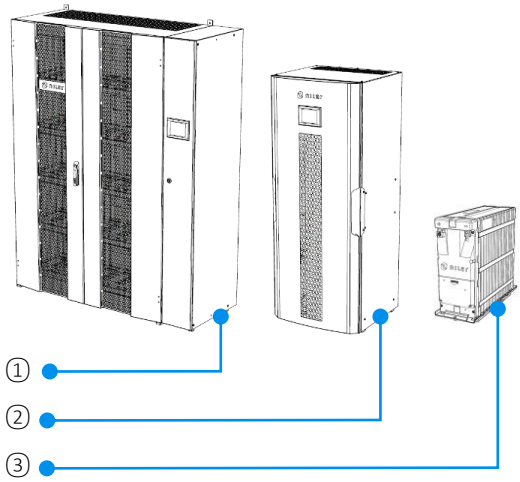
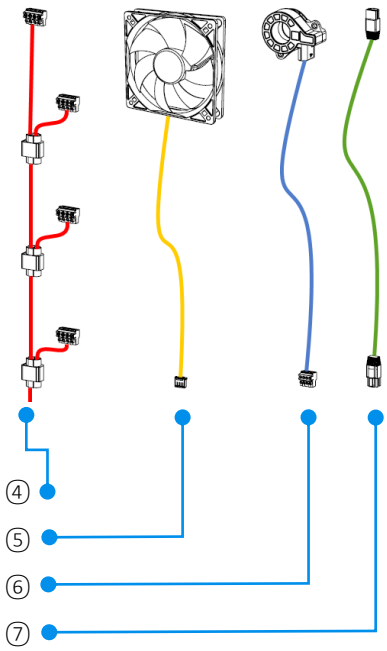


Figure 34: Scope of supply; storage and battery pack



Continues

Figure 35: Scope of supply; IMU connections

6. INSTALLATION

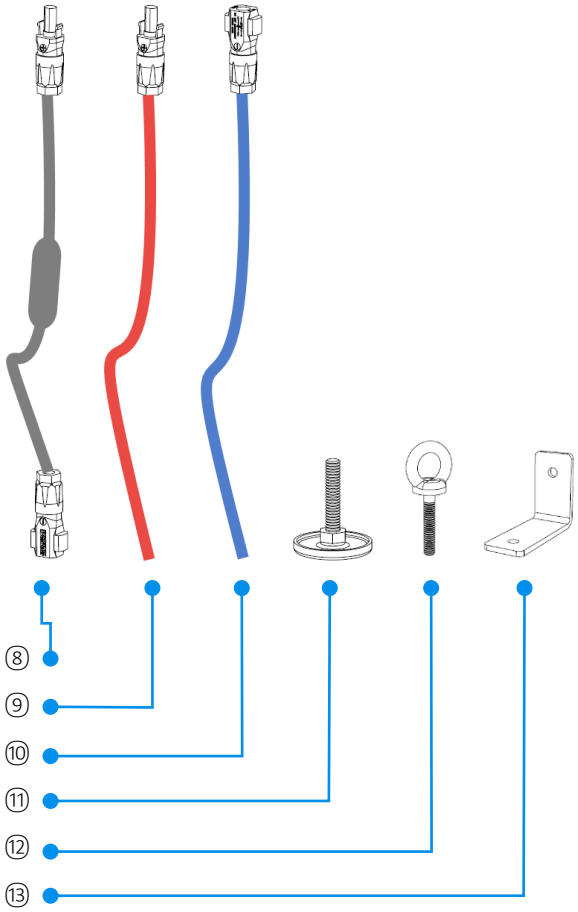


Figure 36: Scope of supply; Power cables, support leg, eye bolt and mounting bracket

Table 6: Denomination table

Denomination	Name	Denomination	Name
①	Rack	⑧	Interpack power cable[4]
②	Cabinet	⑨	Positive (+) power cable
③	Battery pack with tray	⑩	Negative (-) power cable
④	24VDC assembly	⑪	Support leg
⑤	Fan assembly	⑫	Eye bolt
⑥	Current sensor assem.	⑬	Mounting bracket
⑦	Com. cable (inter)		

Note! The required amount of each item per EES solution is listed in Appendix 1 found in the Appendices chapter

Note! In addition to the items described above the scope of supply also always contains one (1) ambient temperature sensor per delivered EES unit. This item is not displayed in this section, but included in the table in Appendix 1 found in the Appendices chapter

[4] *With built-in fuse*

6. INSTALLATION

6.3 Placement

Observe the specified minimum distances to neighboring objects. The minimum distances ensure that there is sufficient space for heat evacuation, that the storage doors as well as the BMS drawer can be opened easily (rack only) and that there is sufficient space for, amongst others, maintenance work

The rack requires some minimum spaces on the top and the front side. The left, right and back side do not require any additional spaces, although a minimum space of 500mm is required during installation and maintenance for access to the CCI (see section 6.5.1).

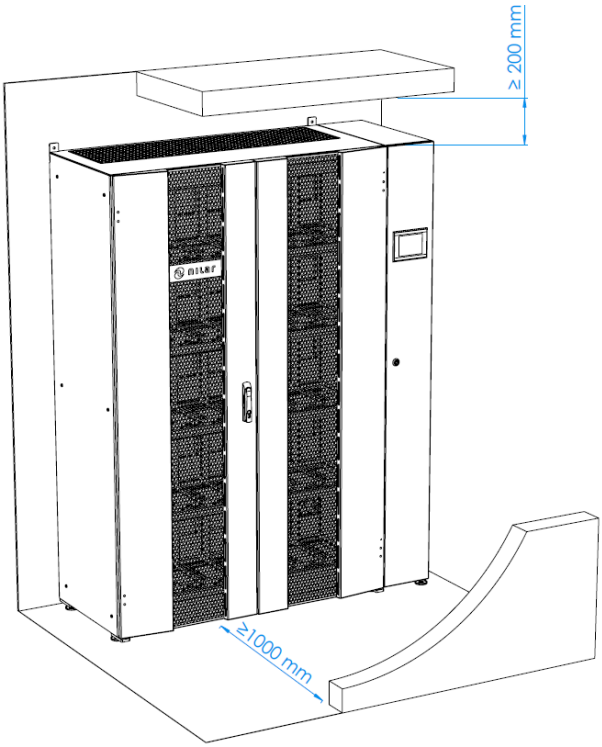


Figure 37: Rack with indicated minimum distances to neighboring objects

The cabinet requires minimum spaces on the top, front and left side. The back side and right side do not require any additional space.

Note! The minimum distance on top (200mm) is with respect to the minimum volume that is required for efficient cooling and proper ventilation of exhaust air. In order to facilitate removal of top plate for inspection or change of components of the BMS, additional space might be required.

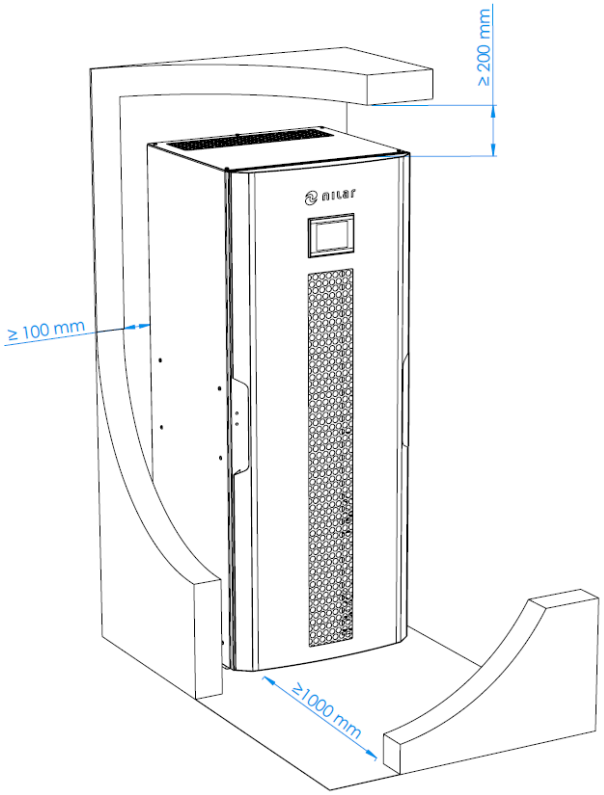


Figure 38: Cabinet with indicated minimum distances to neighboring objects

6. INSTALLATION

6.4 Rack/Cabinet assembly and adjustment

WARNING!

Always adjust the support legs so that the rack/cabinet is standing horizontally straight in both directions.

The racks and cabinets come as fully assembled units and no further assembly is required. Depending on the circumstances, the add-ons described hereinunder might be required.

6.4.1 Rack

In order to balance the rack and compensate for an uneven foundation, it is necessary to adjust the six (6) support legs (①) located in the bottom of the rack. By screwing them individually the rack can be adjusted to be horizontally straight in both directions.

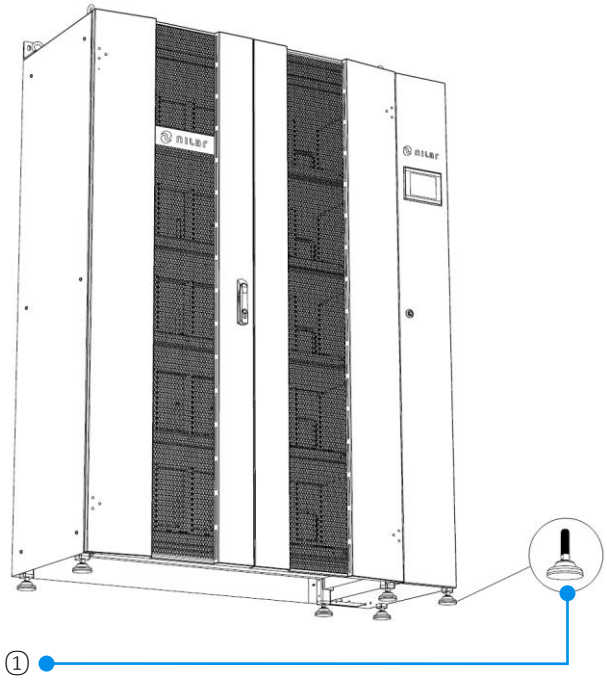


Figure 39: Overview of rack with indication of support legs

The rack is delivered with two (2) mounting brackets that must be attached on top of the rack. The rack must be fixated by attaching the mounting brackets (②) with two (2) screws[5] (③) onto a stable wall (④).

Note! Do not fixate the rack before all the external cables are installed see 6.5 and 6.7 – 6.10.

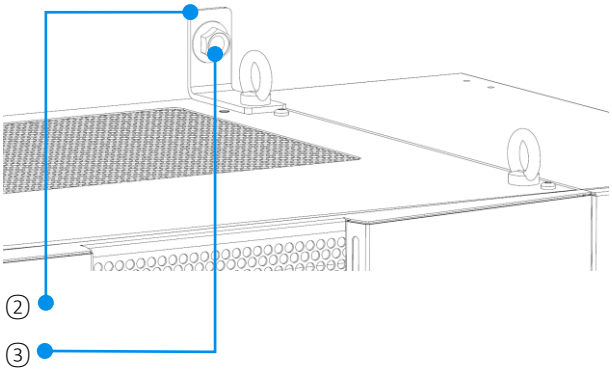


Figure 40: Detail view of mounting bracket with bolt

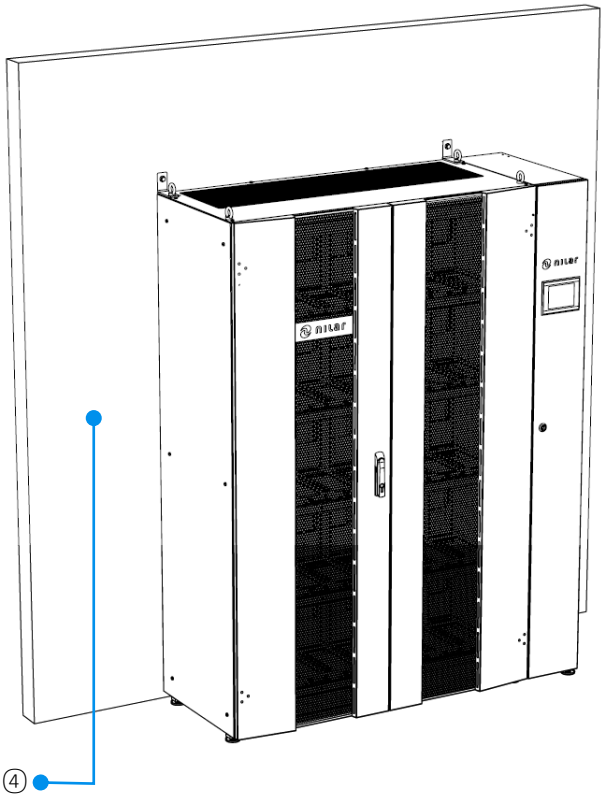


Figure 41: Overview of rack fixated to a stable wall with mounting brackets

[5] Type and length of screws depend on material in wall and the screws are not supplied with the rack.

6. INSTALLATION

If the rack is set up back-to-back with another rack, the two racks need to be attached to each other with the back-to-back assembly set consisting of four (4) M6 torx screws size 30 (①), two (2) crossbars (②) and two (2) M10 bolts (③) with bolt head size 15mm.

Note! The crossbar, screws and bolts are part of the optional back-to-back assembly set and not part of the standard scope of supply in section 6.2 'Scope of supply'. This assembly set needs to be ordered separately.

Do not fixate the racks to each other before all the external cables are installed see sections 6.5 and 6.7 – 6.10.

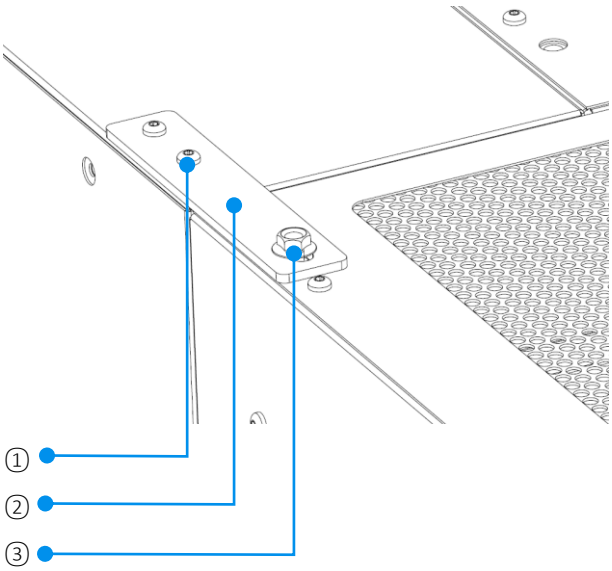


Figure 42: Detail view of crossbar with screws and bolt

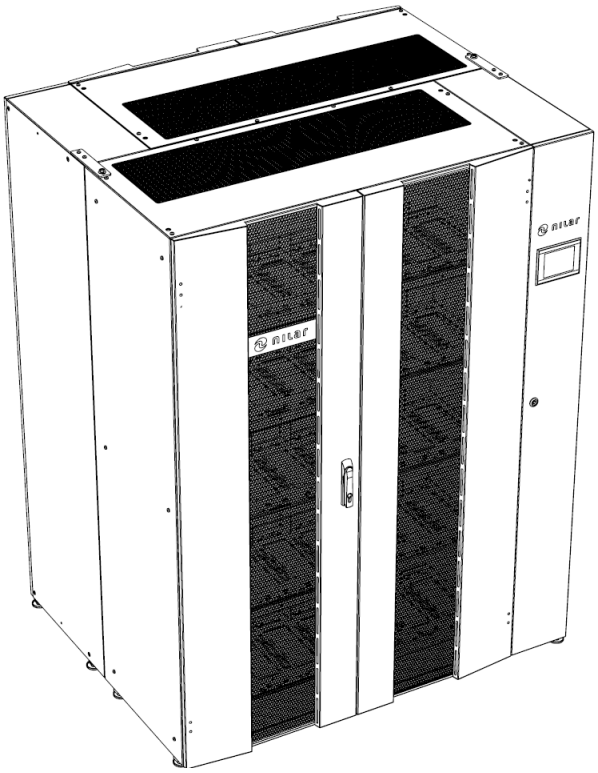


Figure 43: Overview of two racks attached back-to-back

6. INSTALLATION

6.4.2 Cabinet

CAUTION!

During the procedure of attaching the cabinet to a wall, make sure not to contaminate (e.g. dust, small debris) the BMS unit located on top of the cabinet.

CAUTION!

Do not attach the cabinet to the wall before the ESO units are installed (see section 6.6)

Only *valid for products: 21-0005, 21-0008, 21-0011 & 21-0014*

In order to balance the cabinet and compensate for an uneven foundation, it is necessary to adjust the four (4) support legs (①) located in the bottom of the cabinet. By screwing them individually the cabinet can be adjusted to be horizontally straight in both directions.

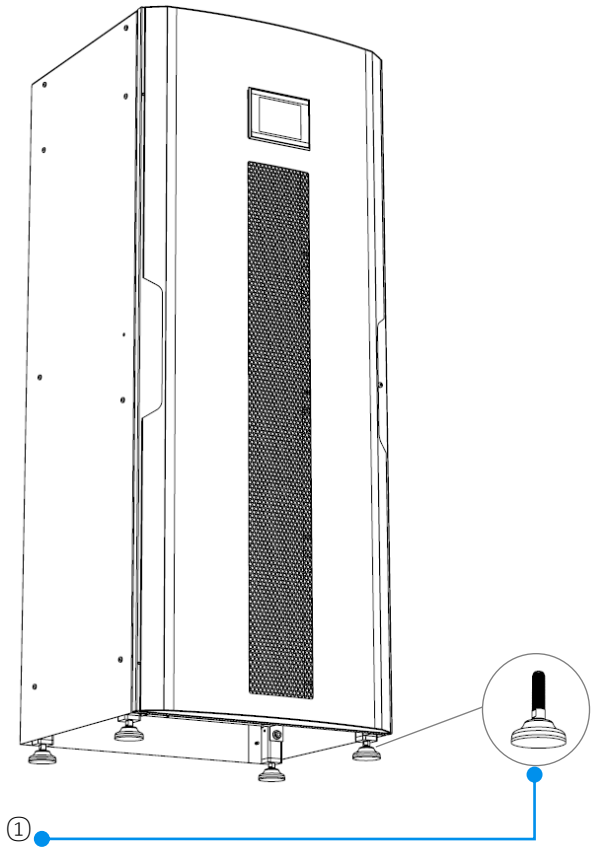


Figure 44: Overview of cabinet with indication of support legs

Attach the cabinet to a stable wall by using three (3) screws[6] in the displayed holes (②) of the cabinet back.

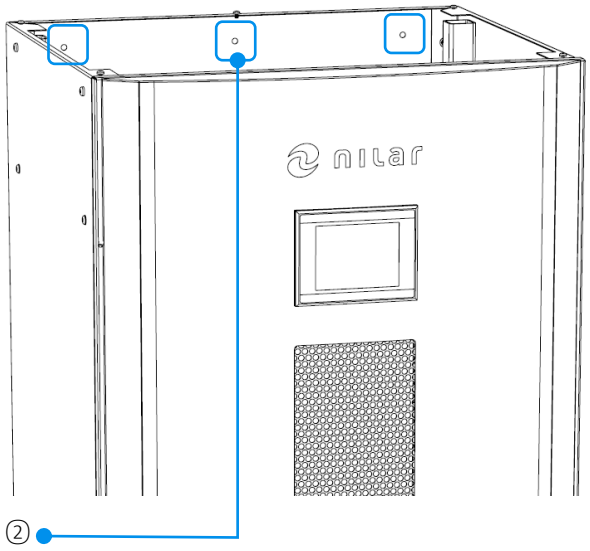


Figure 45: Indication of fixation holes in back plate of cabinet

[6] Type and length of screw depends on material in wall and screws are not supplied with cabinet

6. INSTALLATION

6.5 General information for all external cables

All external cables (applicable for sections 6.7 – 6.10) must enter the rack/cabinet as described in this section.

Nilar recommends that pull strain relief is employed for all external cables.

6.5.1 Rack

Unlock and pull out the BMS drawer (①) from the rack by using the provided key.

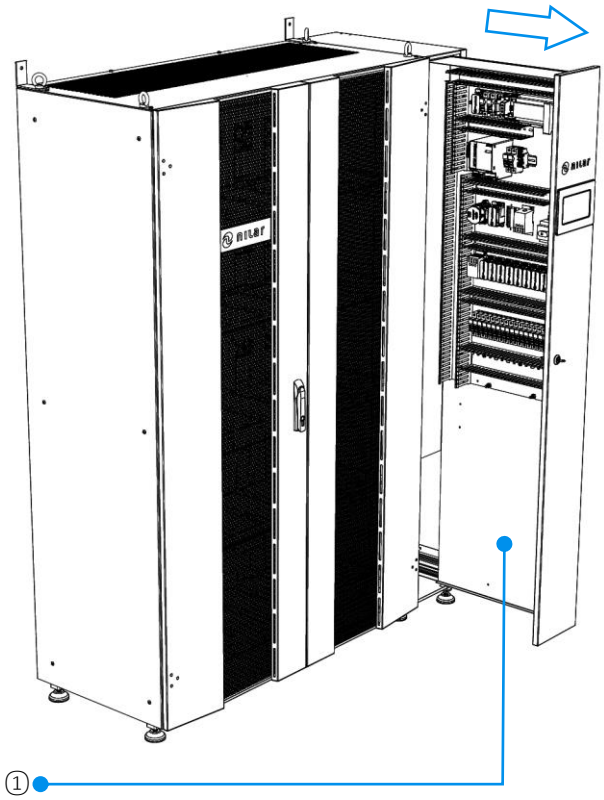


Figure 46: Rack with extended BMS drawer

Remove the Customer Connection Interface (CCI) cover lid, which is attached by four (4) M6 screws; torx size 30 (②).

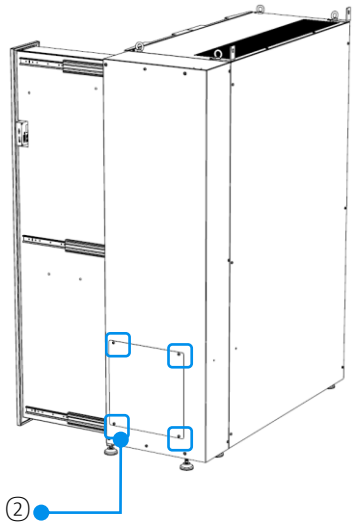


Figure 47: Indication of fixation screws for CCI cover lid

It is now possible to access the CCI, where all external connections are made. All external cables (●) must enter the rack from the bottom on the back side, through the dedicated cable entrance (③).

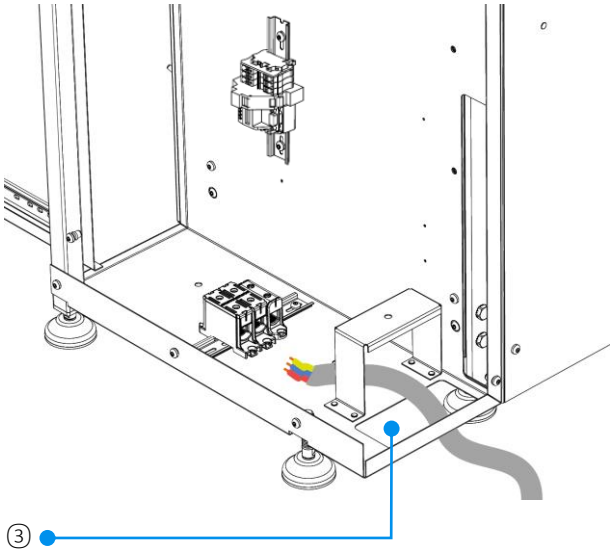


Figure 48: Illustration of routing for external cables in a rack solution (displayed with complete BMS back/side plate removed)

6. INSTALLATION

6.5.2 Cabinet

Remove the CCI cover lid (①) The cover is attached by three (3) M6 screws; torx size 30.

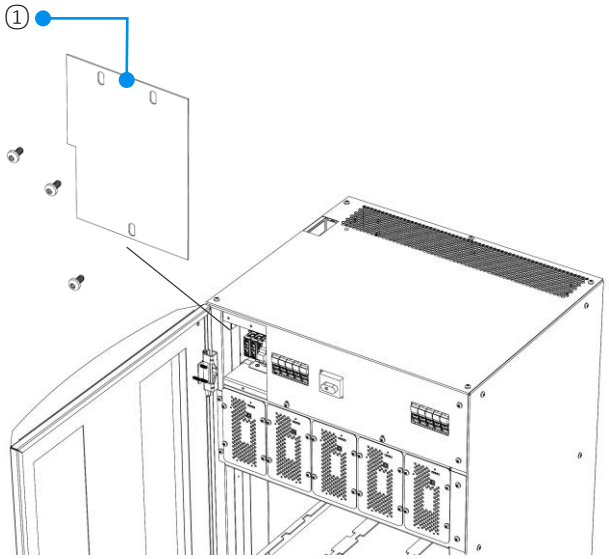


Figure 49: Illustration of CCI cover lid removal

The external cables enter the cabinet's top plate through the dedicated cable entry (②).

The cables are then routed along the cable duct (③) underneath the top plate in the direction towards the Customer Connection Interface (CCI) (④).

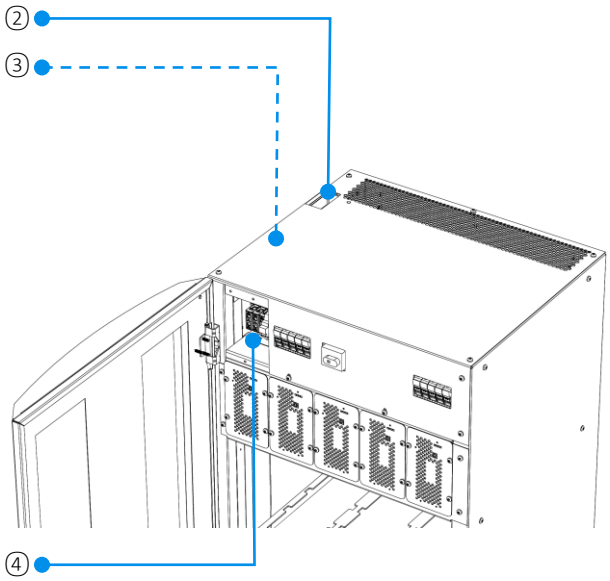


Figure 50: Illustration of cabling for external cables in a cabinet solution

6.6 Installation of ESO units in Cabinets

*<u>Note!</u> This section is **only** valid for cabinets with the product numbers 21-0005, 21-0008, 21-0011 & 21-0014. Not valid for rack and other cabinet products (proceed directly to section 6.7)!*

For products that are not delivered with pre-installed ESO units, the backplate needs to be removed. The backplate is secured horizontally by a screw (⑤) in the middle of the rear area of the top cover. The vertical portion of the backplate is attached with up to ten (10) screws (⑥), depending on the cabinet size. All screws are size M6; torx size 30.

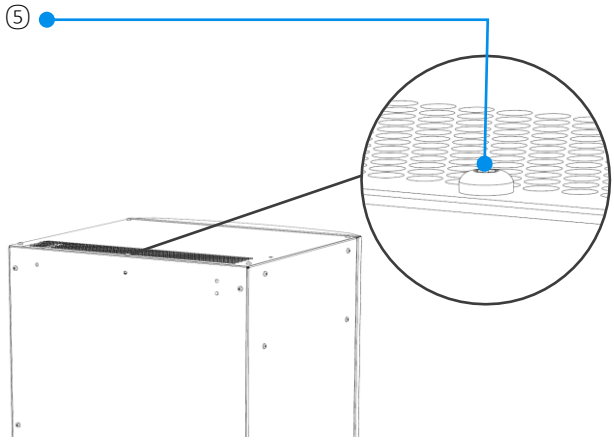


Figure 51: Horizontal attachment of backplate

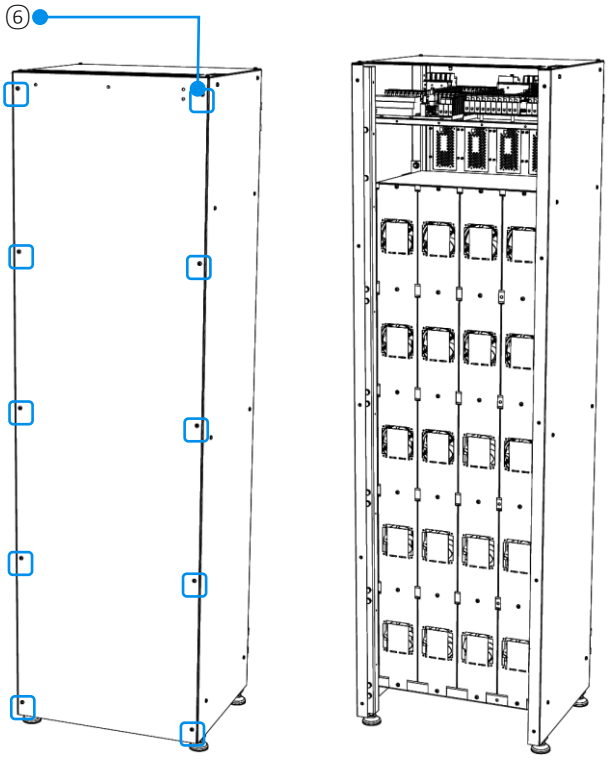


Figure 52: Before and after removal of backplate

6. INSTALLATION

The ESO units are installed from the front side of the cabinet. Open the front lid and remove the ESO covers. The ESO covers are secured by four (4) screws each, size M6; torx size 30.

Note! All ESO units are equal before installation takes place. However, the ESO unit that is installed in the ESO shelf slot to the furthest left (①) seen from the front side is appointed and thereafter always denominated as ESO #1. This is independent on the total number and orientation of the ESOs.

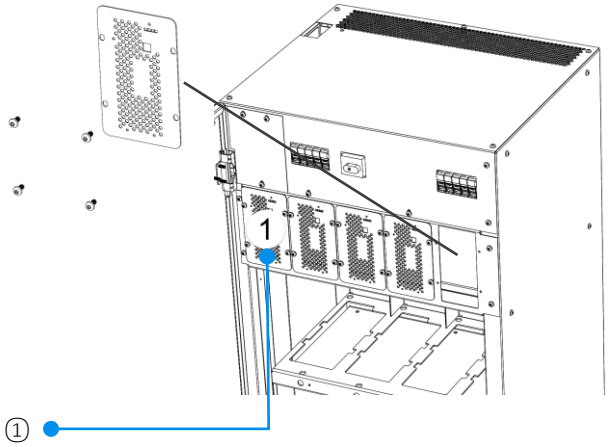


Figure 49: Removal of ESO covers

When the ESO covers are removed, the ESO units are lifted up to the ESO shelf and slid into the ESO slots.

Figure 49: Installation of ESO unit into ESO shelf slot

Connect all the pre-routed cables coming out from the cable duct (③) above the ESO shelf, to the connections on the backside of each ESO unit (②) (⑦) (⑧).

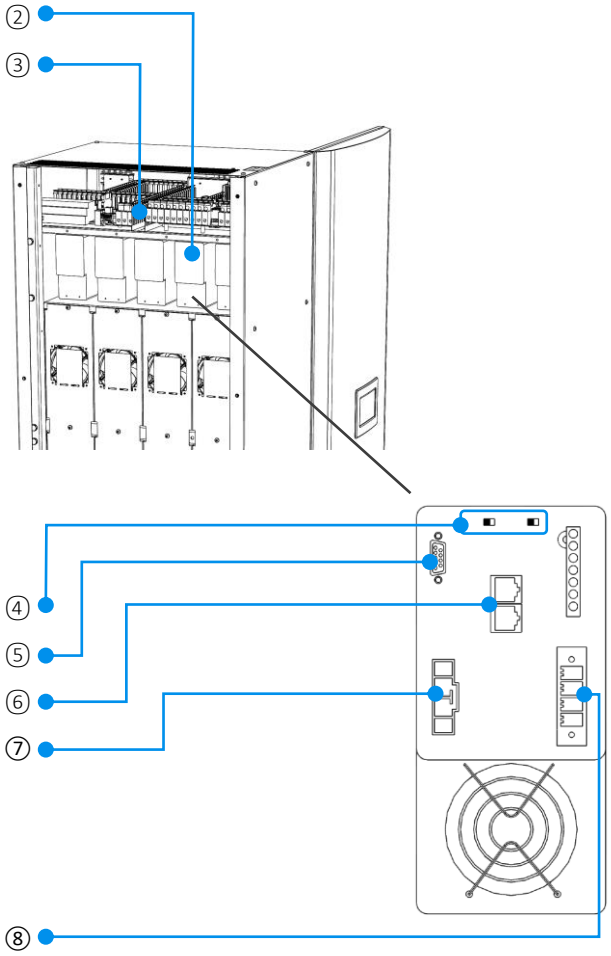


Figure 49: Location of pre-routed cables, ESO units and indication of connections on the backside of a ESO unit

Interconnect all ESO units to each other with the separately supplied RJ45 cables (Com. ESO-ESO) (⑥) to establish a communication bus.

Connect the pre-routed D-sub cable located above the ESO shelf slot #1 to the D-sub connection of the ESO unit located in ESO shelf slot #1 (Com. ESO-BMS) (⑤).

6. INSTALLATION

The outermost ESO units* act as communication termination units and therefore the settings of the termination switches (④) differ from the remaining ESO units. Set the switches on the backside of the ESO units accordingly.

**If the system setup only consists of one (1) or two (2) ESO units, these act as termination units*

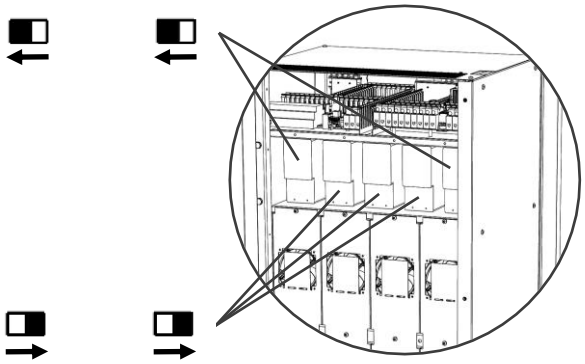


Figure 49: Termination switch settings

Refit the backplate and the ESO covers.

6.7 Connection of Ferroamp system power supply

WARNING!

The Ferroamp system may still provide hazardous voltage and energy, including residual or stored energy, although it is switched off or may appear switched off.

WARNING!

The positive (+) wire and the negative (-) wire of the incoming power cables must always be externally protected by one fuse each. The required size of the two fuses is as follows:

Rack	2x 100A DC-fuses (1000VDC)
Cabinet (5)	2x 50A DC-fuses (1000VDC)
Cabinet (4)	2x 40A DC-fuses (1000VDC)
Cabinet (3)	2x 30A DC-fuses (1000VDC)
Cabinet (2)	2x 20A DC-fuses (1000VDC)

The power cables from the Ferroamp system must be connected as described in this section.

6. INSTALLATION

6.7.1 Rack

The Ferroamp system power cables must be connected to the terminals within the CCI. The installed cables are fixated by inbuilt Hex screws size 5 (①).

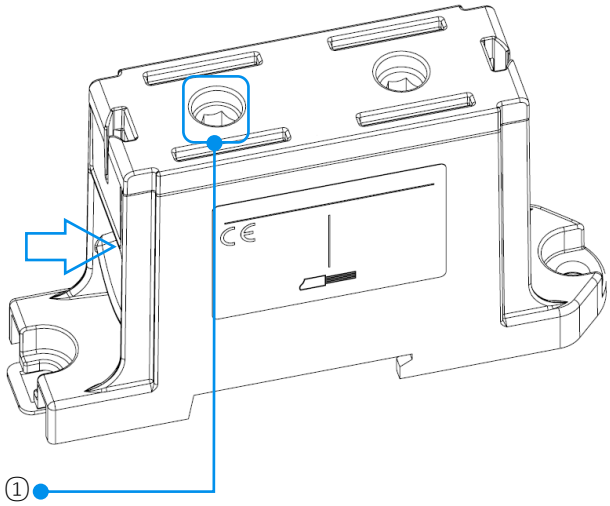


Figure 53: Detail view of CCI terminal in a rack

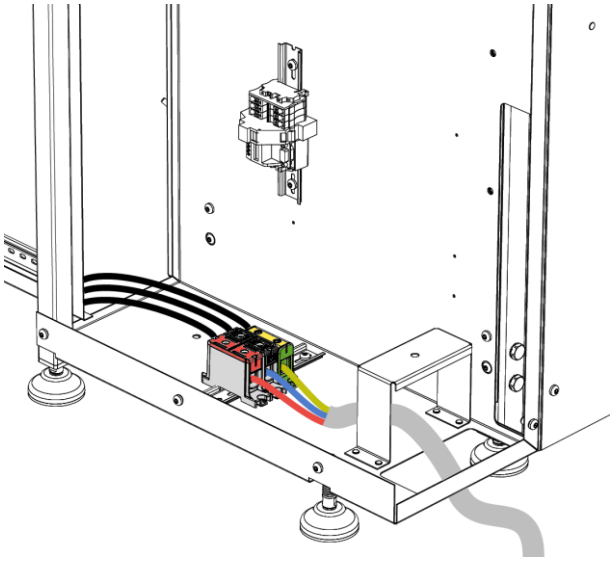


Figure 54: Illustration of the external Ferroamp system power cable and PE connection in the CCI of a rack

Connect the ingoing positive (+) Ferroamp system power cable (●) to the positive (+) terminal located in the CCI and fixate it with the inbuilt Hex screw size 5.

Connect the ingoing negative (-) Ferroamp system power cable (●) to the negative (-) terminal located in the CCI and fixate it with the inbuilt Hex screw size 5.

Connect the ingoing protective earth (PE) cable (●) from the Ferroamp system to the grounding terminal located in the CCI and fixate it with the inbuilt Hex screw size 5.

Note! The actual cable area of the Ferroamp power cable must be dimensioned depending on site conditions and may vary from case to case but should normally not be less than 35mm^2 (Cu). The maximum cable area that can fit in the connection terminal is 50mm^2 (Cu).

6. INSTALLATION

6.7.2 Cabinet

The Ferroamp power cables must be connected to the terminals within the CCI. The installed cables are fixated by inbuilt Hex screws size 5 (①).

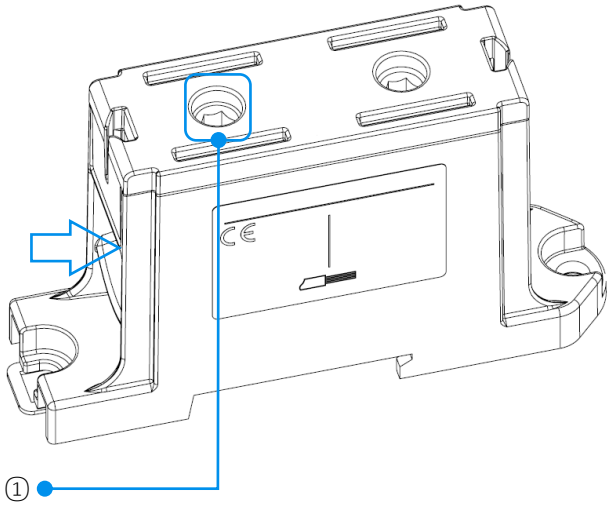


Figure 55: Detail view of CCI terminal in a cabinet

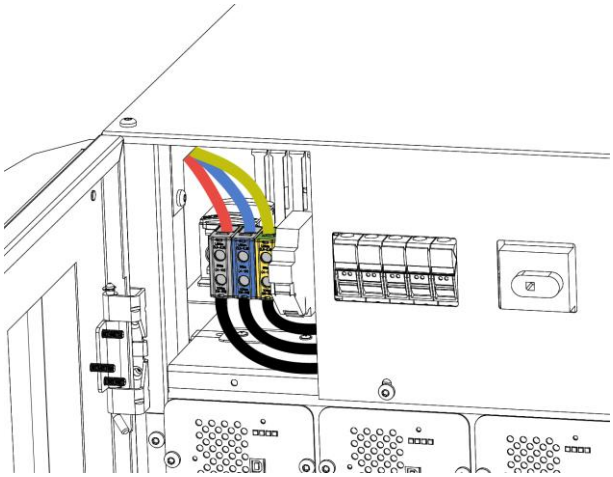


Figure 56: Illustration of the external Ferroamp power cable and PE connection in the CCI of a cabinet

Connect the ingoing positive (+) Ferroamp power cable (●) to the positive (+) terminal located in the CCI and fixate it with the inbuilt Hex screw size 5.

Connect the ingoing negative (-) Ferroamp power cable (●) to the negative (-) terminal located in the CCI and fixate it with the inbuilt Hex screw size 5.

Connect the ingoing protective earth (PE) cable (●) from the Ferroamp system to the grounding terminal located in the CCI and fixate it with the inbuilt Hex screw size 5.

Note! The actual cable area of the Ferroamp power cable must be dimensioned depending on site conditions and may vary from case to case but should normally not be less than 4, 6, 10 and 16mm^2 (Cu) for Cabinet sizes 2, 3, 4 and 5 respectively. The maximum cable area that can fit in the connection terminal is 50mm^2 (Cu).

6. INSTALLATION

6.8 Installation of power supply to BMS

The BMS is powered via the internal DC/DC converter that converts the incoming 760VDC from the Ferroamp system to 24VDC, which is the used operating voltage for Nilar's BMS.

6.8.1 Rack

Connect the external positive (+) power cable (●), the external negative (-) power cable (●) and the protective earth (●) to the dedicated terminals (marked '+' and'-'), as displayed in the following illustration.

Note! The maximum cable area that can fit in the connection terminals is 6mm^2 (Cu).

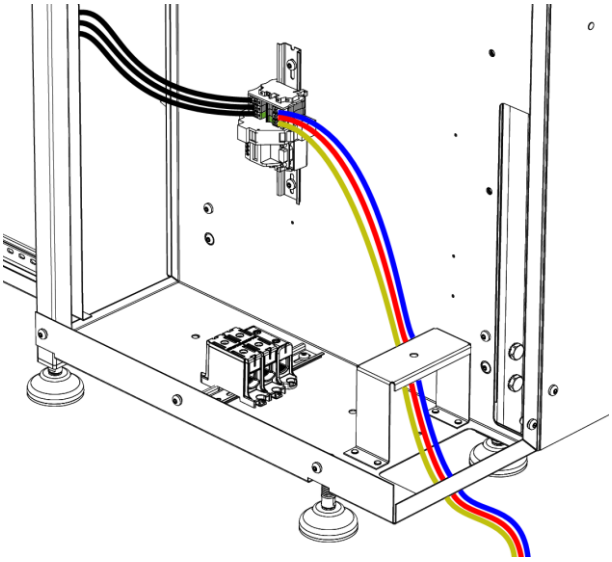


Figure 57: Illustration of 760VDC connection in the CCI of a rack (previous connections not displayed)

6.8.2 Cabinet

In a cabinet the power supply for the BMS is provided by the already installed Ferroamp system power cable (see section 6.7.2.).

6.9 Installation of Internet connection

In order for Nilar to be able to remotely support and update the BMS software, an internet connection is required. The internet connection serves also the purpose of data logging and remote troubleshooting. The internet connection must be configured for a dynamic address (dhcp). If a static address is required, contact your authorized local Nilar representative.

6.9.1 Rack

The external communication cable (●) with internet supply (RJ45) needs to be connected to the dedicated RJ45 connector located in the CCI.

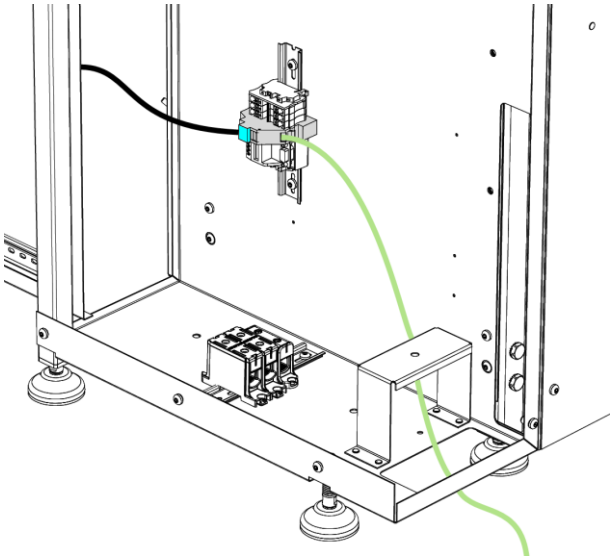


Figure 58: Illustration of Internet connection in the CCI of a rack (previous connections not displayed)

6.9.2 Cabinet

The external communication cable (●) with internet supply (RJ45) needs to be connected to the dedicated RJ45 connector located in the CCI.

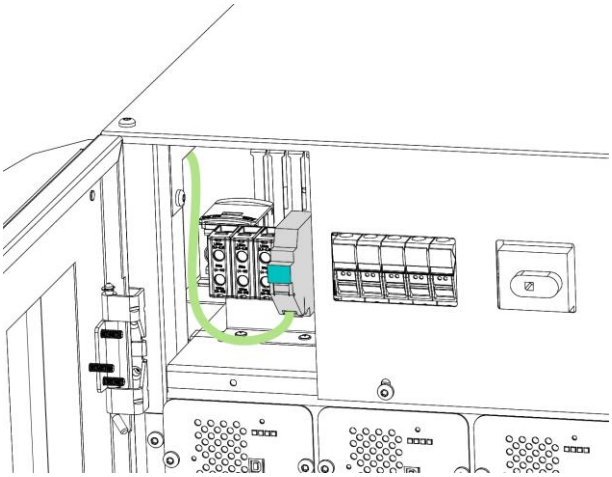


Figure 59: Displayed connection of internet communication cable in the CCI of a cabinet (previous connections not displayed)

6.10 Connection of Ferroamp system communication

To communicate with Ferroamp a connection is needed between Nilar's BMS and one of Ferroamp's ESOs.

6.10.1 Rack

The communication cable is connected to the designated D-sub connector located in the CCI, as displayed in the illustration below:

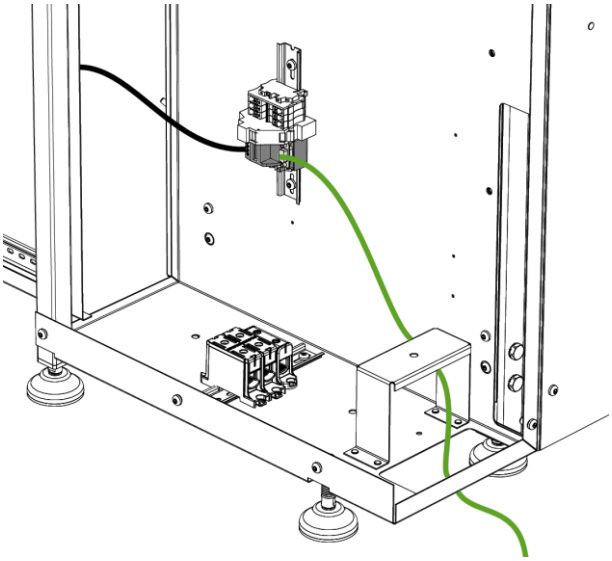


Figure 60: Illustration of EMS connection in the CCI of a rack (previous connections not displayed)

Connect the other end to one of the ESOs with a D-sub cable (9-pin, male to female, straight). This D-sub cable is not provided by Nilar.

6.10.2 Cabinet

Since the ESOs are installed inside the cabinet and not located externally (like it is the case with the rack), the communication cable between the ESO and the Nilar BMS is pre-installed.

Hence no further action is required during the installation phase since the communication between ESO and EnergyHub goes through the already installed Ferroamp system power cables.

6. INSTALLATION

6.11 Preparation of connections prior to battery pack installation

WARNING!

The positive (+) and negative (-) terminal of the battery pack shall NOT be connected to each other. This would result in a short-circuit.

Inspect each terminal post. If the terminal posts show any signs of damage, do not use the product.

WARNING!

Wear electrically insulated gloves when handling battery packs. Battery pack surfaces may carry hazardous voltage due to lowered insulation resistance. Do not place battery packs on conductive surfaces.

6. INSTALLATION

6.12 Orientation of battery pack

The battery packs must always be placed in an upright position (with the terminals in upper position).

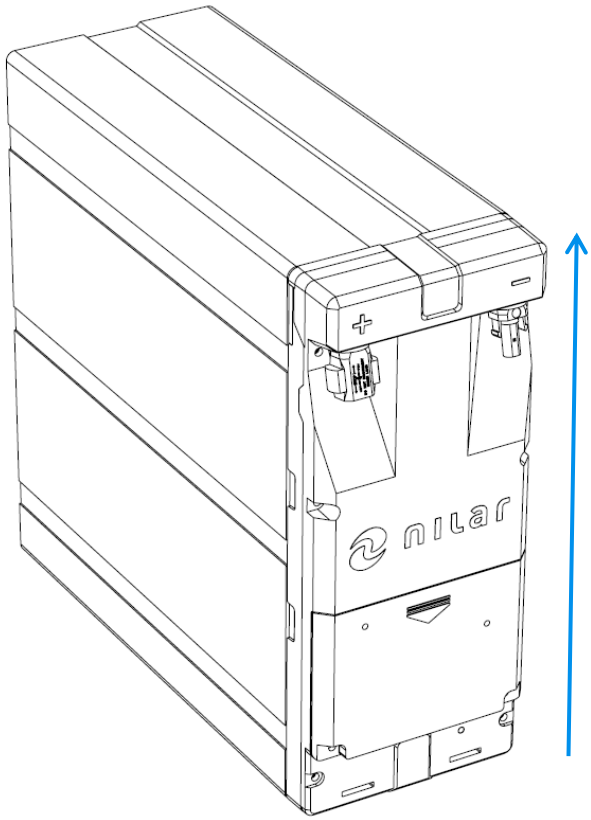


Figure 61: Orientation of battery pack (insulation tray is not displayed)

6.13 Installation of Battery packs

The following section describes how to place and fixate a battery pack in its rack/cabinet.

WARNING!

Never install battery packs without insulation trays.

WARNING!

Wear electrically insulated gloves when handling battery packs. Battery pack surfaces may carry hazardous voltage due to lowered insulation resistance. Do not place battery packs on conductive surfaces.

CAUTION!

Always remove both lifting straps in connection with the installation of the battery packs to avoid potential air flow reduction and/or fan jam.

CAUTION!

The ID-marking on the battery packs ④ and the ID-marking in the rack/cabinet ③ must always match each other. In the rack/cabinet the ID-marking is only placed on the position of the battery pack 'A' in each battery string.

6. INSTALLATION

Place the insulation trays (ⓒ) into the shelf openings (①) as displayed in the following illustration.

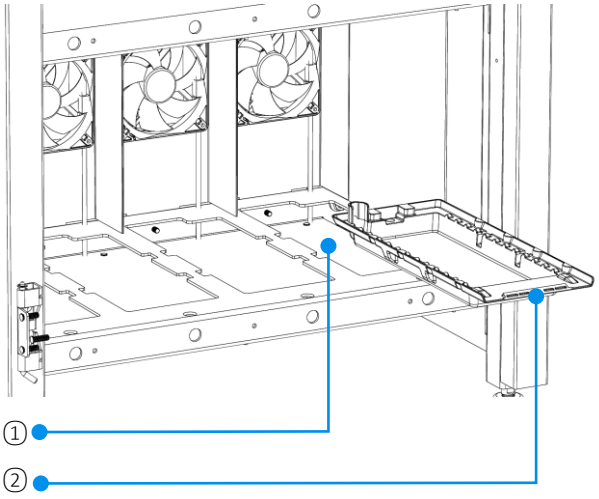


Figure 62: Installation of insulation tray

Lift and slide the battery packs into the insulation trays on their designated shelf slots within the rack/cabinet.

Note! For correct arrangement of battery strings, please see section 6.14. For correct order of battery packs, please see section 6.15.1

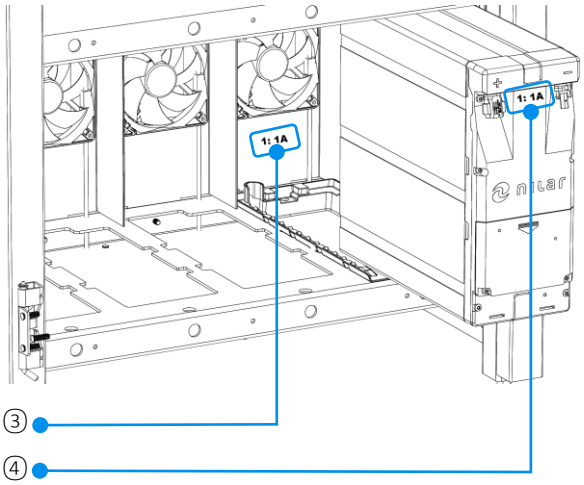


Figure 63: Approximate placement of ID-marking on battery pack and rack/cabinet

6.12.1 Fixation of battery pack

Fix the battery front holders (ⓖ) with the dedicated screws (⑤) by tightening the screws clockwise with a torx driver size 20 until firm.

Note! The lifting straps, as described in section 5.2.1, must be removed from battery packs prior fixation (not possible after installation).

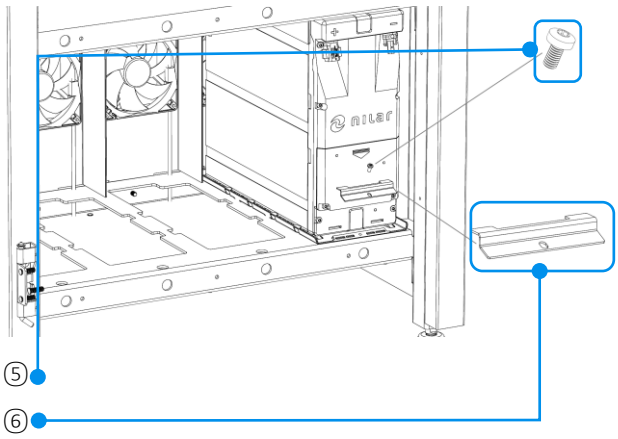


Figure 64: Battery pack prior to attachment with indication of fixation screw and battery front holder

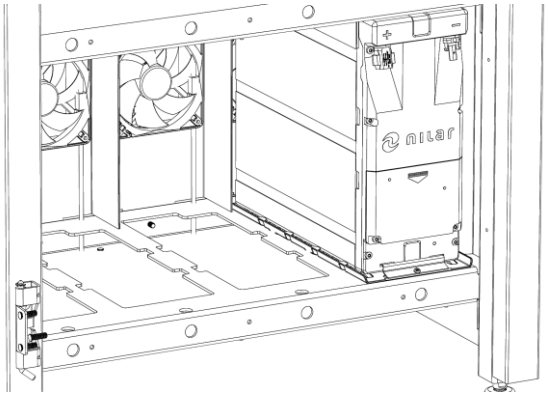


Figure 65: Installed and fixated battery pack

6. INSTALLATION

6.14 Arrangement of battery strings

When arranging battery strings, it follows the priority order:

1. Right to left
2. Bottom to top

6.13.1 Rack

The first battery pack (battery pack ‘A’) in the first string (battery string ‘1’) (①) in a rack solution always is placed in the bottom right corner, and the following battery packs in the same battery string continue leftwards as can be seen in the following illustration.

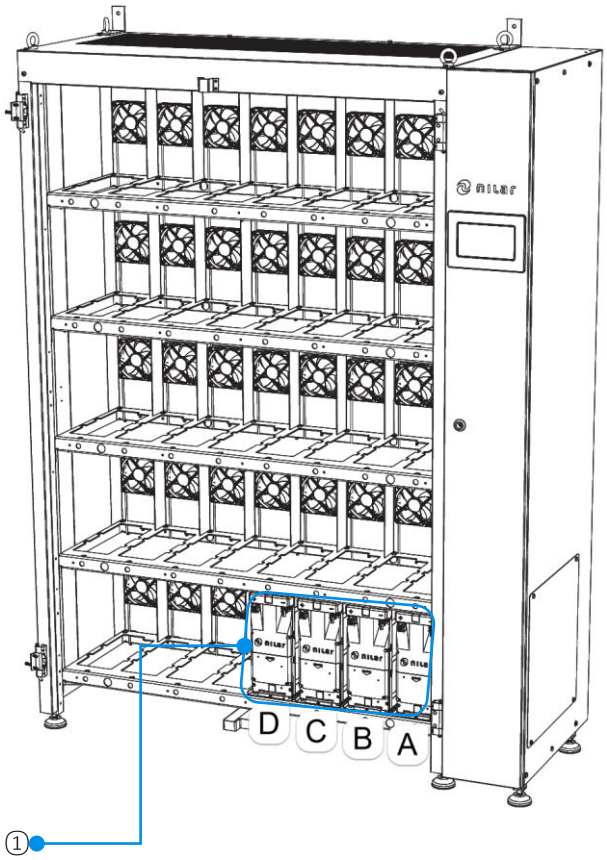


Figure 66: Rack with battery string #1 indicated

Battery string ‘2’ (②) in a rack solution is placed to the left of battery string ‘1’.

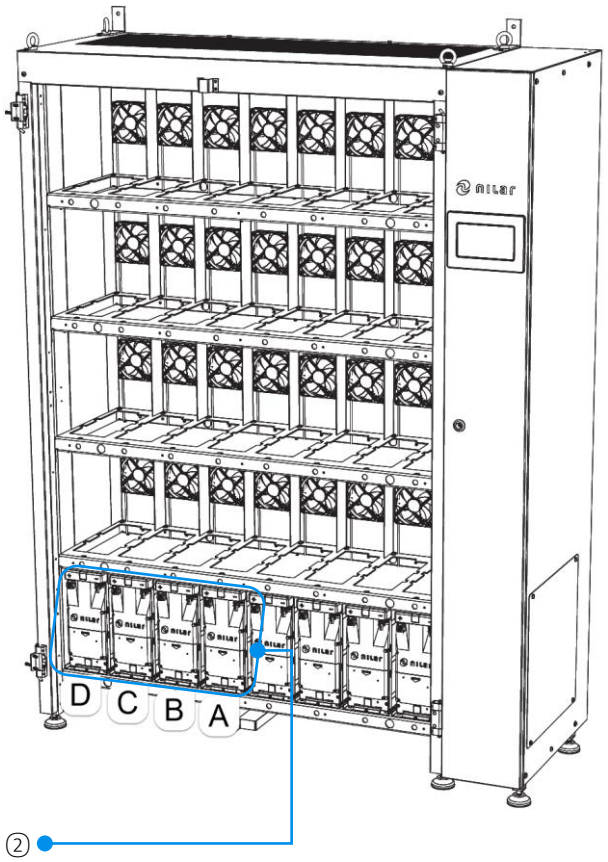


Figure 67: Rack solution with battery string #2 indicated

Battery string ‘3’ will be placed just like battery string ‘1’, but on the second shelf from the bottom.

The described procedures are repeated for the remaining battery packs and battery strings.

6. INSTALLATION

6.14.2 Cabinet

The same principle as in the case with the rack is applicable for battery string ‘1’ (①) in a cabinet solution.

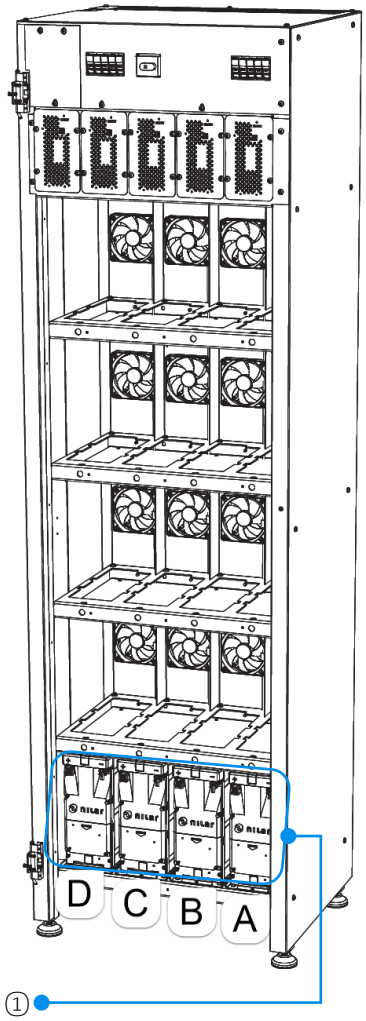


Figure 68: Cabinet with battery string #1 indicated

Battery string ‘2’ (②) in a cabinet solution will be placed just like battery string ‘1’, but on the second shelf from the bottom.

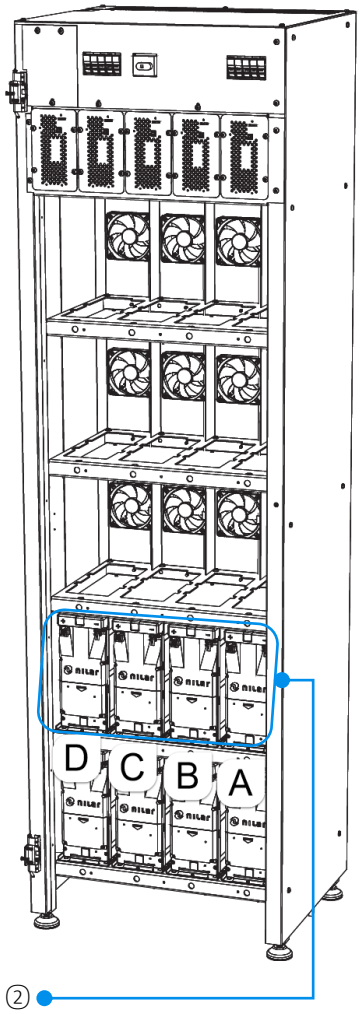


Figure 69: Cabinet solution with battery string #2 indicated

The procedure is repeated for the remaining battery packs and battery strings.

6. INSTALLATION

6.15 Series connection of battery packs to form a battery string

This section describes how to series connect battery packs into a battery string. It is exemplified on one (1) battery string consisting of four (4) battery packs of 144VDC each.

Note! The insulation trays are not displayed in the illustrations of section 6.15.

6.15.1 Order of Battery packs

During manufacturing, the battery packs are sorted, matched and labelled in order to achieve the best performance of the battery string.

Sort the battery packs according to their labels from right to left, where the first battery pack in a battery string is designated as 'A', the second battery pack is designated as 'B' etc.

Note! The denomination labels in the following illustration are only for illustration purposes. The actual labels on the battery packs might deviate in both appearance and placement. For further information regarding ID-marking and system structuring, please contact your authorized local Nilar representative.

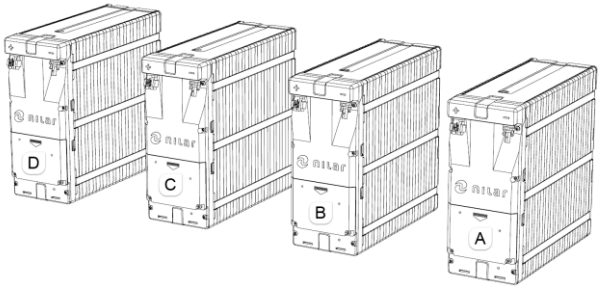


Figure 70: Battery string sorted according to labeling, from right to left

6.15.2 Removal of cover lid

Remove the cover lid of the IMU by loosening the two (2) torx screws size 20 (①) with a screwdriver for all the battery packs.

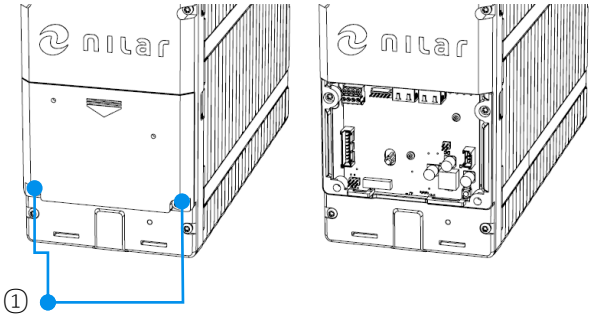


Figure 71: Before and after IMU cover lid removal

6.15.3 Installation of current sensor cable

CAUTION!

Please make sure that the clamping screws ② are visible on the front side of the connector and that the cables are pointing down towards the cable entry (see section 6.14.10).

Connect the cable for the current sensor into the designated connection port on the IMU (see section 4.13.4) of battery pack 'D' in each battery string.

This is indicated in light blue (●) in the following figures.

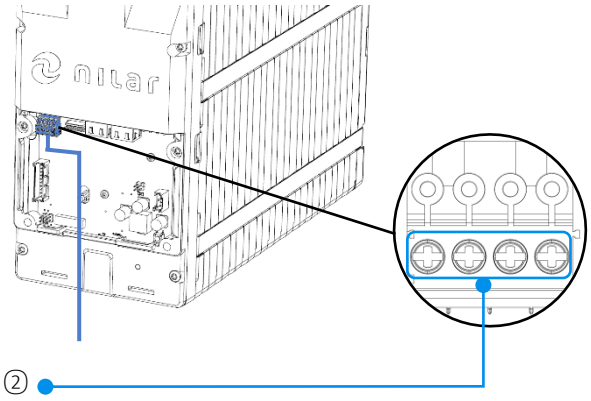


Figure 72: Installation of current sensor cable on IMU

6. INSTALLATION

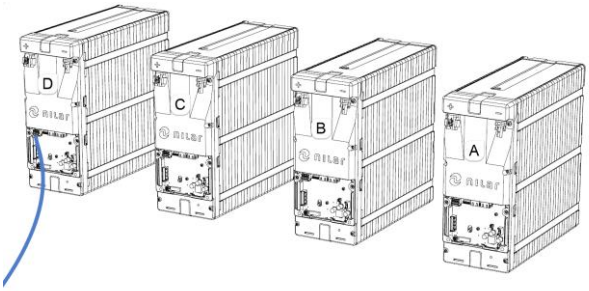


Figure 73: Installation of current sensor cable on battery pack 'D'

6.15.4 Connection of CANopen communication cables

Connect the pre-routed ingoing CANopen communication cable with its RJ45 plug into one of the two (2) CAN ports (CAN1 and CAN2) of battery pack 'A' (see section 4.13.7).

This is indicated in green (●) in the following figures.

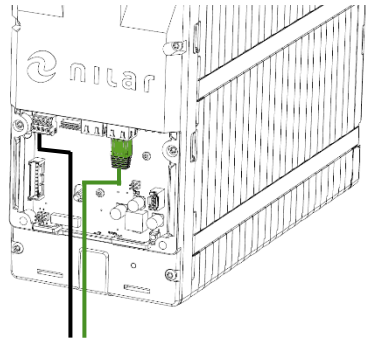


Figure 74: Installation of ingoing CANopen communication connection into CAN2 socket on IMU

Connect the interpack CANopen communication cable with its RJ45 plug into the other CAN port of battery pack 'A' (see section 6.15.1). Connect the other side of this cable into a CAN port of battery pack 'B'.

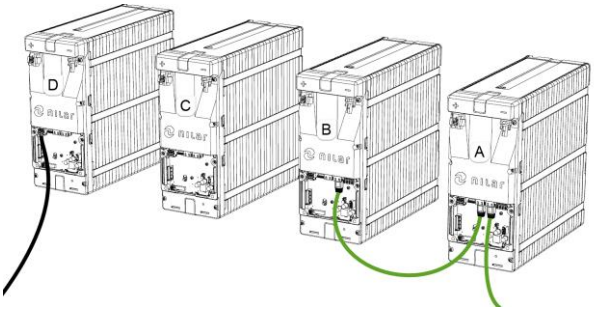


Figure 75: Installation of CANopen communication cable in battery string

Repeat the procedure between battery packs 'B' → 'C' → 'D'.

The CAN socket of the last battery pack ('D') in battery string '1' connects to the CAN socket of the closest battery pack of the closest next string.

Repeat all the above for all battery strings, except for battery pack 'D' of the last battery string which instead is connected to the pre-routed outgoing communication cable.

The connection between battery strings is made as displayed in the following illustration. The dotted line (…) illustrates the already pre-installed parts and the solid line (—) shows the communication loop that must be connected during this installation step.

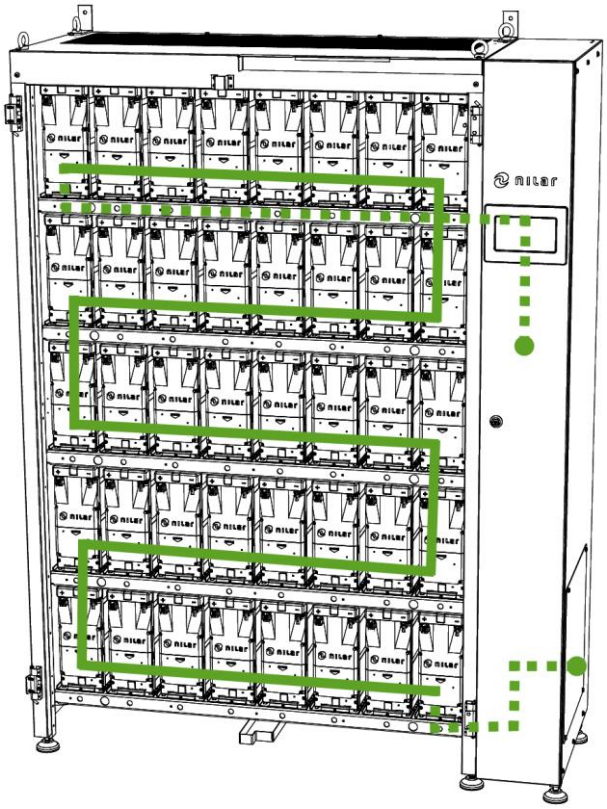


Figure 76: Illustration of CANopen communication loop

6. INSTALLATION

6.15.5 Installation of fan connection

Connect the cable for the fan into the fan connection port on the IMU of each battery pack (see section 4.13.8).

This is indicated in yellow (●) in the following figures.

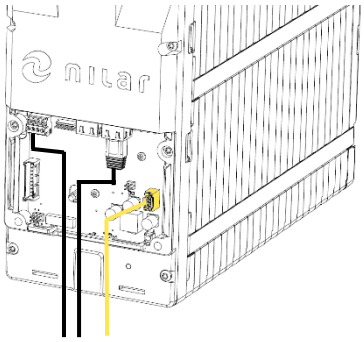


Figure 77: Installation of fan connection on IMU

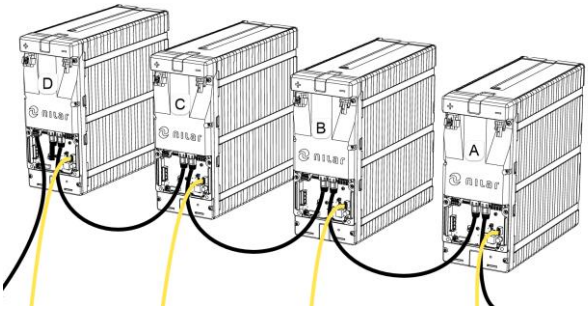


Figure 78: Installation of fan cables in battery string

6.15.6 Installation of 24VDC power supply

CAUTION!

Please make sure that the clamping screws ① are visible on the front side of the connector and that the cable fixing points incl. cables are pointing down towards the cable entry (see section 6.15.9).

Connect the 24VDC assembly's spin-off cable to every battery pack's 24VDC connection port of the IMU (see section 4.13.9).

This is indicated in red (●) in the following figures.

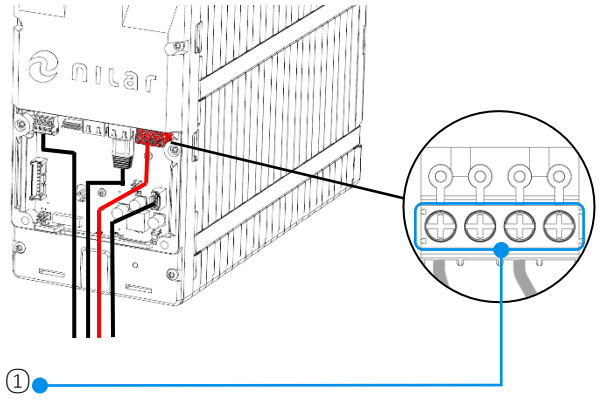


Figure 79: Installation of 24VDC power supply connection on IMU

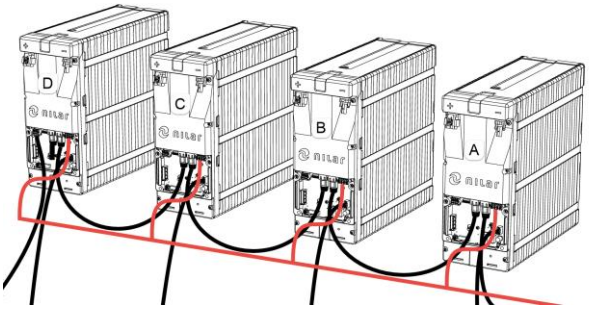


Figure 80: Finished installation of 24VDC power supply on battery string

6. INSTALLATION

6.15.7 Installation of ambient temperature sensor cable

There is only one (1) ambient temperature sensor per rack/cabinet and it is always installed on battery pack ‘A’ of battery string ‘1’.

Connect the cable for the ambient temperature sensor into the designated connection port on the IMU (see section 4.13.5).

This is indicated in purple (●) in the following figure.

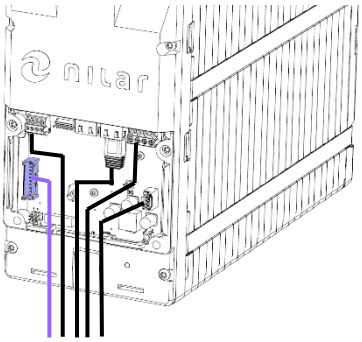


Figure 81: Installation of ambient temperature sensor connection on IMU 1:A

Place the cable in the cable duct below the battery string.

After this is done, all cable connections on the IMUs are complete.

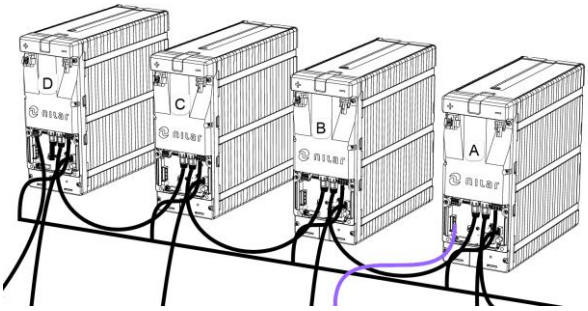


Figure 82: Installation of ambient temperature cable on battery pack ‘A’ of battery string ‘1’

6.15.8 Address setting of battery packs

The addresses are already set during production at the Nilar production facility (see section 4.12.6).

No action is required during installation. However, if a battery string needs to be replaced, the new battery packs inherit the older battery packs addresses. This is the case since the address is not unique to a battery pack but specific to the physical position in the system. See Appendix 3 in the Appendices chapter for information about position specific addresses.

6.15.9 Mounting of IMU cover lid

Install the IMU cover lid back while checking that all cables are routed through the cable entry.

Secure the IMU cover lid with its two (2) torx screws (see section 6.15.2).

Repeat for all battery packs.

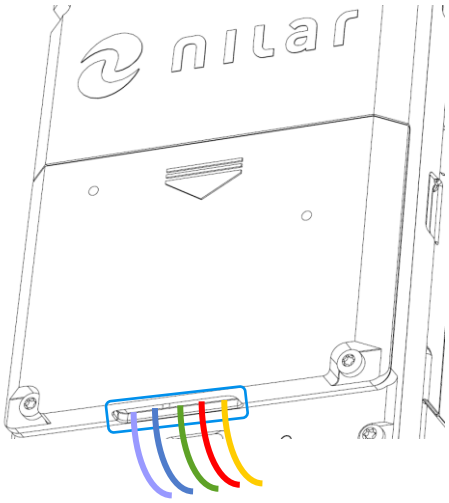


Figure 83: Detail view of cable entry on cover lid of IMU

6. INSTALLATION

6.15.10 Installation of negative power cable

WARNING!

Before any power cables are connected to the battery packs, make sure that the EES is **NOT** connected to any external power source. The Control Power switch must be turned off and fuses/MCBs must be taken out / switched off before any connection can commence (see section 7.1).

Plug in the factory installed negative (-) cable connector from the BMS into the negative (-) chassis connector of battery pack 'A'.

This is indicated in blue (●) in the following figures.

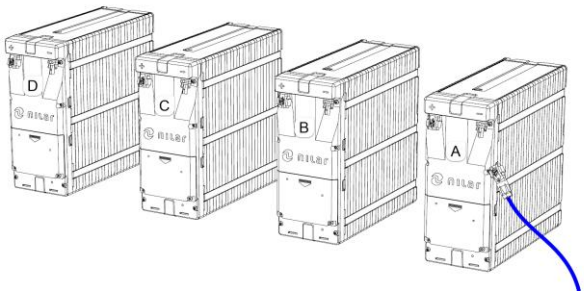


Figure 84: Installation of negative (-) cable (IMU connections are not displayed)

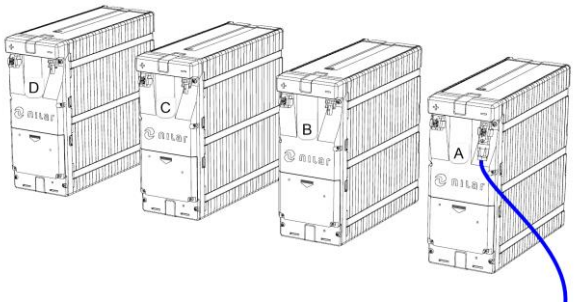


Figure 85: Finished installation of negative (-) cable (IMU connections are not displayed)

6.15.11 Installation of interpack cables

WARNING!

Please be careful when connecting the interpack cables **NOT** to connect the positive (+) and the negative (-) terminal of one battery pack with each other.

This would result in a short-circuit.

Plug in the positive (+) cable connector of the interpack cable (●) into the positive (+) chassis connector of battery pack 'A'. Connect the negative (-) cable connector of the interpack cable into the negative (-) chassis connector of battery pack 'B'.

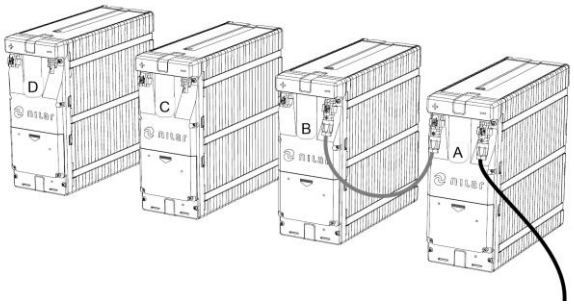


Figure 86: Finished installation of interpack cable between battery pack 'A' and 'B' (IMU connections are not displayed)

Repeat the procedure of installing interpack cables between battery pack 'B' → 'C' → 'D' (or any other last battery pack of that particular battery string).

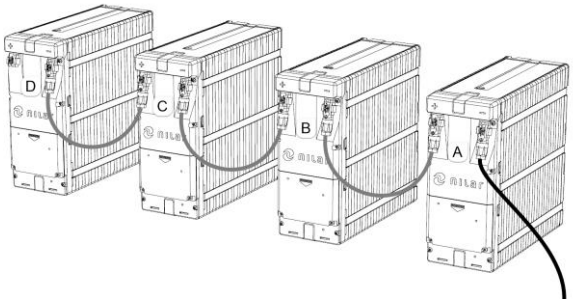


Figure 87: Finished installation of interpack cables for complete battery string (IMU connections are not displayed)

6. INSTALLATION

6.15.12 Installation of positive power cable

Note! The positive power cable is already laced through the current sensor during production in the correct way. However, if this should not be the case or if any component must be changed, it is important to install the current sensor as described in this section.

Lace the factory installed incoming positive (+) power cable connector through the current sensor (see section 4.13.4).

The text marking "LEM"(①) of the current sensor must point towards the positive (+) chassis connector of battery pack 'D' (or any other last battery pack of that particular battery string).

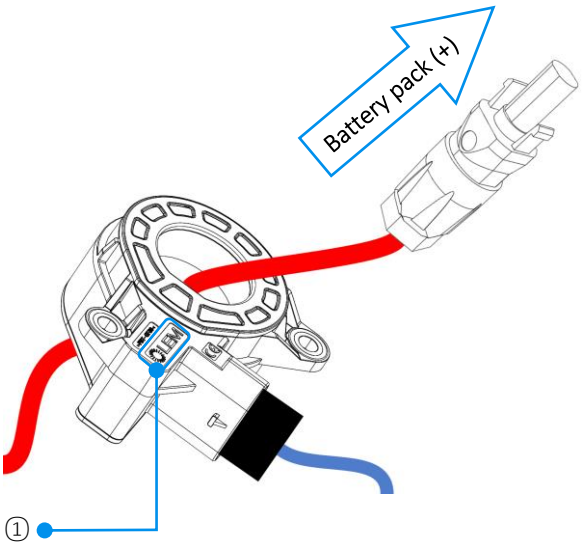


Figure 88: Current sensor displayed with correct installation direction

The positive (+) power cable is indicated as red (●) in the following figures. The current sensor cable is indicated as light blue (●).

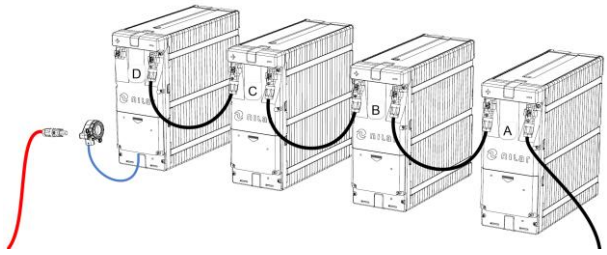


Figure 89: Installation of positive (+) power cable including current sensor (remaining IMU connections are not displayed)

Note! One battery string requires one current sensor. The current sensor is always installed on the positive terminal of battery pack 'D' (or any other last battery pack of that particular battery string).

Plug in the positive (+) cable connector into the positive (+) chassis connector of battery pack 'D' (or any other last battery pack of that particular battery string).

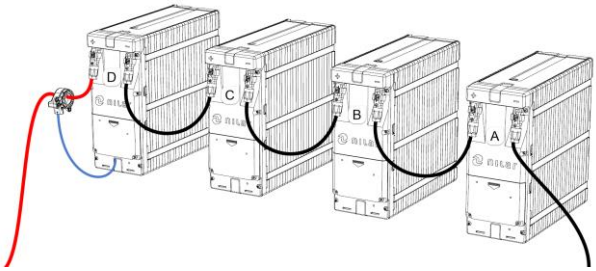


Figure 90: Finished installation of positive (+) power cable including current sensor (remaining IMU connections are not displayed)

The connections are now completed for one battery string. Repeat procedures from section 6.15.5 and onwards for all battery strings.

6. INSTALLATION

6.16 Installation protocol

All the installation steps are also available in a condensed version as an installation protocol.

Nilar strongly advises to go through the installation protocol and its various installation steps prior to the start-up. This in order to verify that all the vital parts have been checked and thereby minimizing failures during operation.

The installation protocol is found in the Appendices chapter as Appendix 4 in this installation manual.

7. OPERATION

7. Operation

This chapter will explain how the EES is started initially and how the EES is operated via the HMI (although in most cases, the EES will be operated via the EnergyHub Cloud).

The operating zone is between 0% to 100% SoC.

7.1 Start-up

Note! When switching the system on, the start-up is delayed by two-three (2-3) minutes by a time relay. This time allows the EnergyHub to start up and reach a stable voltage before the EES starts up.

The principle of starting up the EES is the same, independently of the configuration. On the hardware side it consists of:

1. Inserting the battery string fuses in the BMS
2. Inserting the fuses for incoming power supply
3. Switching the Miniature Circuit Breakers (MCB) in the BMS to position 'ON' ('I').
4. Turning the Control Power switch in the BMS to position 'ON' ('I').

7.1.2 Start-up components of rack

In a rack solution the number of components are:

- MCB, three (3) per unit
- Two (2) fuses for BMS power supply
- One (1) Control Power switch
- Battery string fuses, two (2) per string

The identification in the BMS of the start-up components are:

①	MCB *(PLC, HMI)*	**FA3**
	MCB *(IMUs)*	**FA4**
	MCB *(time relay)*	**FA5**
②	Fuses *(battery strings)*	**F1 – F20**[7]
③	Control Power switch	**QA1**
④	Fuses *(BMS power supply)*	**FA1, FA2**

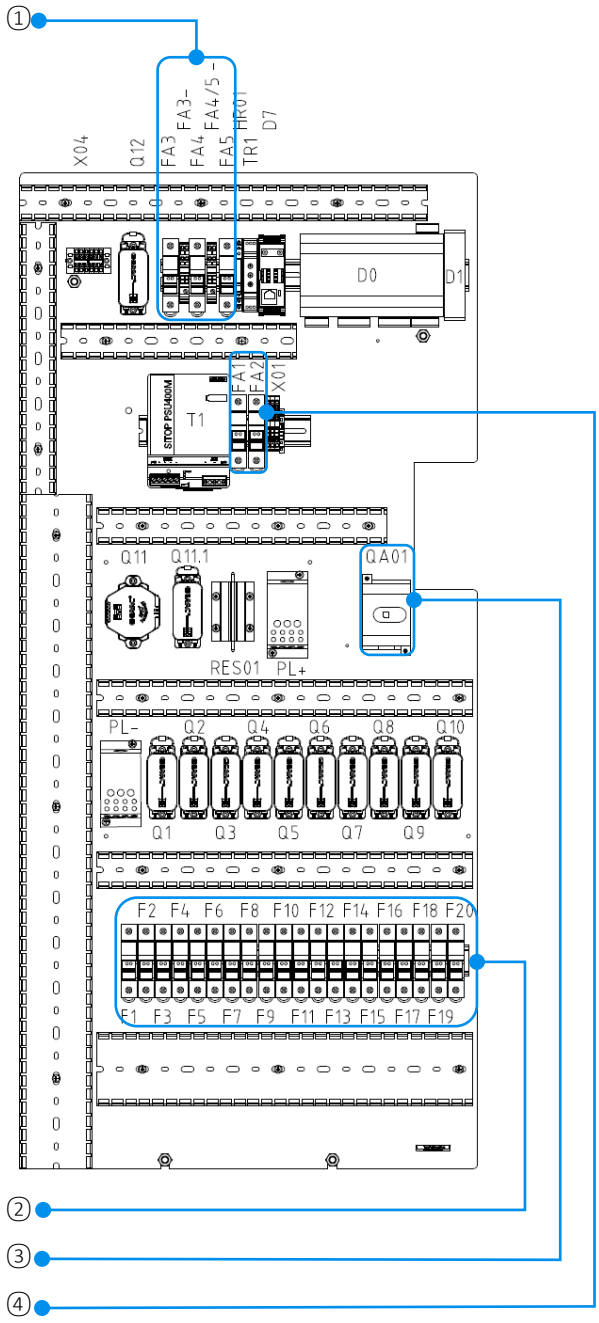


Figure 91: Location of start-up components of a BMS in a rack

[7] Uneven numbers are for the positive (+) battery string side and even numbers are for the negative (-) battery string side.

7. OPERATION

7.1.3 Start-up components of cabinet

In a cabinet solution the number of components are:

- MCB, three (3) per unit
- Two (2) fuses for BMS power supply
- One (1) Control Power switch
- Battery string fuses, two (2) per string

The identification in the BMS of the start-up components are:

①	MCB *(PLC, HMI)*	**FA3**
	MCB *(IMUs)*	**FA4**
	MCB *(time relay)*	**FA5**
②	Fuses *(BMS power supply)*	**FA1, FA2**
③	Fuses *(positive battery strings)*	**F1, F3, (F5) (F7), (F9)[8]**
④	Control Power switch	**QA1**
⑤	Fuses *(negative battery strings)*	**F2, F4, (F6), (F8), (F10)[8]**

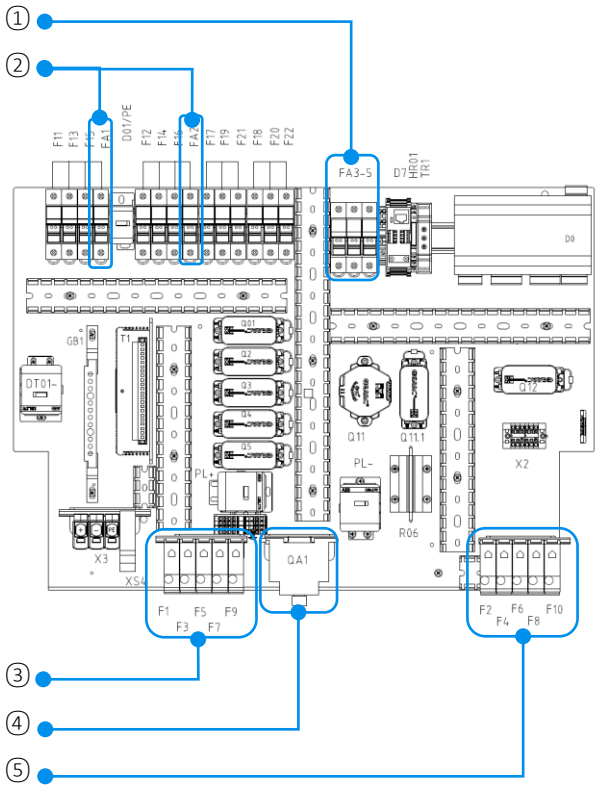


Figure 92: Location of start-up components of a BMS in a cabinet with 5 battery strings

[8] Uneven numbers are for the positive (+) battery string side and even numbers are for the negative (-) battery string side. Depending on the number of battery strings the fuses vary between 2 and 5 fuses for each side of the battery string.

7. OPERATION

7.2 BMS – alerts and limits

The Nilar BMS understands specific characteristics of Nilar battery packs and is developed to optimize utilization of installed battery capacity and service life. The BMS will issue warnings or alarms to higher level systems when battery conditions are out of range. If critical conditions are detected in a battery string, the BMS will disconnect that particular battery string.

There are three (3) different levels of alerts that the BMS communicates and also displays on the HMI:

- *Alarm*

  An alarm is triggered if the actual value exceeds or falls below the limit value. The EES will not operate if that happens.

- *Warning*

  Alerts the user that the actual values are moving towards the limit values for an alarm level.

- *Information*

  Informs the user about general status / key values that do not harm the product but can, in some cases, delay the prompted action.

A detailed table of all the alarms, warnings and information messages is available in the Appendices chapter as Appendix 2.

7.2.1 Operational limits

The operational limits for triggered alerts in the software are set in cooperation with your authorized local Nilar representative. The settings are optimized by Nilar since they, to a large extent, depend on factors such as ambient conditions, system and type of application etc.

7.3 HMI - Local interface

The HMI (①) is the display for the PLC that controls the BMS (and the IMU).

In this section the various screens of the HMI are described, addressing different functionalities and settings in the system.

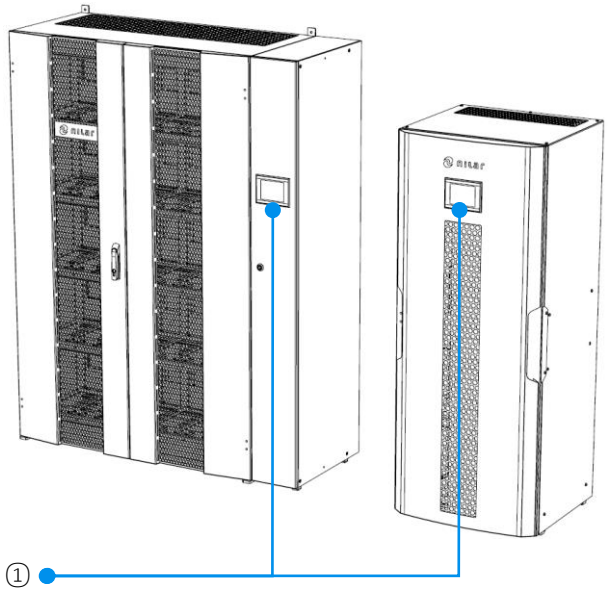


Figure 93: Location of HMI on rack and cabinet

7. OPERATION

7.3.1 General HMI information

The figure below explains the various segments of the display.

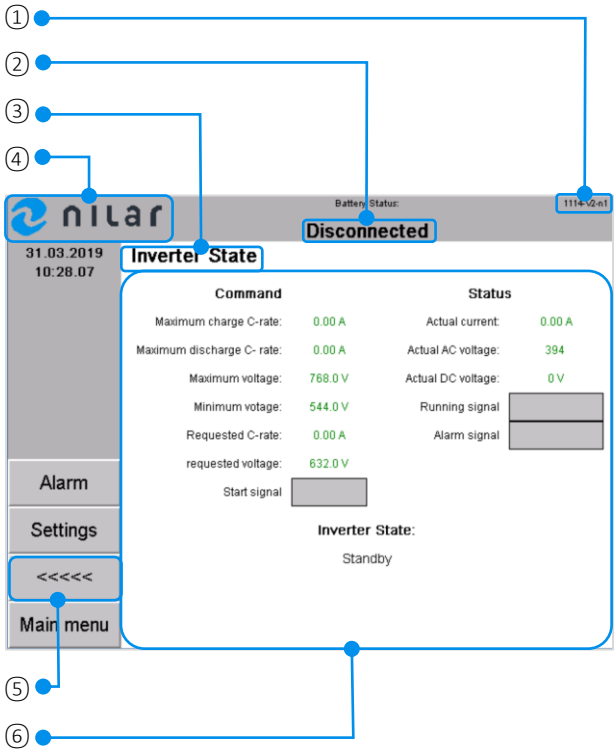


Figure 94: General information, HMI

① Serial number of EES

② Battery status field:

Grey (●) equals status: **OK**

Red (●) equals status: **Alarm**

③ Page header, for orientation/information purpose

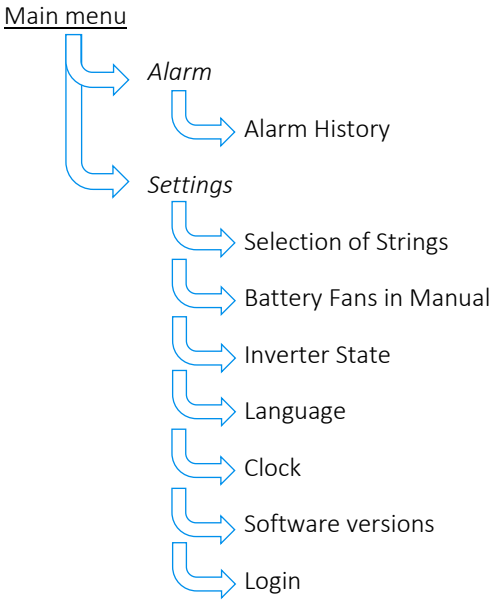
④ Press the Nilar logotype in order to view the company's contact information

⑤ Press the arrows (<) to return to the previous menu

⑥ The white (○) area displays the various content for the function specified in the page header (③)

7.3.2 HMI Structure

The structure tree for the HMI is as follows:



7.3.3 Main menu

In the main menu (⑥) of the HMI, the status for EES voltage, SoC, total current and highest battery pack temperature is presented in green.

Note! A negative (-) value of the current implies that the EES is charging.

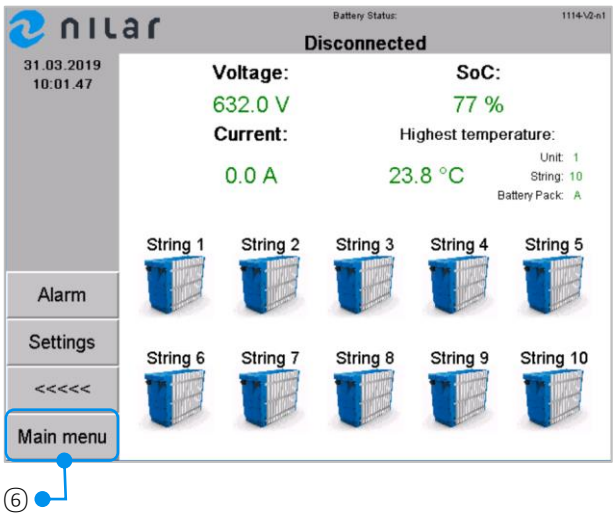


Figure 95: HMI main menu page

7. OPERATION

7.3.4 Alarms

In the Alarm section, all the active alarms are shown. To access the Alarm section, press the button marked 'Alarm' (①).

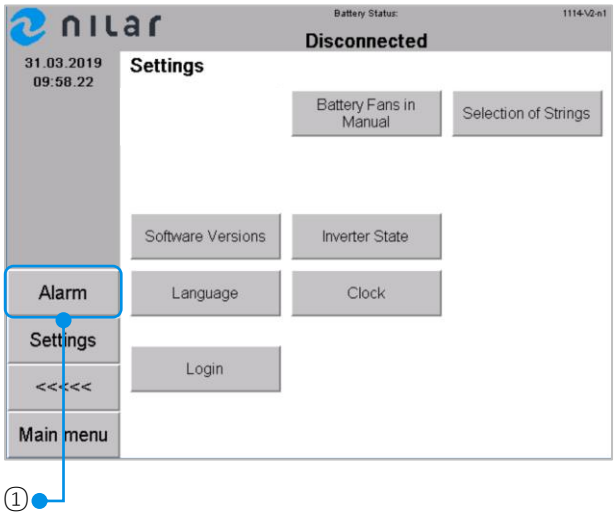


Figure 96: HMI, accessing the Alarm section

Active alarms

Active alarms, warnings and information are displayed.

Alarms will be shown in Red.

Warnings will be shown in Yellow.

Information will be shown in Green.

By pressing the buttons 'UP' and 'DOWN', it is possible to scroll between the various alarms in the list.

By pressing 'CONFIRM' the alarms will be deleted from the alarm list.

The alarms will only be able to delete if the cause for triggering the alarm in the first place, is no longer existent (e.g. a too high temperature in a battery pack that now has cooled down to operational conditions). If this is not the case, the alarm will not be able to delete.

If the user wants to check historical alarms, this is done by pressing the 'Show history' button in the right bottom corner of the screen (②) when being in the 'Alarm' menu. This is displayed in the following figures below.

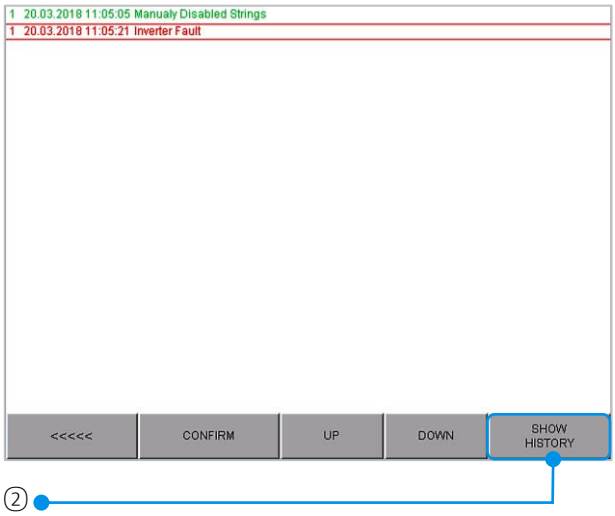


Figure 97: HMI, list of active alarms and accessing historical alarms

Alarm history

Historical alarms, warnings and information are displayed

Alarms will be shown in Red.

Warnings will be shown in Yellow.

Information will be shown in Green.

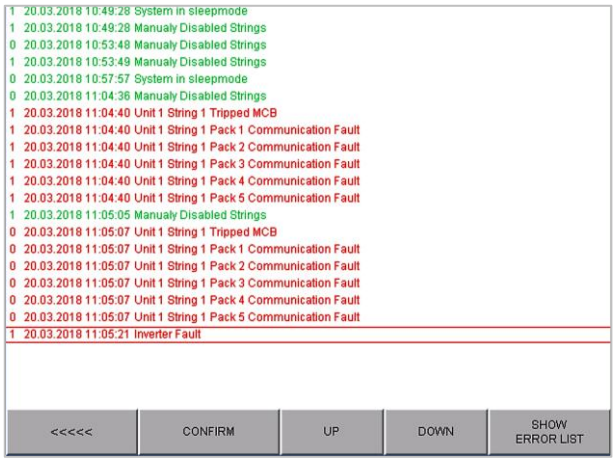


Figure 98: HMI, historic alarms

Note! A detailed table of all the alarms, warnings and information messages is available in the Appendices chapter as Appendix 2.

7. OPERATION

7.3.5 System measurements

In the main menu, a number of measurements can be viewed by clicking on the desired battery string (①).

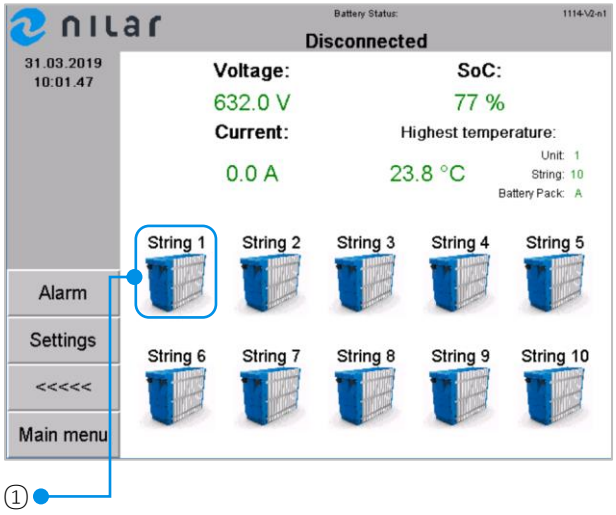


Figure 99: HMI, accessing the measurements section

In this menu all the measurements for the battery packs (③) of a specific battery string (②) are presented. By pressing the right or left oriented arrows, the user can change in-between the various battery strings.

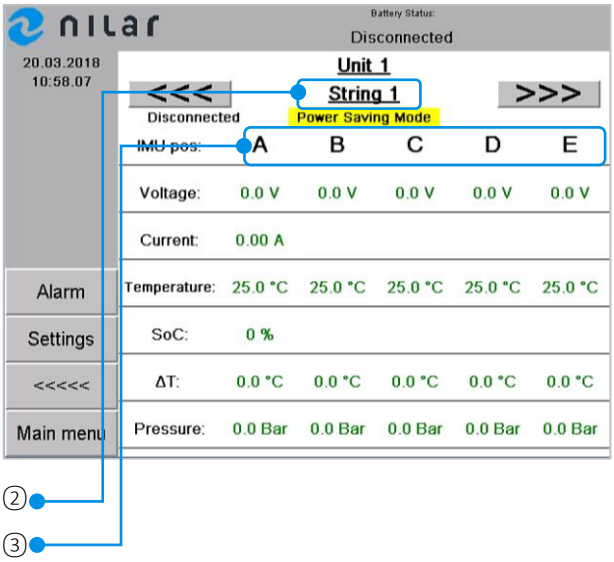


Figure 100: HMI, measurement section

7. OPERATION

7.3.6 Enable/Disable battery strings

If a problem with a battery string occurs, that specific battery string can be disabled manually. This means that all the alarms, warnings and information regarding that particular battery string are turned off and the battery string will remain disconnected. The selection of battery strings is accessed through the Settings menu (①).

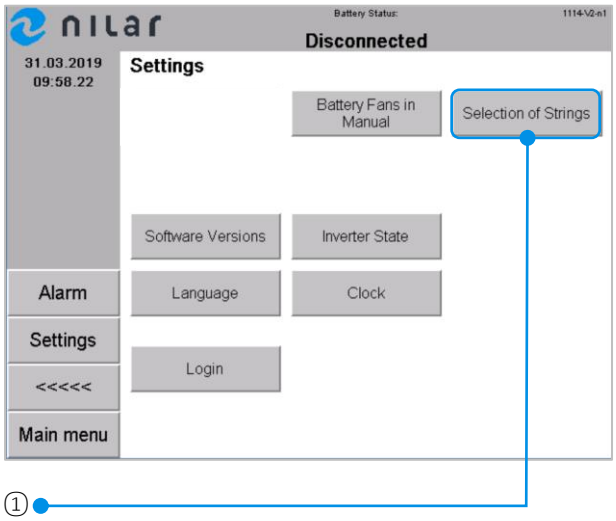


Figure 101: HMI, accessing battery string selection section

The desired battery string(s) can be disabled by pressing the correlating grey (●) button(s). The grey button(s) switches its color to yellow (●) to confirm the disabling (②). Press the button(s) once more and the desired battery string(s) will be enabled again. In the following example all battery strings, except battery string 1, are enabled.

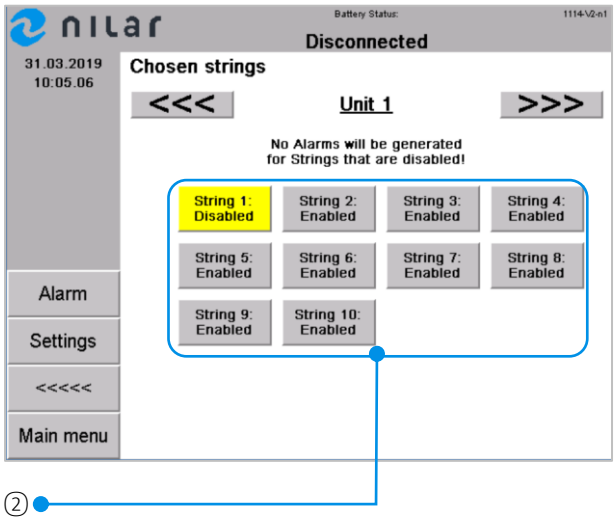


Figure 102: HMI, string selection menu. All battery strings enabled except for battery string 1

In the example shown in following figure, all battery strings are disabled (③).

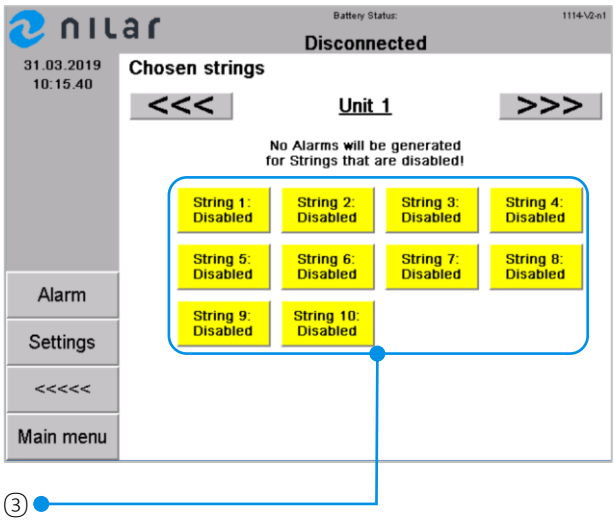


Figure 103: HMI, battery string selection menu. All battery strings disabled

Note! It is not possible to override decisions made by the BMS. If for instance the BMS has disabled a string due to malfunction, the user cannot manually enable that string in the HMI.

7. OPERATION

7.3.7 Manual activation of fans

The button for manually starting the fans (①) is located on the Settings menu. Simply click on the button 'Battery Fans in Manual' to toggle between Start and Automatic mode. If the button is yellow (●) the fan is activated manually and if the button is grey (●) the fan is in automatic mode (starts automatically once the battery exceeds a certain temperature).

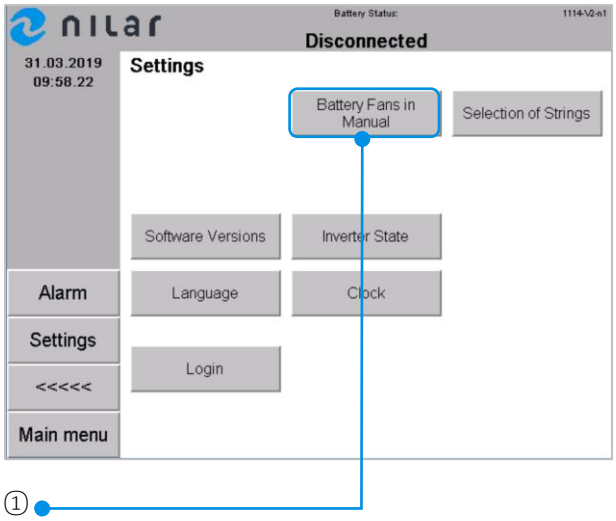


Figure 104: HMI, activating manual start of fans

7.3.8 Inverter state

The EES system's communication with the inverter and the inverter's various settings and information is accessed through the Settings menu (②).

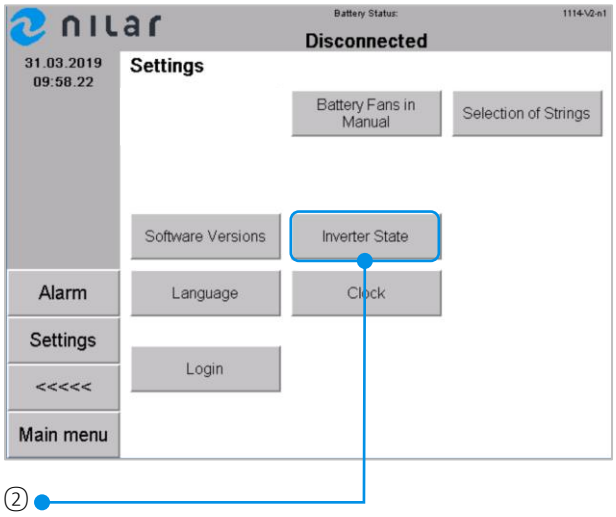


Figure 105: HMI, accessing inverter settings section

The menu is divided in Commands and Statuses. However, the status values are disabled in Ferroamp EES solutions.

At the bottom of the screen, the Inverter's state can be viewed ('Running', 'Standby' and 'Alarm').

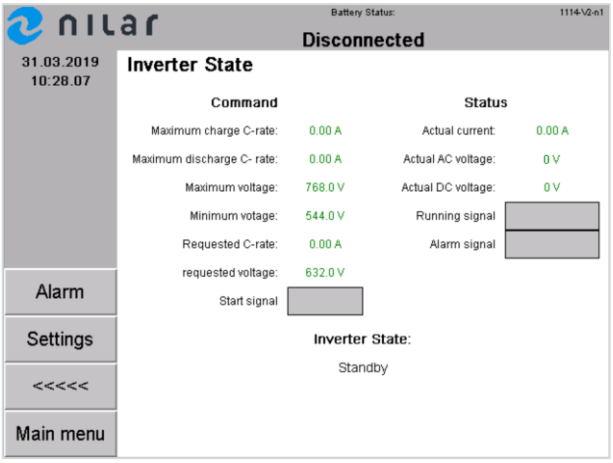


Figure 106: HMI, inverter settings menu

7.3.9 Language settings

The language settings are accessed as illustrated in the following example (③).

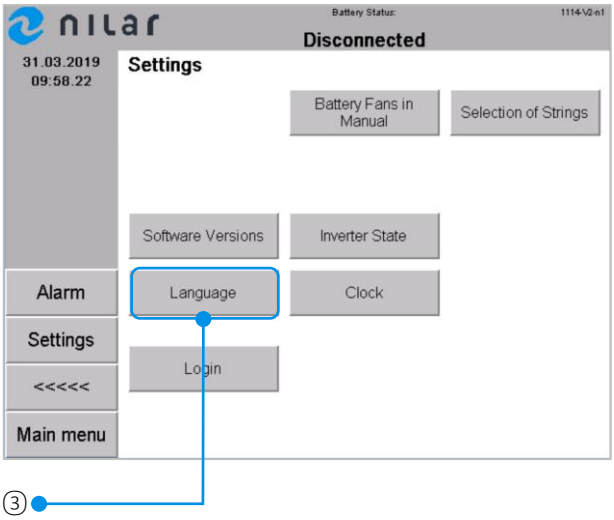


Figure 107: HMI, accessing language settings menu

7. OPERATION

The HMI currently supports four (4) languages: Swedish, English, German and French. The desired language is chosen by clicking the correlating country's flag.

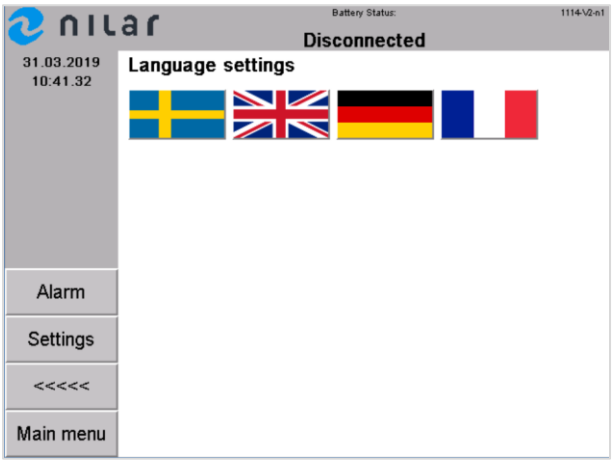


Figure 108: HMI, language settings menu

7.3.10 Setting of time and date

Both the time and the date can be set manually. The settings are accessed as illustrated in the following example (①).

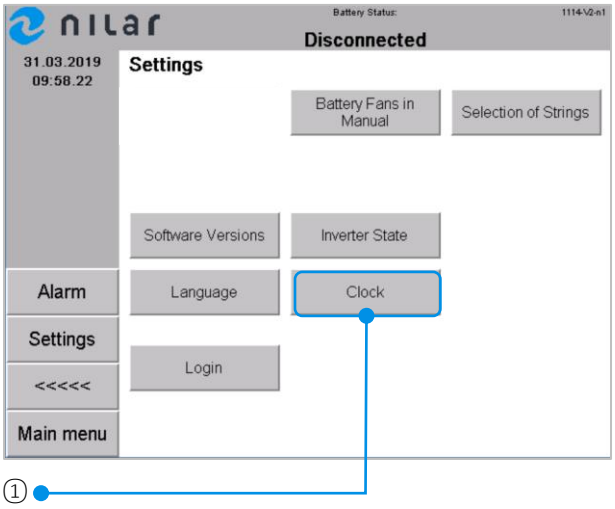


Figure 109: HMI, accessing time & date setup section

By clicking on the input fields for time and date (②) a number pad will be opened (③).

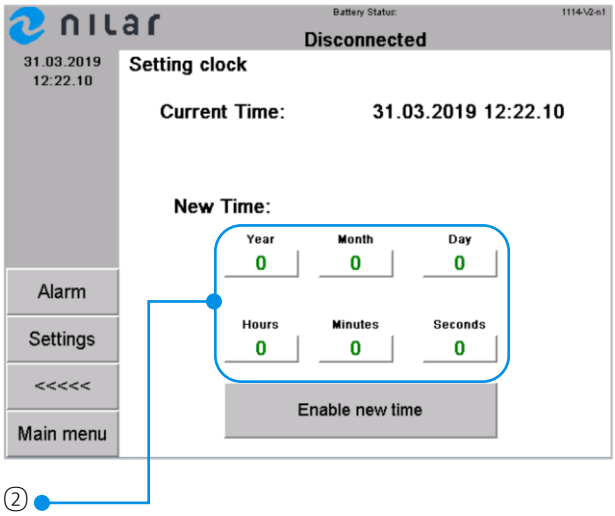


Figure 110: HMI, time & date setup menu

Enter the desired value and press 'RET' to retain the new value.

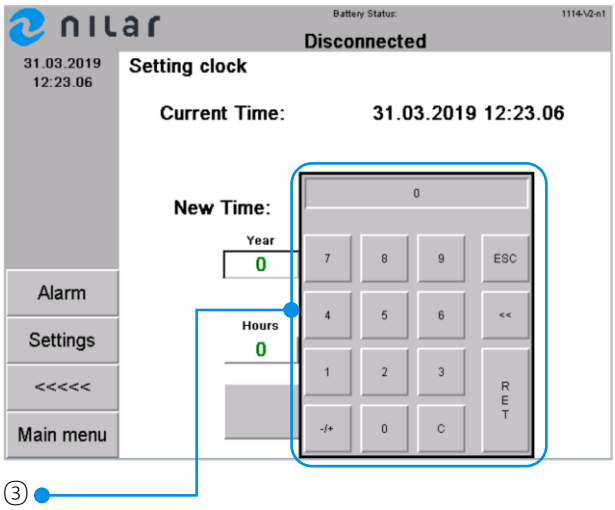


Figure 111: HMI, enter and retain new values for time & date

7. OPERATION

When all new values are chosen, press the button marked 'Enable new time' (①). The button will change its color to green (●) to confirm the new settings.

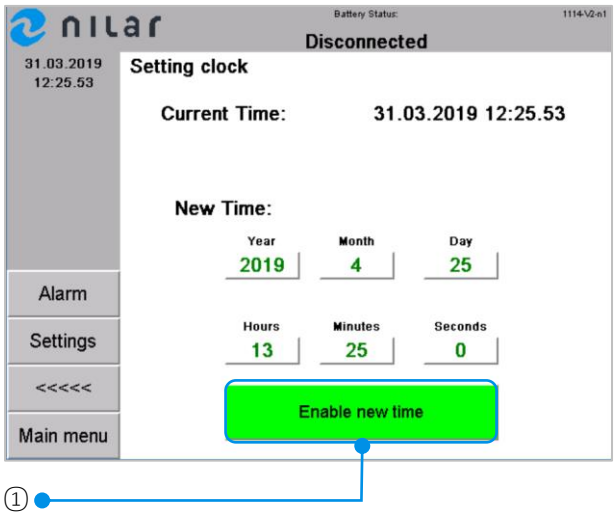


Figure 112: HMI, enabling of new time & date settings

7.3.11 Software versions

It is possible to check what software versions are installed in the EES by clicking the button marked 'Software versions' (②) in the Settings menu of the HMI.

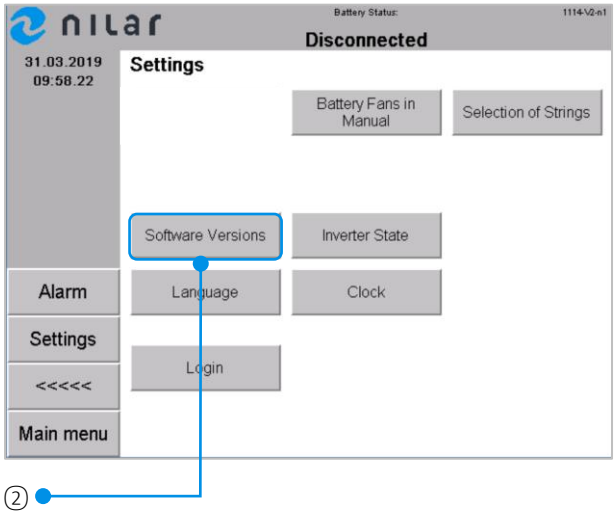


Figure 113: HMI, accessing software Versions section

After accessing the section, the software versions for the HMI, BMS and PLC are displayed (④). This section can also be accessed by clicking the button marked 'PLC' in the bottom part of the menu (③).

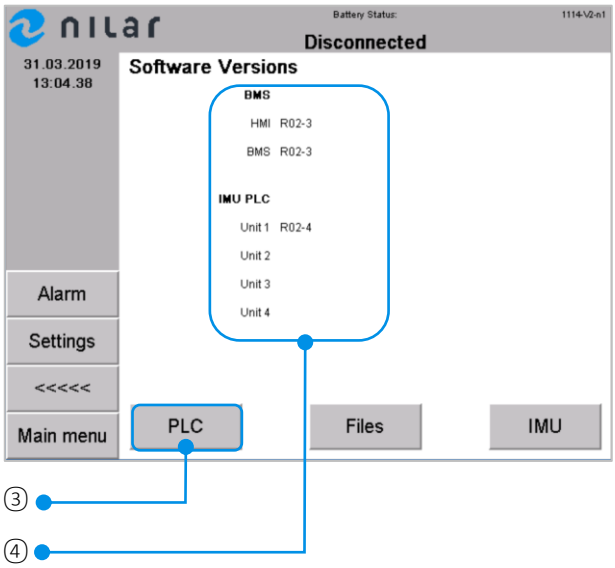


Figure 114: HMI, installed software versions for HMI, BMS and PLC

By clicking the button marked 'Files' (⑥), the installed versions for the setup and the settings file are displayed (⑤).

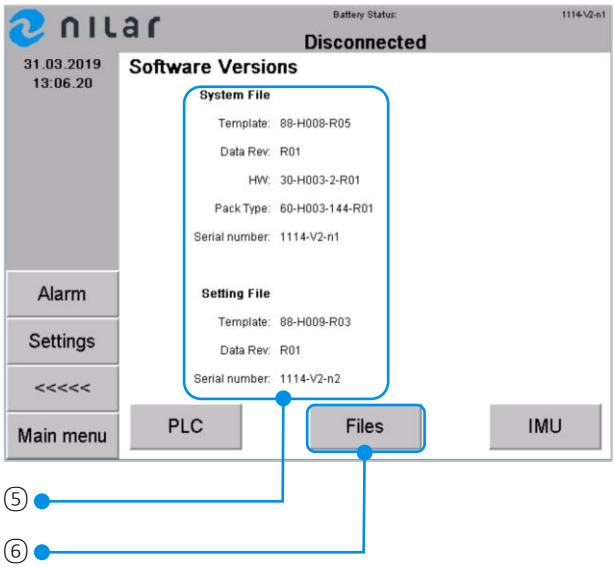


Figure 115: HMI, installed versions of setup and settings file

The button marked 'IMU' (②) gives access to the view of all installed software versions for every IMU in the EES (①). By clicking the arrows, it is possible to toggle between the various battery strings.

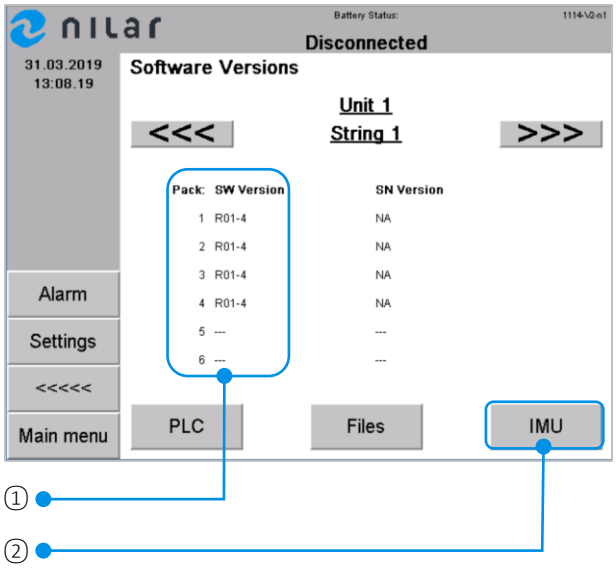


Figure 116: HMI, installed versions of IMU software

Note! The second column in the 'Software Version' menu normally displays the serial number (SN) for each IMU. In the illustrated example this is not applicable (NA) since it is not available for the exemplified software of the IMU.

7.3.12 Password protected functions

CAUTION!

The functions described in this section are configured in connection with the initial EES installation. Do not change these settings without consulting your authorised local Nilar representative

System settings such as the selection of inverter, selection of communication protocol and set-up of IP-addresses are password protected. These functions can be accessed by clicking the button marked 'Login' (③) in the Settings menu of the HMI.

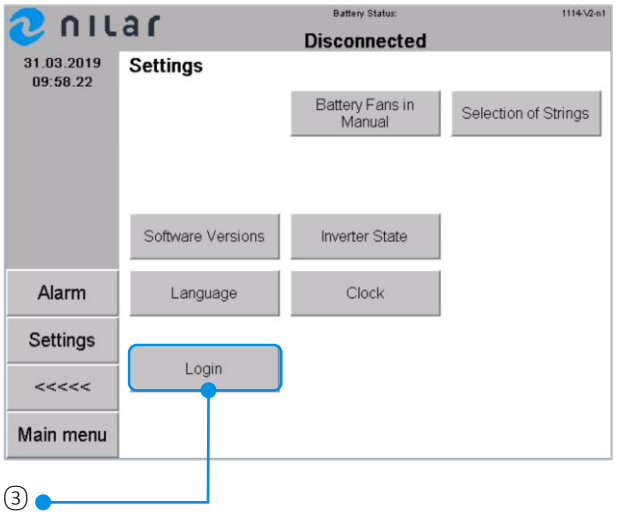


Figure 117: HMI, accessing password protected functions

7. OPERATION

By clicking on the 'Login' button a pop-up window will appear. In order to proceed the button marked 'Password' (①) must by clicked.

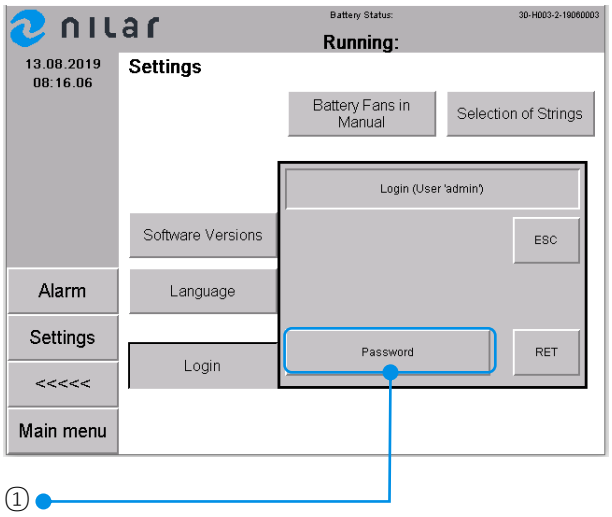


Figure 118: HMI, entering password

By clicking 'Password' a number pad will be opened. The numeric password[9] is entered by pressing the correlating numbers. After entering the correct password, the number pad is closed by pressing 'RET' (②).

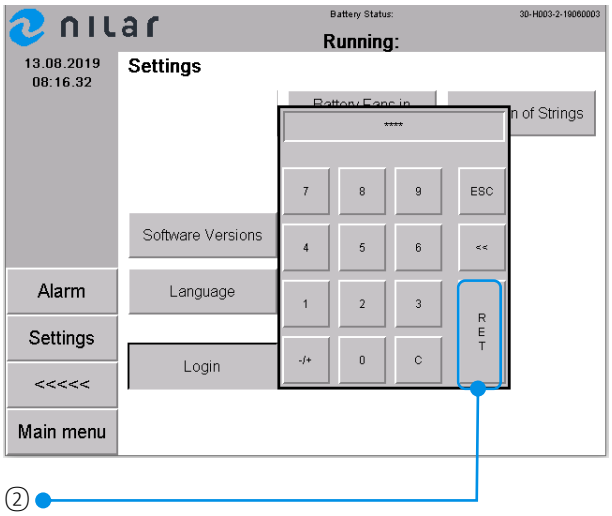


Figure 119: HMI, confirming password

By pressing 'RET' (③) in the pop-up window it will be closed and the system settings are now made accessible.

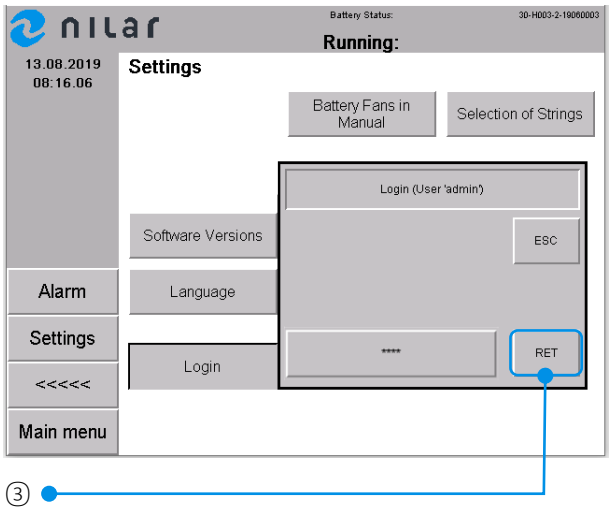


Figure 120: HMI, confirming password

The, now unlocked, 'System Settings' menu is accessed by clicking the correlating button (④).

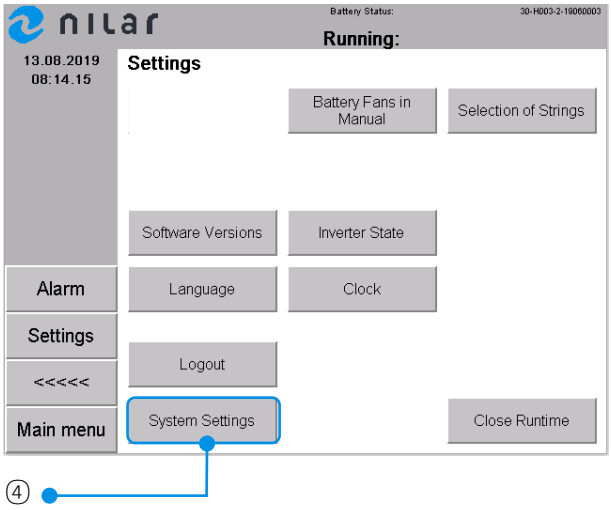


Figure 121: HMI, accessing the now unlocked System Settings menu

[9] May be provided separately by your authorized local Nilar representative or requested directly from Nilar

7. OPERATION

The BMS automatically detects which communication protocol is in use and displays this information in the upper part of the 'Batterybank Settings' menu. In the following illustration the communication in use is CANopen.

It is also in this menu that the user can select which type of inverter is used together with the Nilar EES, which is indicated by the green (●) colored button.

Note! For Nilar – Ferroamp set-ups the communication protocol is always CANopen and the only inverter alternative is EMS Inverter (EnergyHub)

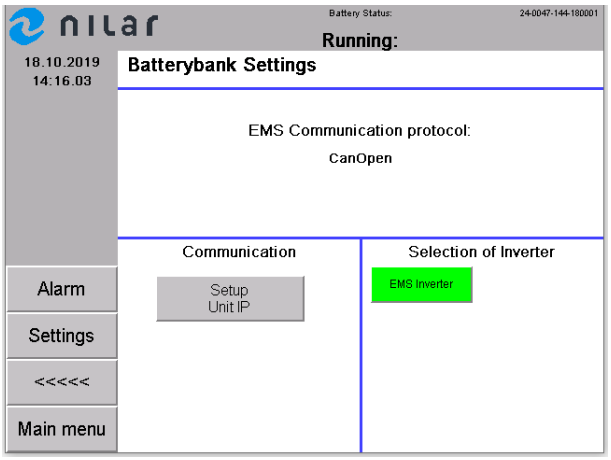


Figure 122: HMI, the unlocked System Settings menu

The system setting menu is also were the Unit IP address is configured.

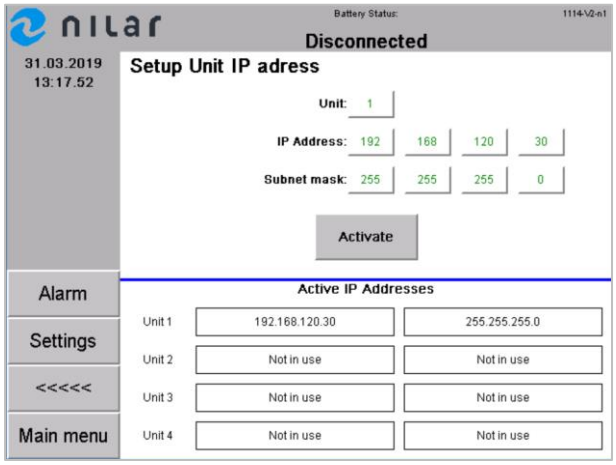


Figure 123: HMI, configuration of IP-address (displayed address is for example purpose only)

7.3.13 Contact Information

The contact information (①) is accessed by clicking the Nilar logotype (②) in the upper left corner of the screen.

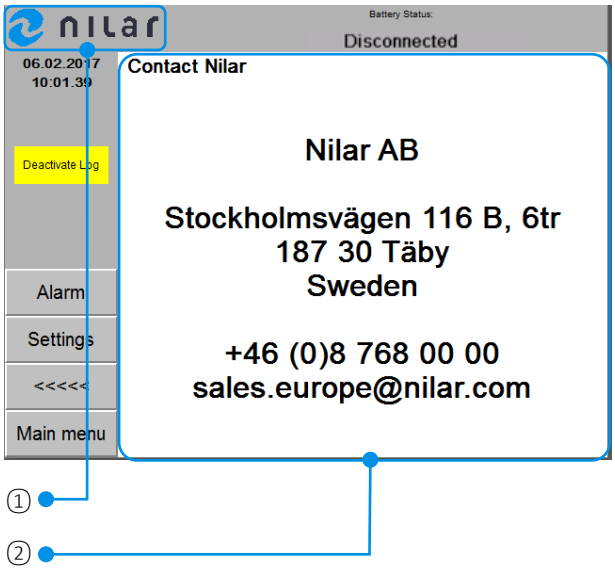


Figure 124: HMI, contact information menu

7. OPERATION

7.4 Shut-off

WARNING!

The complete EES system (incl. peripheral equipment such as the inverter) may still provide hazardous voltage and energy, including residual or stored energy, although it is switched off or may appear switched off.

The Nilar battery packs cannot be switched off.

7.4.1 Shut-off through software

The normal procedure to shut-off the EES is through the Ferroamp EnergyHub Cloud tool.

7.4.2 Automatic shut-off

The software can also shut off battery string(s) automatically (but not the whole EES). Two different automatic shut-offs are possible:

- Automatic shut off of a battery string, manual restart. This applies for errors that cause problems for one string but not for the whole system.

  This is the case if, for instance, the pressure difference is too high within a battery string.

- Automatic shut off of a battery string, automatic restart. This applies when the limits for a battery string are reached. The battery string reconnects automatically when adequate values are within limits.

  This is the case if, for instance, the voltage is too low for a module.

7.4.3 Physical shut-off

CAUTION!

This method may never be used during charge or discharge. Negligence of this may damage the EES and peripheral equipment.

The EES can be shut off physically by making use of the Control Power switch (see section 7.1) which shuts off the control power supply and switches off the EES.

This method is not recommended by Nilar.

8. MAINTENANCE

8. Maintenance

This chapter details how to maintain the Nilar EES.

WARNING!

The complete EES system (incl. peripheral equipment such as the inverter) may still provide hazardous voltage and energy, including residual or stored energy, although it is switched off or may appear switched off.

8.1 Protective measures during maintenance

CAUTION!

Always wear PPE (Personal Protective Equipment) when handling battery packs. At minimum this includes:

Safety glasses, safety shoes with steel toe and electrically insulated gloves.

Personnel involved in the work on a battery pack, or in close vicinity, must be competent to carry out such tasks and must be trained in all necessary special procedures.

8.2 Inspection and maintenance measures

For functional and safety reasons, the customer is responsible that regular inspections of the EES and its operating environment are carried out.

The following needs to be inspected/performed at least every six (6) months:

- Visually check for external signs of damage. Consult your authorized local Nilar representative if any damage is detected.
- Open the doors of the rack / front lid of the cabinet and visually check for signs of electrolyte leakage or any other deviation from normal conditions. Consult your authorized local Nilar representative if any leakage etc. is detected.
- Check that the cable connectors look undamaged and that the battery packs are properly positioned on the shelfs.
- Check for any deviation from normal conditions in the BMS (look, listen and smell). Consult your authorized local Nilar representative if any deviation is detected.
- Check general appearance and cleanliness. If necessary, clean by using a dry cloth.

9. Decommissioning

This chapter gives an instruction on how to proceed when decommissioning the Nilar EES.

WARNING!

The complete EES system (incl. peripheral equipment such as the inverter) may still provide hazardous voltage and energy, including residual or stored energy, although it is switched off or may appear switched off.

CAUTION!

Always wear PPE (Personal Protective Equipment) when handling battery packs. At minimum this includes:

Safety glasses, safety shoes with steel toe and electrically insulated gloves.

9.1 Temporarily decommissioning

When decommissioning the Nilar Battery pack temporarily for a period of time, please refer to section *5.3 Storage* for information about how to store the product. Please refer to chapter *6. Installation* for information about dismantlement by following the installation steps backwards.

9.2 Permanent decommissioning

The procedure for permanent decommissioning varies depending on whether the cause is due to end-of-life / no usage of product or if the cause is due to damage.

9.2.1 End-of-life / No usage

When the product has reached its end-of-life or is not needed any longer, it must be treated just like an operational battery pack during decommissioning.

In 2002 the European Union introduced the Directive on Waste Electrical and Electronic Equipment (WEEE). The directive requires the end-user to dispose of any WEEE separately. Electrical and Electronic Equipment are labelled with the following 'crossed out wheeled bin' symbol.

Figure 125: WEEE symbol for separate disposal

Always return any obsolete battery packs to Nilar AB or any authorized local Nilar representative. From there on Nilar covers all costs arising from the collection, treatment and recycling of all waste industrial batteries and accumulators collected in accordance with the Directive 2006/66/EC 'Battery directive'.

9.2.2 Damage

When the product has been damaged and constitutes a hazard or is malfunctioning, it must be decommissioned.

The damaged product must be treated with carefulness.

Always use your PPE and refer to the MSDS for correct handling of the product.

For further instructions regarding handling and/or transportation of a damaged product, contact your authorized local Nilar representative.

10. TROUBLESHOOTING

10.Troubleshooting

This chapter covers some of the issues that can occur with the EES after installation or during operation and provides useful troubleshooting steps to help any user resolve an issue. The measures must follow the same logical order as described (A.1 → A.2, etc.).

WARNING!

The complete EES system (incl. peripheral equipment such as the inverter) may still provide hazardous voltage and energy, including residual or stored energy, although it is switched off or may appear switched off.

CAUTION!

Always wear PPE (Personal Protective Equipment) when handling battery packs. At minimum this includes:

Safety glasses, safety shoes with steel toe and electrically insulated gloves.

<u>Power supply</u>

Q.1) Does the EES not start up?

A.1) Check that the Control Power switch is in position “ON” (see section 7.1).

A.3) Check that the MCBs are in position ‘ON’ (‘I’) (see section 7.1).

A.4) Check that the battery string fuses are inserted and functioning (see section 7.1).

A.5) Contact your authorized local Nilar representative.

Q.2) Has the IMU no power supply (LED is off)?

A.1) Check that the 24V power supply cable is properly connected to the designated port on the IMU (see section 6.14.6).

A.2) Check that the MCB (see 7.1) has not tripped (‘OFF’/’0’) and that the 24V power supply works properly (troubleshoot the power supply located in the BMS).

A.3) Reset the IMU by using the manual Reset button (see section 4.12.2).

A.4) Contact your authorized local Nilar representative.

10. TROUBLESHOOTING

HMI

Q.3) Does the HMI signal a communication fault with the IMU (CANopen)?

A.1) Check that the CANopen communication cable is properly connected to the designated port on the IMU (see section 6.15.4).

A.2) Check that the CANopen communication cable is properly connected to the designated port in the BMS. Locate by following cable.

A.3) Check that the CANopen bus is properly terminated (see section 6.15.4).

A.4) Reset the IMU by using the manual Reset button (see section 4.12.2).

A.5) Restart the EES (see section 7.1 & 7.6)

A.6) Check that the address is correct (see section 4.12.6). Refer to the address matrix (see appendix 3).

A.7) Contact your authorized local Nilar representative.

Q.4) Does the HMI signal a communication fault between the EES and the EMS?

A.1) Check that the communication cable is properly connected to the EES (see section 6.10).

A.2) Check that the communication cable is properly connected to the Ferroamp system.

A.3) Contact your authorized local Nilar representative.

Q.5) Does the HMI signal an inverter fault?

A.1) Check the manual of the EnergyHub.

A.2) Contact your authorized local Nilar representative.

Q.6) Does the HMI signal a contactor fault?

A.1) Contact your authorized local Nilar representative.

Q.7) Does the HMI signal a current fault?

A.1) Reduce charge/discharge current via the EnergyHub Cloud tool.

A.2) Contact your authorized local Nilar representative.

Q.8) Does the HMI signal a tripped MCB?

A.1) Check which MCB (see section 7.1) has tripped ('OFF'/'0') and reset it and manually reconnect the battery string.

Note! This procedure may not be repeated several times. If that is the case, the root cause for the tripped MCB must be investigated and fixed. Please contact your authorized local Nilar representative if this is the case.

A.2) Contact your authorized local Nilar representative.

Q.9) Does the HMI signal for high voltage?

A.1) Reduce the inverter voltage (HMI of inverter /EMS) and manually reconnect the battery string.

A.2) Contact your authorized local Nilar representative.

Q.10) Does the HMI signal that a battery pack is overheated?

A.1) Allow the EES to cool down before attempting a restart.

Q.11) Does the HMI signal a pressure difference?

A.1) Check for signs of triggered rupture discs and/or electrolyte leakages inside the rack/cabinet. If such signs are visible, immediately switch off the system and contact your authorized local Nilar representative.

Fans

Q.12) Can the fan(s) not be controlled?

A.1) Check that the CANopen communication is established and the cables for the fan(s) properly connected (see section 6.15.5).

A.2) Control that the fan(s) is/are functioning, i.e. troubleshoot the fan(s). Replace fan(s) if necessary.

A.3) Contact your authorized local Nilar representative.

10. TROUBLESHOOTING

Current measuring

Q.13) Does the current measurement not work?

A.1) Check that the CANopen communication is established.

A.2) Check that the current sensor cable is properly connected to the designated port on the IMU (see section 6.15.3).

A.3) Check that the current sensor is properly installed on the measuring side (see section 6.15.12).

A.4) Check that the current sensor is functioning (troubleshoot the current sensor). Replace if necessary.

A.5) Contact your authorized local Nilar representative.

Missing/wrong values

Q.14) Is there no voltage value (or is a wrong value displayed)?

A.1) Check that the CANopen communication is established.

A.2) Contact your authorized local Nilar representative.

Q.15) Is there no pressure value (or is a wrong value displayed)?

A.1) Check that the CANopen communication is established.

A.2) Contact your authorized local Nilar representative.

Q.16) Is there no temperature value (or is a wrong value displayed)?

A.1) Check that the CANopen communication is established.

A.2) Contact your authorized local Nilar representative.

Charge/discharge problems

Q.17) Does the battery string not charge/discharge?

A.1) Check that the power cables are properly connected to the terminal posts (see section 6.15.10 & 6.15.12).

A.2) Check that the interpack cables are properly connected to the terminal posts (see section 6.15.11).

A.3) Contact your authorized local Nilar representative.

11. Appendices

Appendix 1: Scope of supply matrix (number of items per EES size, as displayed in section 6.2)

CAPACITY \ ITEM		①	②	③	④*	④*	⑤	⑥	N/A	⑦**	⑦**	⑧	⑨	⑩	⑪	⑫	⑬
		Rack	**Cabinet**	**Battery pack**	**24VDC connection assembly (4)**	**24VDC connection assembly (8)**	**Fan**	**Current sensor assembly**	**Ambient temperature sensor**	**Com. cable (interpack)**	**Com. cable (interstring)**	**Interpack power cable**	**Positive (+) power cable**	**Negative (-) power cable**	**Support leg**	**Eye bolts**	**Mounting bracket**
144V	**11,5 kWh**	-	1 (size 2)	8	2	-	8	2	1	6	1	6	2	2	4	0	0
	17,2 kWh	-	1 (size 3)	12	3	-	12	3	1	9	2	9	3	3	4	0	0
	23 kWh	-	1 (size 4)	16	4	-	16	4	1	12	3	12	4	4	4	0	0
	28,8 kWh	-	1 (size 5)	20	5	-	20	5	1	19	4	15	5	5	4	0	0
	57,6 kWh	1	-	40	-	5	40	10	1	35	4	30	10	10	6	4	2

** For cabinet solutions, one (1) 24VDC assembly cable with four (4) spin-out connectors is required per battery string. For rack solutions, one (1) 24VDC assembly cable with eight (8) spin-out connectors is required per battery string.*

*** Interpack and interstring cables are similar, with the exception of the length where the interstring cable is the longer version*

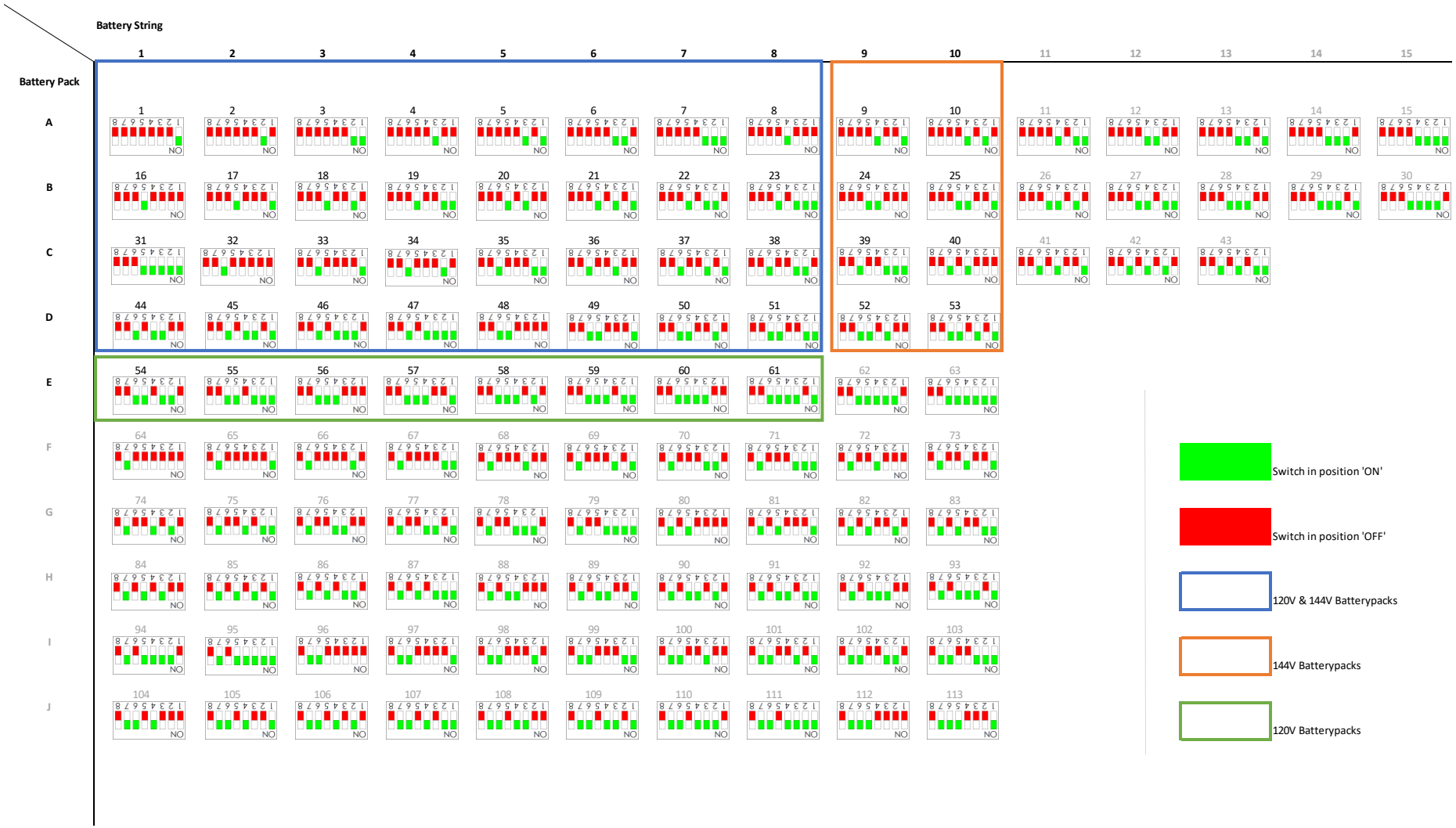
11. APPENDICES

Appendix 2: List of alarms, warnings and information messages

EES	UNIT	STRING	PACK	Alarm	Warning	Info		Connection not allowed	No Action	Reduced max. allowed current	EES disconnect	String disconnect		
												Manual Restart	Automatic Restart	Confirm Restart
X				X			High Ambient Temperature	X			X			
X				X			Inverter Fault	X			X			
X					X		Temperature		X					
X						X	System in Power save mode		X					
X						X	Reduced C-Rate			X				
X				X			Communication Fault EMS	X			X			
X				X			Communication Fault Unit 1	X			X			
X						X	Low battery Temperature		X					
X						X	Manualy Disabled Strings		X					
X						X	Cell balancing completed		X					
X						X	Charging Complete		X					
X						X	Low State of Charge		X					
	X					X	Low State of Charge		X					
	X			X			Contactor Test Failed, Positive Contactor	X			X			
	X			X			Error in Precharge Function	X			X			
	X					X	Charging Complete						X	X
		X				X	Charging Complete						X	X
		X		X			String Contactor Fault	X			X			
		X		X			High Current Fault	X				X		
		X		X			String Fuse fault	X				X		
		X				X	Low State of Charge						X	X
			X	X			Communication Fault	X			X			
			X	X			High Pressure	X			X			
			X	X			High Voltage	X				X		
			X	X			Overheated	X			X			
			X	X			Pressure Diff. dP	X				X		
			X			X	Temp Diff.		X					
			X			X	Voltage Diff.		X					
			X			X	Sensor Fault		X			X		
			X	X			Pressure Fault	X				X		

11. APPENDICES

Appendix 3: Address setting of individual battery packs



11. APPENDICES

Appendix 4: Installation protocol (checklist)

nilar

Installation protocol

Checklist for Electrical Energy Storage (EES) installations
-FERROAMP versions-

Document ID:

Customer

Contact person	Company
Telephone number	**Address**

Product

Type	Rating (kWh)
Inst. Date	**Location**

Explanation:
Fulfilled? = Answers if the actual post is fullfilled according to the Instruction manual
Reference = Details in what chapter/section information about the corresponding checkpoint is to be found
Comments = Must always be stated when a checkpoint is answered with a "NO"

A.	Preparation & Pre-installation	Fulfilled?	Reference in Manual *Doc. Id. 73-H010*	Comments *(Must always be stated for any "NO" answer)*
A:1	Is the general safety instruction understood?	☐ YES ☐ NO	1	
A:2	Has a transporation control been carried out?	☐ YES ☐ NO	5.1.1	
A:3	Are the delivered products undamaged?	☐ YES ☐ NO	5.1.1	
A:4	Are the warnings and cautions for Ch. 6 understood?	☐ YES ☐ NO	6	
A:5	Are the general conditions on site met?	☐ YES ☐ NO	6.1	
A:6	Is the full scope of supply delivered?	☐ YES ☐ NO	6.2	
A:7	Is the placement according to requirements?	☐ YES ☐ NO	6.3	
A:8	Is the EES correct assemblied?	☐ YES ☐ NO	6.4	

B.	Installation of auxiliaries	Fulfilled?	Reference in Manual	Comments *(Must always be stated for any "NO" answer)*
B:1	Is the general information for external cables followed?	☐ YES ☐ NO	6.5	
[B:2]	[Are the ESO units installed correctly]	☐ YES ☐ NO	6.6	*Only valid for products: 21-0005, 21-0008, 21-0011 & 21-0014!*
B:3	Are the Ferroamp power supply cables connected correctly?	☐ YES ☐ NO	6.7	*Check also Ferroamp instruction*
B:4	Is the power supply for the BMS connected correctly?	☐ YES ☐ NO	6.8	*Valid for rack solutions only! Check also Ferroamp instruction*
B:5	Is the Internet connection installed correctly?	☐ YES ☐ NO	6.9	
B:6	Is the Ferroamp communication connection installed correctly?	☐ YES ☐ NO	6.10	*Valid for rack solutions only! Check also Ferroamp instruction*

C.	Installation of batterypacks	Fulfilled?	Reference in Manual	Comments *(Must always be stated for any "NO" answer)*
C:1	Are the warnings/cautions for Ch. 6.11 understood?	☐ YES ☐ NO	6.11	
C:2	Are the battery packs oriented correctly?	☐ YES ☐ NO	6.12	
C:3	Are the warnings/cautions for Ch. 6.13 understood?	☐ YES ☐ NO	6.13	
C:4	Are the battery packs installed correctly?	☐ YES ☐ NO	6.14	
C:5	Are the warnings/cautions for Ch. 6.15 understood?	☐ YES ☐ NO	6.15	
C:6	Are the battery packs sorted correctly?	☐ YES ☐ NO	6.15.1	
C:7	Are the current sensor cables installed correctly?	☐ YES ☐ NO	6.15.3	
C:8	Are the communication cables installed correctly?	☐ YES ☐ NO	6.15.4	
C:9	Are the fan connections installed correctly?	☐ YES ☐ NO	6.15.5	
C:10	Are the 24VDC power supply cables installed correctly?	☐ YES ☐ NO	6.15.6	
C:11	Is the ambient temperature sensor cable installed correctly?	☐ YES ☐ NO	6.15.7	
C:12	Are the IMU cover lids mounted correctly?	☐ YES ☐ NO	6.15.9	
C:13	Are the negative terminal cables installed correctly?	☐ YES ☐ NO	6.15.10	
C:14	Are the interpack cables installed correctly?	☐ YES ☐ NO	6.15.11	
C:15	Are the current sensors installed correctly?	☐ YES ☐ NO	6.15.12	
C:16	Are the positive terminal cables installed correctly?	☐ YES ☐ NO	6.15.12	

For a more detailed information see Instruction Manual

Responsible installer / Site manager

Signature: _____

Name: _____

Date: _____

11. APPENDICES

Appendix 5: Examples of RCD-installations

WARNING!

Only authorized electricians are allowed to carry out the installation.

Always install an RCD of the type B or B+. If an RCD of another type (AC, A or F) already is installed before the inverter, it has to be replaced by an RCD of type B or B+.

Perform a test of the installed RCD in direct connection with the completed installation by pressing the RCD's test button.

If a type B or B+ RCD already is installed before the inverter, it does not need to be replaced. However, its function must still be verified by using its test button before it can be considered approved.

An RCD of the type B or B+ can detect all types of leakage fault currents, even pure direct current.

Since it is essential that the correct type of RCD is installed (type B/B+), it is important to distinguish them. The different types are defined in IEC 60755 and are marked accordingly:

Type B:  Type B+:  

Type AC:  Type A:  Type F:  

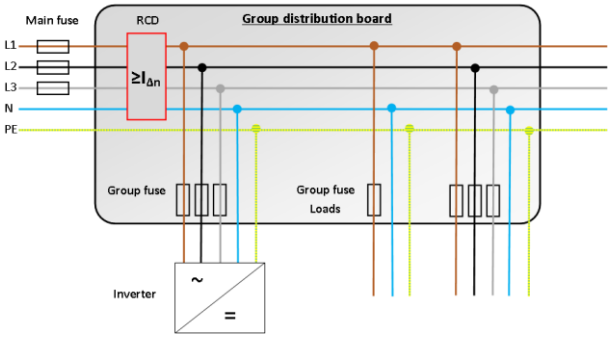
The installation of the RCD varies depending on if the installation site consists of a:

1) **A Group distribution board**
   → *Installation 'G'*

2) **A Main distribution board and a Sub distribution board**
   → *Installation 'M'*

INSTALLATION 'G'

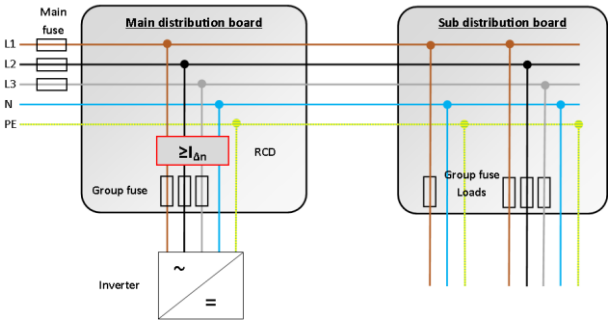
If the inverter is connected to a group distribution board then the RCD should be connected there as well:



The function of the RCD must be tested regularly* by using its test button.

INSTALLATION 'M'

If the inverter is connected to a main distribution board then the RCD should be installed in the lines to the inverter:



The function of the RCD must be tested regularly* by using its test button.

Check** often that the RCD has not triggered.

** Performed by the facility owner more often than every 6th month or according to manufacturer's recommendations.*

*** Performed by the facility owner.*

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