



Operating Manual

EnergySkid

Document : Operating manual
Version release date : 14 July 2022, V1.3
Related software build : 2.12.0.5

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Disclaimer

It is essential that you understand the information in this document. This document is not a substitute for common sense, nor a substitute for employee training. It appeals upon all of its customers, professional operators and service providers to demonstrate responsible behaviour and responsibility to the highest standards.

**WARNING!**

Do not carry out any work until you have read and understood the content of this document and the safety notices in particular. Failure may result in serious injury or death.

Copyright Statement

This manual is under the copyright of Time Shift BV, with all rights reserved. Please keep the manual properly and operate in strict accordance with all safety and operating instructions in this manual. Please do not operate the product without reading through the manual.

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1 User information

This operating manual is about the installation and operation of the EnergySkid Battery Energy Storage System (BESS). Before installation, please read this manual carefully.

Commissioning and maintenance of the EnergySkid must be carried out by the technicians appointed by the manufacturer or an authorized service partner. This manual refers to the 'Operator' as the person or persons that use and operate the product.

1.1 Identification of the product

The EnergySkid is a 21ft containerised energy storage system equipped with an array of lithium-ion battery strings that can be independently controlled via DC/DC converters. All DC/DC converters are linked to a common DC bus available at the DC interface. The DC bus is isolated by a Motorised Circuit Breaker (MCB). The DC interface is designed for maximum 1.600A DC at a voltage range of 800 to 1.100V DC. For further specifications on the capabilities and limitation of the product, refer to the corresponding Datasheet.



Figure 1: 3D view of the product

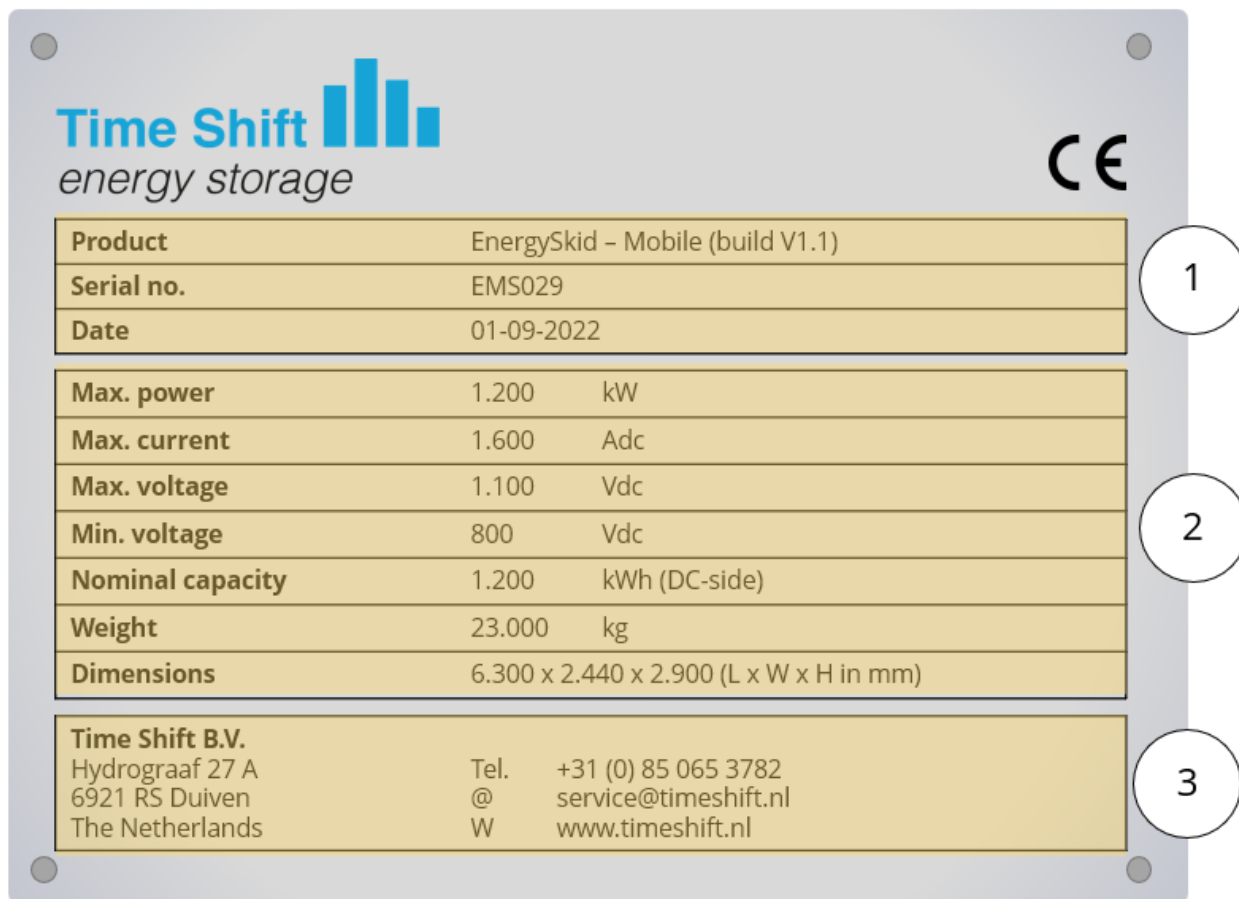


Figure 2: Example name plate of the product

The name plate contains relevant product information for operating the product, this name plate can be consulted for identification of the product.

Item	Description
1	Product name, product type and version Serial no Manufacturing date
2	Product specifications
3	Manufacturer information

Table 1: Name plate information

The operator should take the product specifications and limits in mind designing the (temporary) connection towards the AC / DC Converter. More specifications can also be consulted in the Datasheet of the product.

1.2 Scope of this manual

The operating manual instructs the operator on the product, safety, installation, preparations for commissioning, operating as well as troubleshooting and maintenance. Additional documentation is available for product related topics.

Additional documentation:

- Product Datasheet
- Modbus Protocol Manual
- HMI Manual




The illustrations used in these operating instructions are reduced to the essentials and may differ from the delivered product. The manufacturer may change these operating instructions and content therein.

1.3 Target audience

This manual is intended for any person that will operate the product. Persons who will operate the product should be familiar with the hazards involved as well as work- and safety regulations and have the appropriate qualifications. The operator should know how the battery system works, behaves, and operates.

Persons who will operate the product should be aware that the product contains extremely powerful equipment. Misuse can cause severe injuries, as well as critical damage to the equipment. Unauthorized persons are not allowed to operate the product. Unauthorized persons must keep a safe distance from the product.

1.4 Symbols used in this manual

Symbol	Description
	DANGER! Danger to life due to high voltage and electric shock.
	DANGER! Indicates a direct danger situation which will lead to death or severe injury.
	WARNING! Indicates a possible danger situation which can lead to death or severe injury.

	CAUTION! Indicates a possible danger situation which can lead to lesser or lighter injury.
	NOTICE Indicates a possible danger situation which can lead to damage to property or to the environment.
	Use head protection.
	Wear hearing protection.
	Use hand protection.
	Disconnect and safeguard against reconnection.
	Pay attention to supplementary documents to these operating instructions.
	Harmful substances
	Substances hazardous to the human health
	WEEE identification

1.5 Intended Use

The product is designed and intended to use as follows:

- The product is constructed for outdoor use. It meets protection class IP54 if properly installed;
- The product is not suitable for operation in areas with the risk of explosion. Keep it away from flammable or combustible materials;
- It is prohibited to open the product when it is raining or the humidity is greater than 80%;
- Only operate the product with maximum permissible connected loads stated on the name plate. Always comply with the conditions in the Data Sheet.

All changes and modifications to the product, its structure or its software are prohibited and will result in loss of warranty.

Intended use includes reading the operating manual and complying with all contained instructions. The operator is responsible to make these available to relevant personnel.

1.6 Consequences and risks caused by non-compliance with this manual

- Non-compliance with this operating manual will lead to forfeiture of warranty and all rights to claim damages.
- Non-compliance may lead to the following consequences:
 - Hazards to persons due to electrical, thermal, mechanical, and chemical effects;
 - Failure of important product functions;
 - Failure of prescribed maintenance and servicing practices;
 - Hazard to the environment due to leakage of hazardous substances.




2 Safety


This chapter describes the safety risks and measures involved in working with the product.

Due to the nature of the product and its operation, there are safety risks involved with its usage and operation. A list of risks is presented in this chapter together with their corresponding measures to reduce and avoid incidents.

It is the responsibility of the operator to get familiar with these risks and measurements, as well as the described protocols in case of an emergency.

When utilizing the product, the operator should wear the basic personal protective equipment (PPE) as mentioned below:


	Wear high visibility vest.
	Wear safety boots.
	Use hand protection.


	<p>NOTICE</p> <p>The PPE required might vary per site and type of work to be performed. Please verify this with the site manager.</p>
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2.1 Safety Risks


Below, the safety risks with its corresponding symbols and measures are listed. The operator must be familiar with this symbols and risks to take appropriate measures when operating the product.


Safety signs are visible on the product and contain important information for safe operation of the system. It is strictly forbidden to tear or damage safety signs. Make sure that the signs are always clearly visible. If damaged, replace the signs immediately.



	<p>WARNING!</p> <ul style="list-style-type: none"> Failure in following the safety measures can result in serious or fatal injuries as well as in critical damage to the product.
---	---


	<p>DANGER!</p> <p>Danger to life due to disregarding the instructions for action!</p> <p>If you disregard the safety instructions or perform unauthorized actions, it may lead to serious injury or death.</p> <ul style="list-style-type: none"> Read and obey all safety instructions, warnings, and symbols on the product and within the operating manual; Do not perform activities without appropriate authorization or qualification; For questions contact customer service; Improper use of the product may pose a substantial danger to all persons involved.
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  	<p>DANGER!</p> <p>Danger to life due to high voltage!</p> <p>Touching live parts can result in death or serious injury due to electric shock.</p> <ul style="list-style-type: none"> Before you work on the product, check if it is disconnected externally and safeguarded against reconnection; Do not touch live parts or uninsulated cable ends; It is forbidden to open the battery rooms; Check with suitable test equipment that no residual voltage is present in the DC connections; Do not remove, alter or adjust protection or security devices, either temporarily or permanently; Observe that after completion of work all protective covers are mounted; Make sure a ground connection is provided before you connect DC Link cables; Observe that the DC Link cables are still under voltage if they are not disconnected from the product externally.
--	---

	<p>DANGER!</p> <p>Danger to life through physical contact with electrical parts!</p> <p>Any contact with copper bar, contactor and terminal inside the product or connected with the loop of utility grid might result in burning or fatal electric shock.</p> <ul style="list-style-type: none">▪ Do not touch any terminals or conductors connected to the loop of utility grid;▪ Pay attention to any instruction and safety documents about power on-grid.
---	---

	<p>WARNING!</p> <p>Possible high leakage current!</p> <ul style="list-style-type: none">▪ Before you connect any power output, make sure that the grounding is reliable;▪ Ground the unit in accordance with local electrical regulations.
---	---

 	<p>CAUTION!</p> <p>Damage to components by unauthorized operations in the power electronics and power distribution cabinets!</p> <p>Damage to components can affect the functioning of the product. This can lead to lesser or lighter injury.</p> <ul style="list-style-type: none">▪ Obey the safety rules and warnings;▪ Never leave doors open;▪ Remove dust and water accumulation and dirt from the interior area.
---	--

	<p>DANGER!</p> <p>Danger to life due to fire!</p> <p>Unsuitable installation or operation of the product can cause fire or explosion, which may cause damage to the product and result in serious injury or death.</p> <ul style="list-style-type: none">▪ Do not install in potentially explosive atmospheres;▪ Do not install on inflammable materials;▪ Do not install in areas where flammable materials are present;▪ Never use inflammable solvents for cleaning;▪ Do not smoke near the product;
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- Do not use open fire tools near the product;
- Do not start any fire near the product.

**NOTICE**

The manufacturer does not accept responsibility for errors or damages if safety regulations are not met during handling, operation, troubleshooting and maintenance.

**NOTICE**

All maintenance must be carried out by the manufacturer or authorized service providers. Doors and/or cover plates must be kept closed at all times.

2.2 In case of Emergency

In case of an emergency, the operators and owners of the product should take appropriate actions to ensure the safety of all operators as well as the product.

The actions to take depend on the location and nature of the emergency.

An emergency at the product while operating or maintaining requires immediate action of the operator. An emergency can be of different natures:

- Severe injury or risk of death;
- Fire or smoke in or nearby the product;
- Emergency at the location of the product while the operator is operating the product;
- Unusual behaviour of the product;
- Unusual smells;
- Unusual noises.

In case of any of these emergencies, the operator must press the Emergency Button to stop the system immediately. When the Emergency Button is pushed, all equipment is stopped immediately, no AC and DC current can flow after this action.

The Emergency Button is located inside the Service Room (C0) of the product. An additional external Emergency Button can be connected via the Power Entry panel (C1).

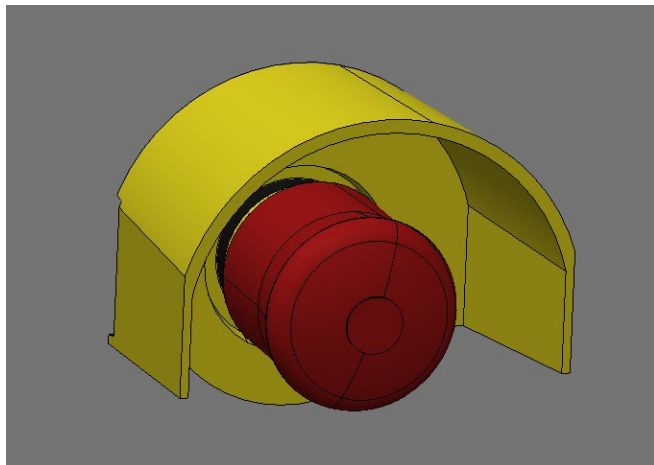


Figure 3: 3D view of the Emergency Button on cabinet C4 in the Service Room

Once the Emergency Button is pressed and the operator is completely out of danger notify the site manager.

In case of fire or severe injury call the local emergency authorities and follow their instructions.


	<p>NOTICE</p> <p>Only use the Emergency Button in case of emergency and/or immediate danger. Never use the Emergency Button as a stop button in normal operation.</p>
--	--

	<p>NOTICE</p> <ul style="list-style-type: none">▪ Additional safety measures might be in place depending on the operation site.▪ It is the responsibility of the operator to become acquainted with the local emergency measures.
--	---

In case of fire near the product, the Emergency Button should be pressed without putting the operator or operation in danger. Follow the local emergency guidelines.

3 Product Description

This chapter provides information on the functionality of the EnergySkid as well as the general arrangement drawings and layout of the product.

	<p>NOTICE</p> <p>It is responsibility of the user to get acquainted with the information on this chapter to guarantee the proper usability of the product.</p>
---	---

3.1 Functional Description

The EnergySkid is a Battery Energy Storage System (BESS). It consists of battery strings, power electronics a control cabinet and a DC distribution cabinet. Further components of the BESS include protection devices (circuit breakers), cooling systems and a high-level control system to coordinate the operation of all components in the system.

This product only outputs a DC voltage between 800 and 1.100 Vdc. An external AC/DC converter, another EnergySkid or a PowerSkid can be connected via the DC-link interface (power entry panel C1) to exchange energy.

There are two versions of the product, namely 'Stationary' and 'Mobile'. Key differences are listed below.

Features	EnergySkid - Mobile	EnergySkid - Stationary
Auxiliary power	UPS integrated for black start and stand-alone operation	Requires external power supply
HMI controls	Advanced	Basic
Usable capacity	10-95%	0-100%
Weight	23.000 kg	23.000 kg
AC/DC converter	Island Mode	Grid Mode

Table 2: Key differences between Mobile and Stationary versions of the EnergySkid

3.2 General Arrangement Drawing

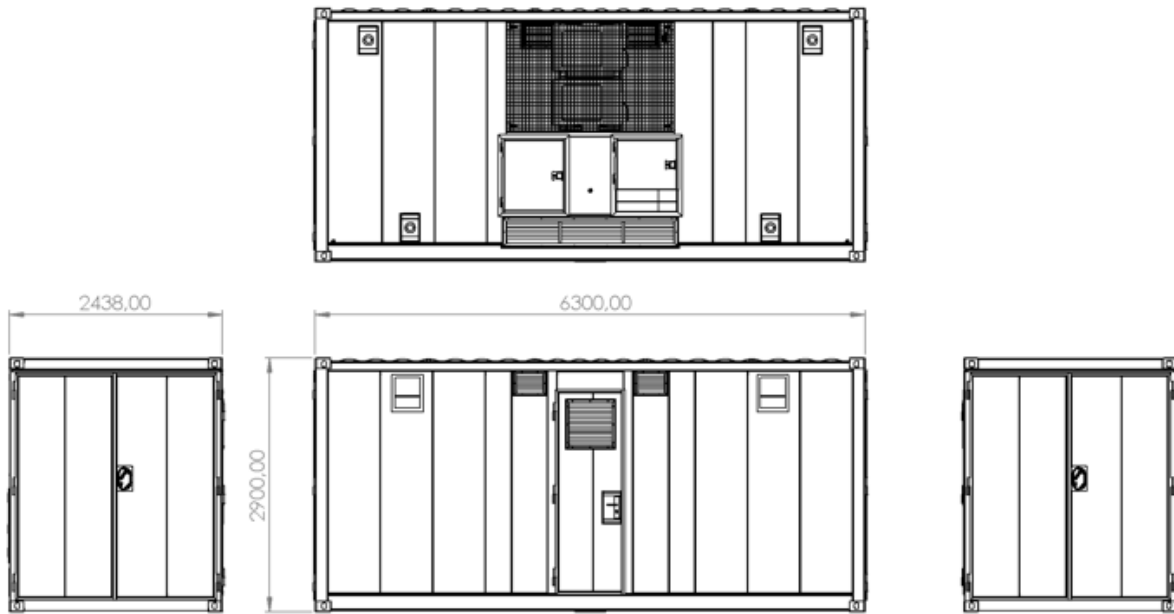


Figure 4: 2D view of General Arrangement Drawing

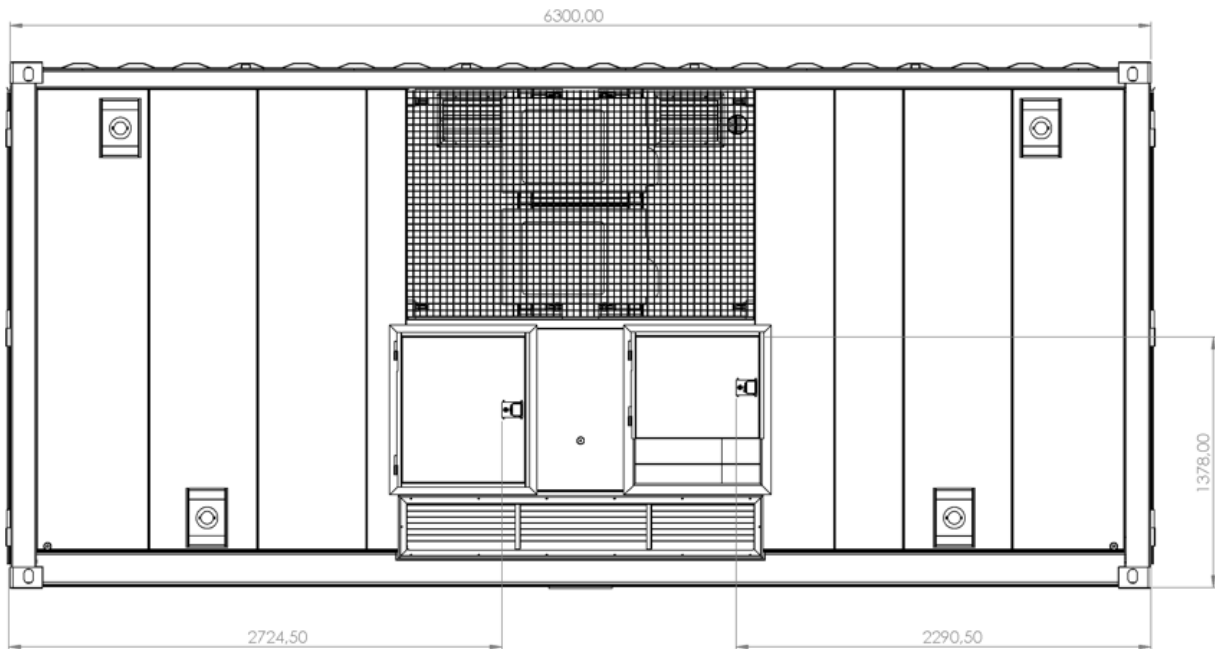


Figure 5: 2D view of the 'Power Entry panel' side of the product

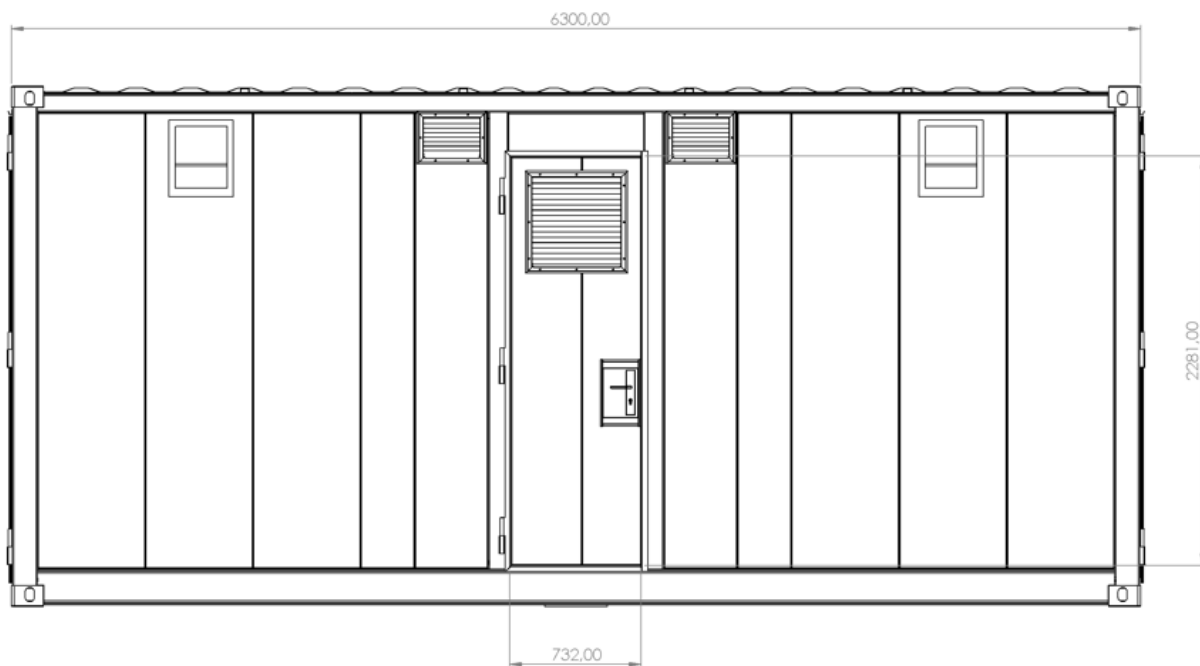


Figure 6: 2D view of the 'Service Room' side of the product



Figure 7: 2D view of the 'Battery room' side of the product

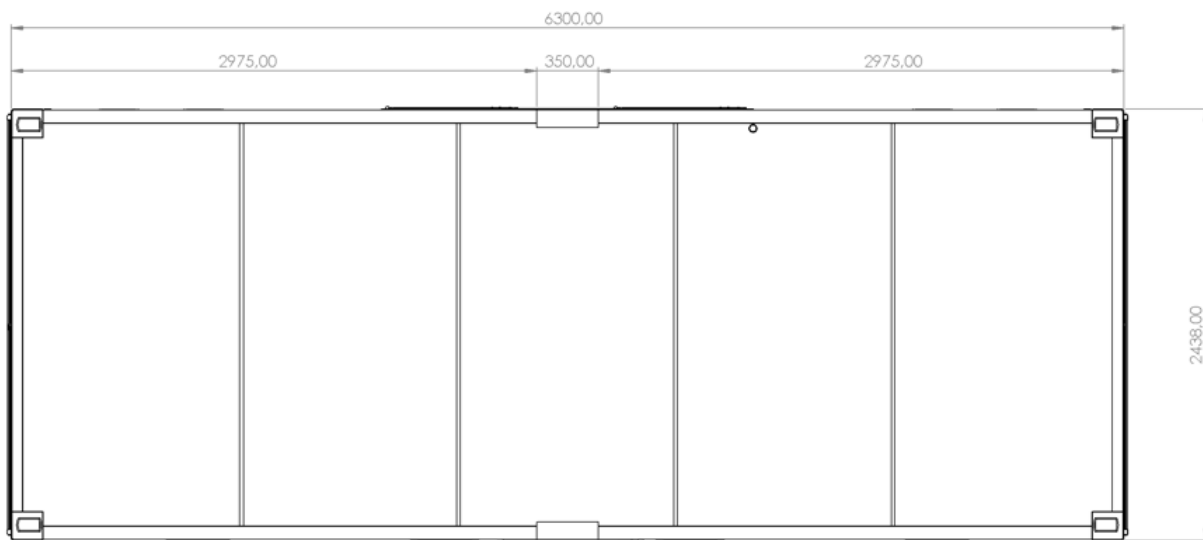


Figure 8: 2D view of the bottom of the product

3.3 Product layout

Overview of the product and component location identification.

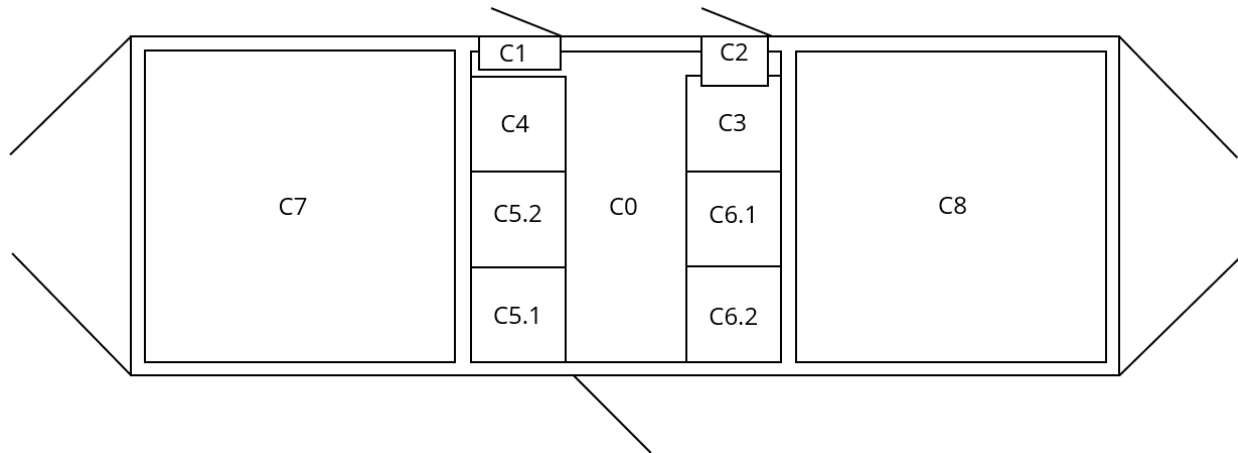


Figure 9: 2D overview of the product

Location	Description	Function
C0	Service room	Power electronics, DC distribution and control cabinet. HMI for basic monitoring and control
C1	Power entry panel	Interface panel for DC lines, Earthing, communication, external fire panel, external Emergency Button, auxiliary power inlet.
C2	MCB	Motorised circuit breaker for DC lines into the product.
C3	Auxiliary supplies	All 230Vac related distribution for auxiliaries.
C4	Control cabinet	Control cabinet of the product.
C5.1	DC/DC Converter cabinet – left door	DC/DC converters linked to batteries in C7
C5.2	DC/DC Converter cabinet – right door	DC/DC converters linked to batteries in C7
C6.1	DC/DC Converter cabinet – left door	DC/DC converters linked to batteries in C8
C6.2	DC/DC Converter cabinet – right door	DC/DC converters linked to batteries in C8
C7	Battery room 1	Battery strings
C8	Battery room 2	Battery strings

Table 3: Rooms and components of the EnergySkid

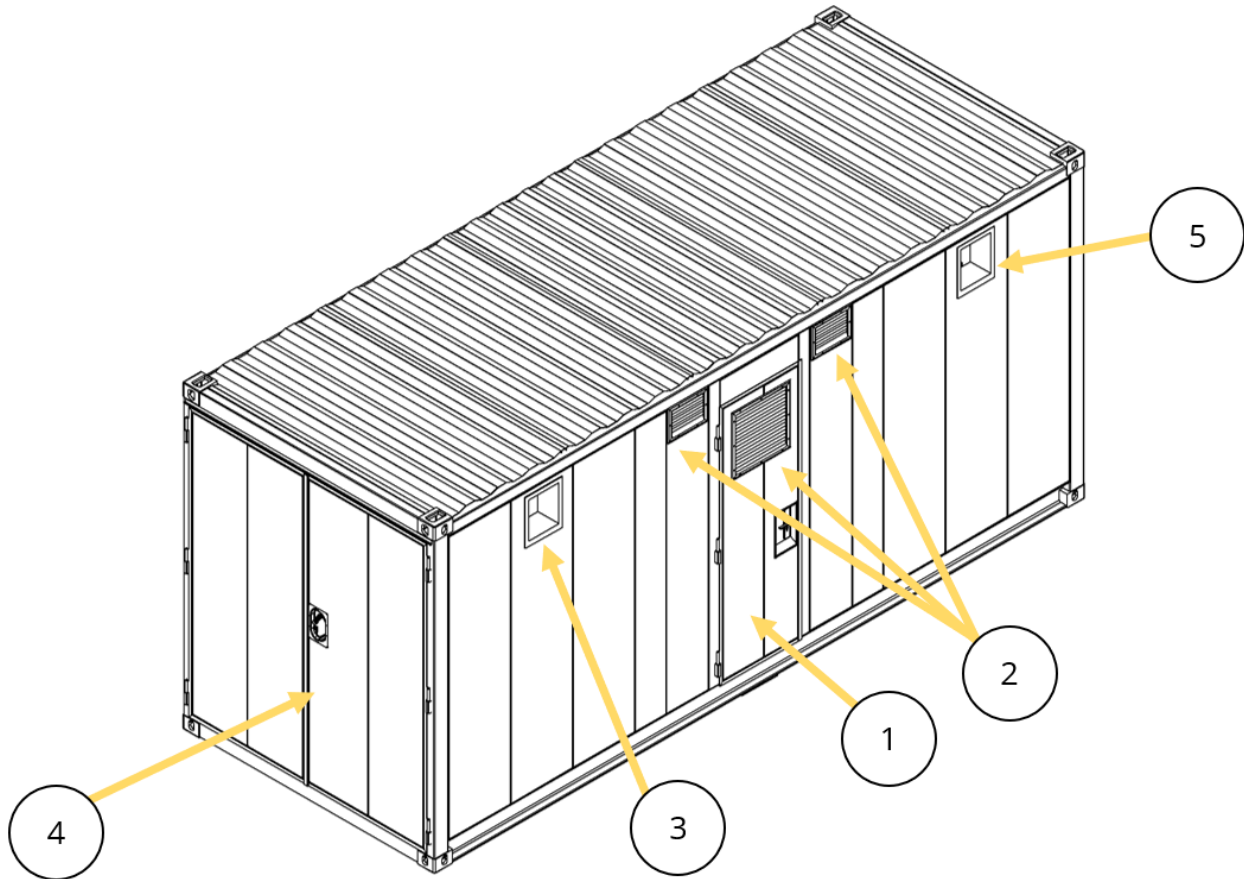


Figure 10: 3D view of the 'Service Room' side of the product

Item	Location	Description
1	C0	Door to the service room
2	C0	Ventilation grille – air outlet
3	C7	Pressure release valve battery room 1
4	C7	Door to battery room 1
5	C8	Pressure release valve battery room 2

Table 4: Components and rooms on the “Service Room” side of the product.

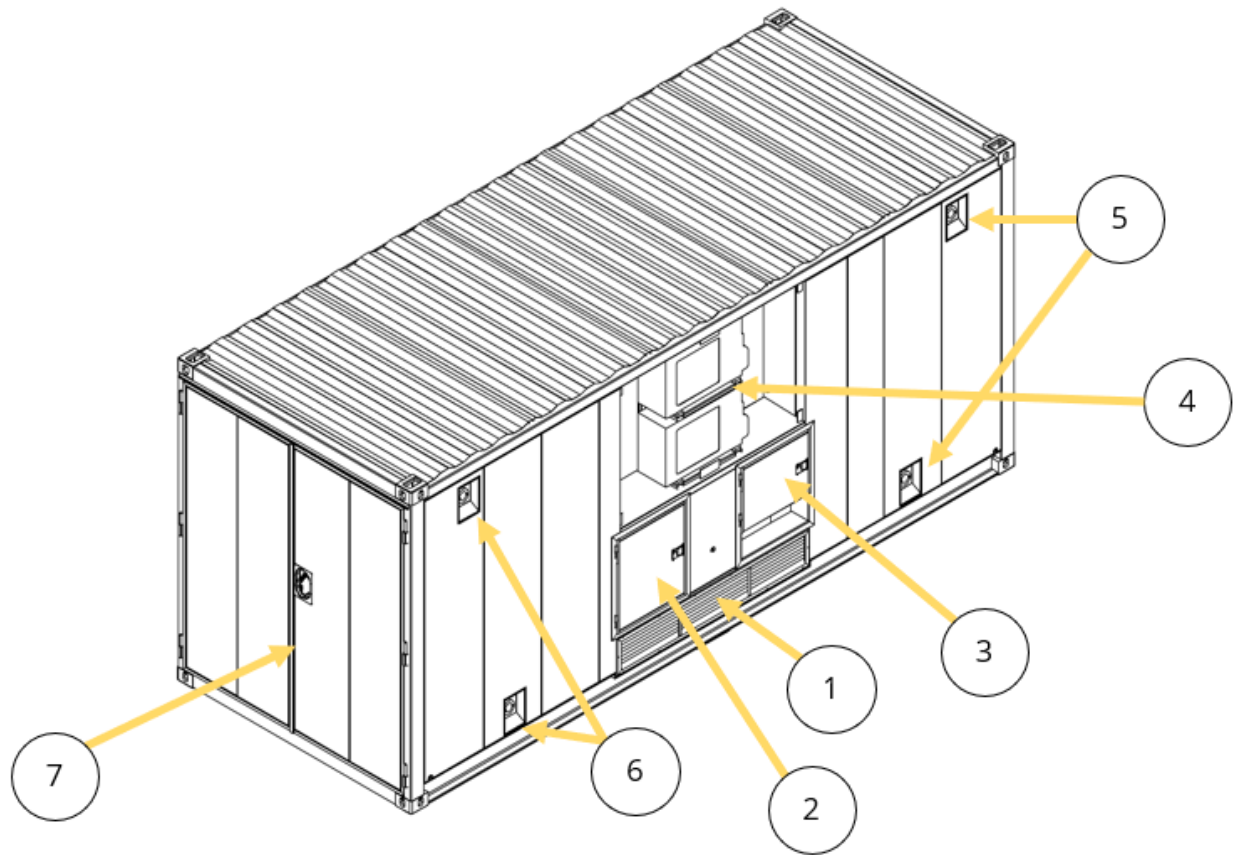


Figure 11: 3D view of the 'Power Entry panel' side of the product

Item	Location	Description
1	C0	Ventilation grille – air inlet
2	C2	Motorised Circuit Breaker
3	C1	Power Entry panel
4	C0	HVAC
5	C7	Fire hose connection battery room 1
6	C8	Fire hose connection battery room 2
7	C8	Door to battery room 2

Table 5: Components and rooms on the “Power Entry Panel” side of the product

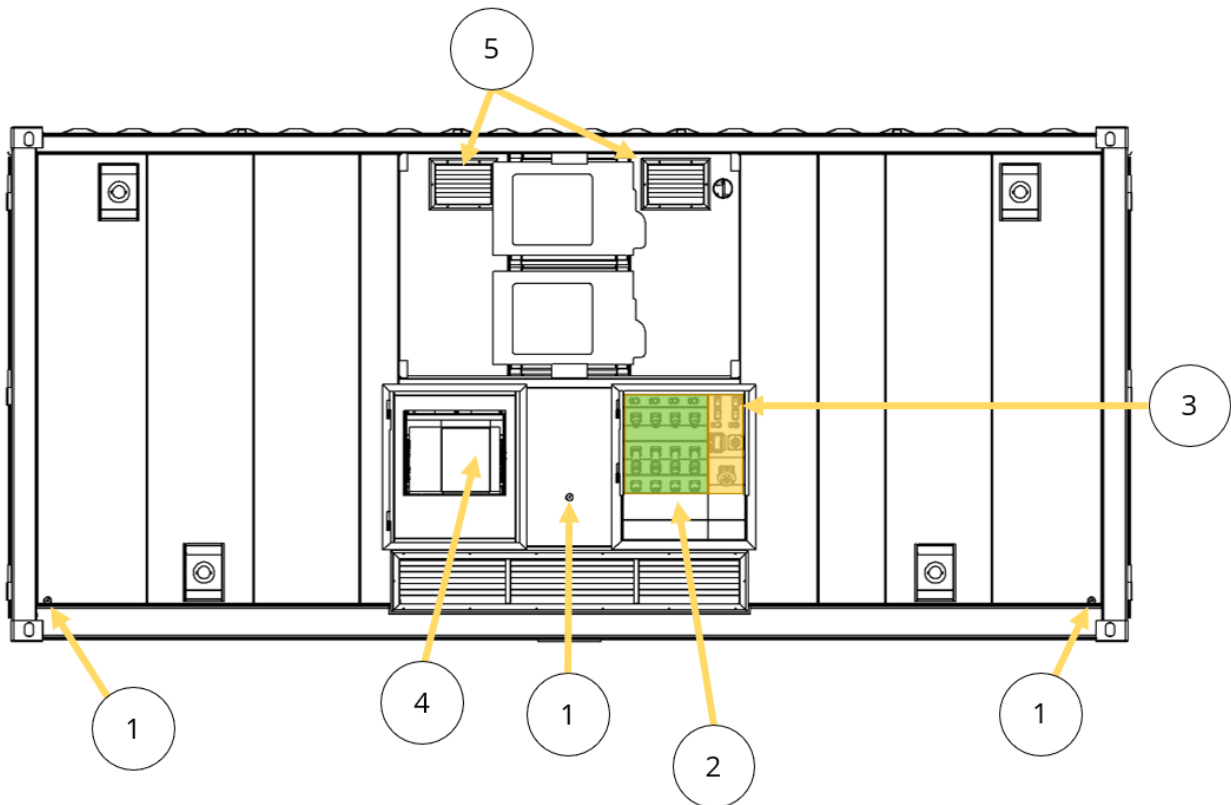


Figure 12: 2D view of the 'Power Entry panel' side focused on the electrical connections

Item	Location	Description
1	C0	Earthing rods
2	C1	Power Entry panel 'DC-Link' marked green
3	C1	Power Entry panel 'Communication and Auxiliaries' marked yellow
4	C2	Motorized Circuit Breaker
5	C0	Ventilation grille – air outlet

Table 6: Electrical connections on the "Power Entry Panel" side of the product

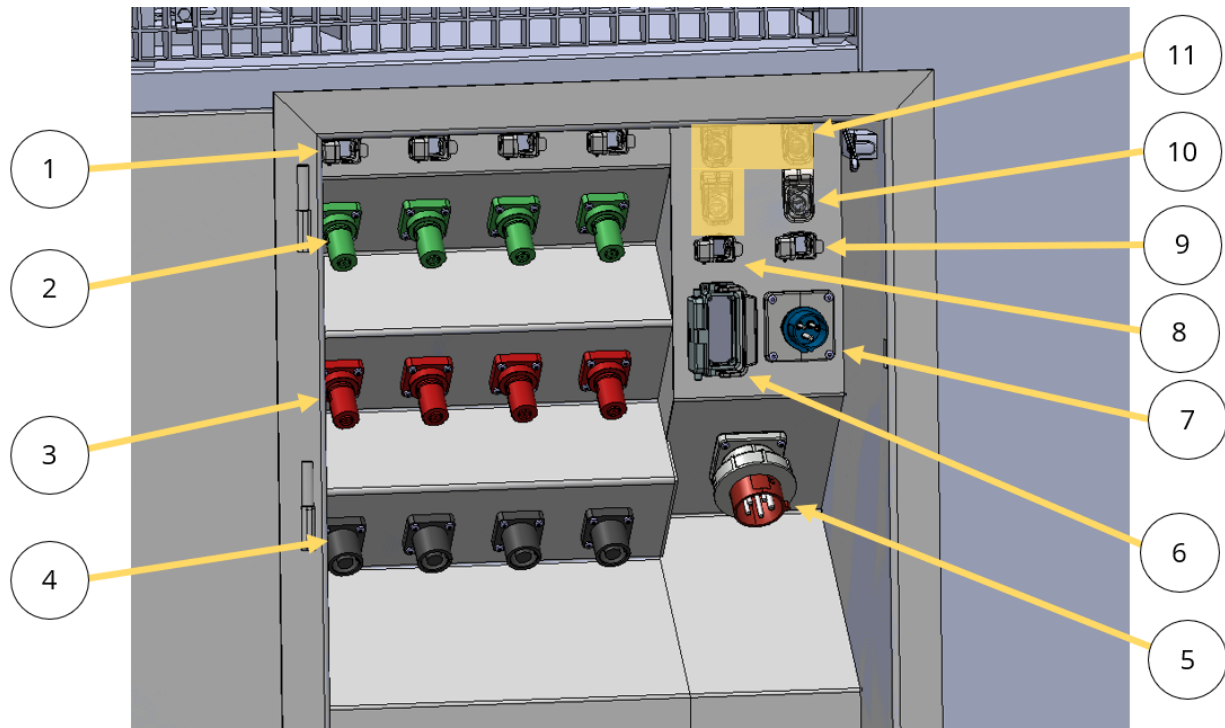


Figure 13: 3D view of the Power Entry panel in detail

Item	Description	Mobile	Stationary
1	DC-Link communication line connection	Mandatory per DC-link connection	N/A
2	PE connection	Mandatory per DC-link connection	N/A
3	Positive connection	Mandatory	Mandatory
4	Negative connection	Mandatory	Mandatory
5	5-Pin 32 Ampere CEE connection for auxiliaries	Mandatory during operating	Mandatory
6	16-Pin connection for user configurable digital inputs and outputs	Optional	Optional
7	3-Pin 16 Ampere CEE connection for UPS battery charger	Mandatory	N/A
8	4-Pin+PE connection for external fire panel	Optional	Optional
9	3-Pin+PE connection for external Emergency Button	Mandatory	Mandatory
10	RJ45 connection for Remote control via Modbus TCP	Optional	Optional
11	RJ45 connections for external devices such as AC/DC Converters and energy meters	Mandatory	Mandatory

Table 7: Components on the Power Entry panel

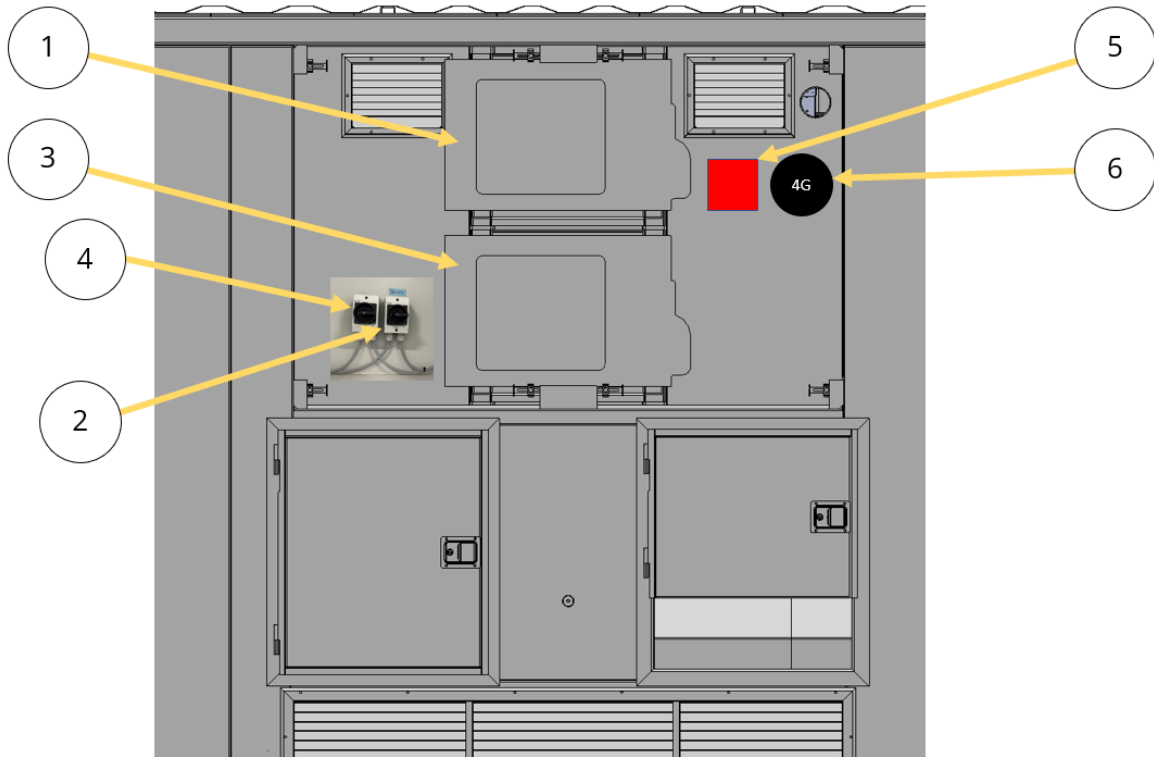


Figure 14: 2D view of HVAC and auxiliaries location

Item	Location	Description
1	C0	HVAC 1 for battery room 1
2	C0	Operating switch of HVAC 1
3	C0	HVAC 2 for battery room 2
4	C0	Operating switch of HVAC 2
5	C0	Fire alarm horn
6	C0	4G antenna

Table 8: Components on the HVAC area of the product.

3.4 Schematic Diagram

The diagram below shows the basic composition and operation of the BESS.

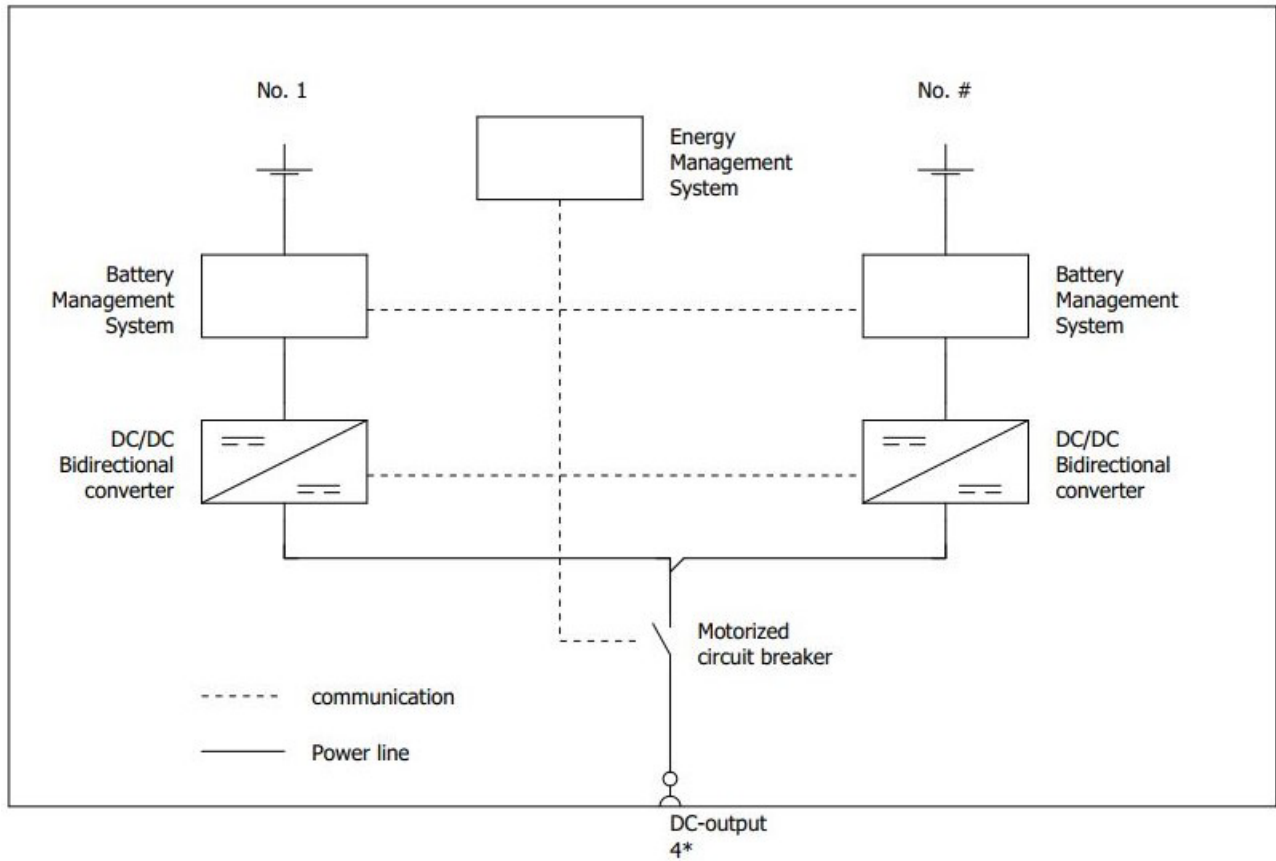


Figure 15: Simplified electric diagram of the BESS

3.5 External doors and locks

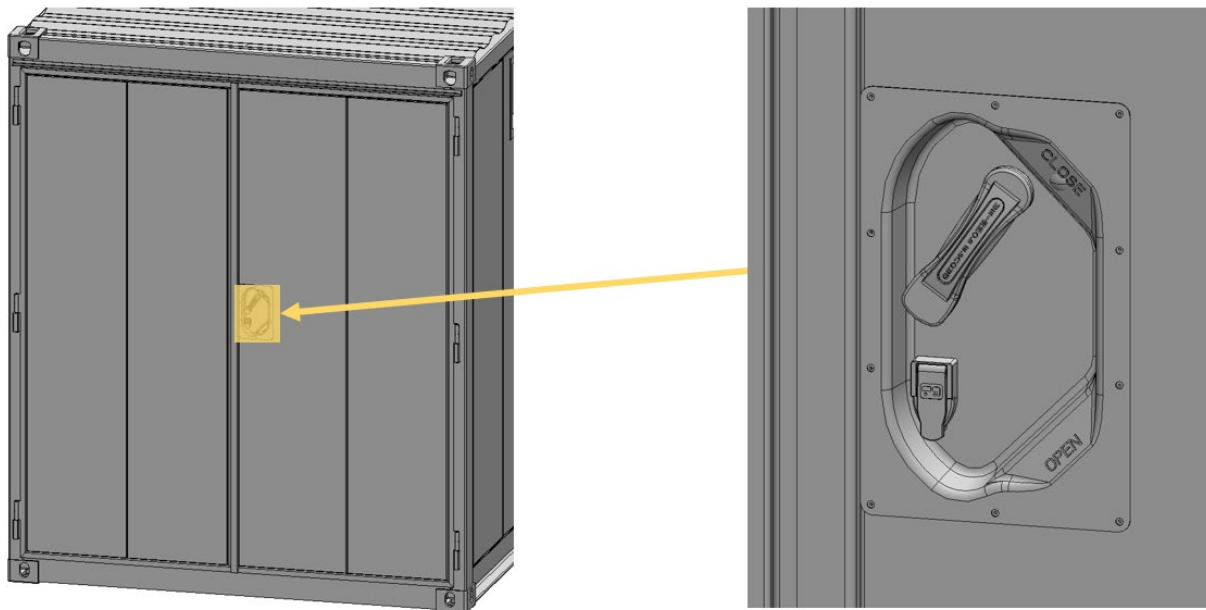


Figure 16: 3D view of the door lock of Battery Rooms - C7 and C8

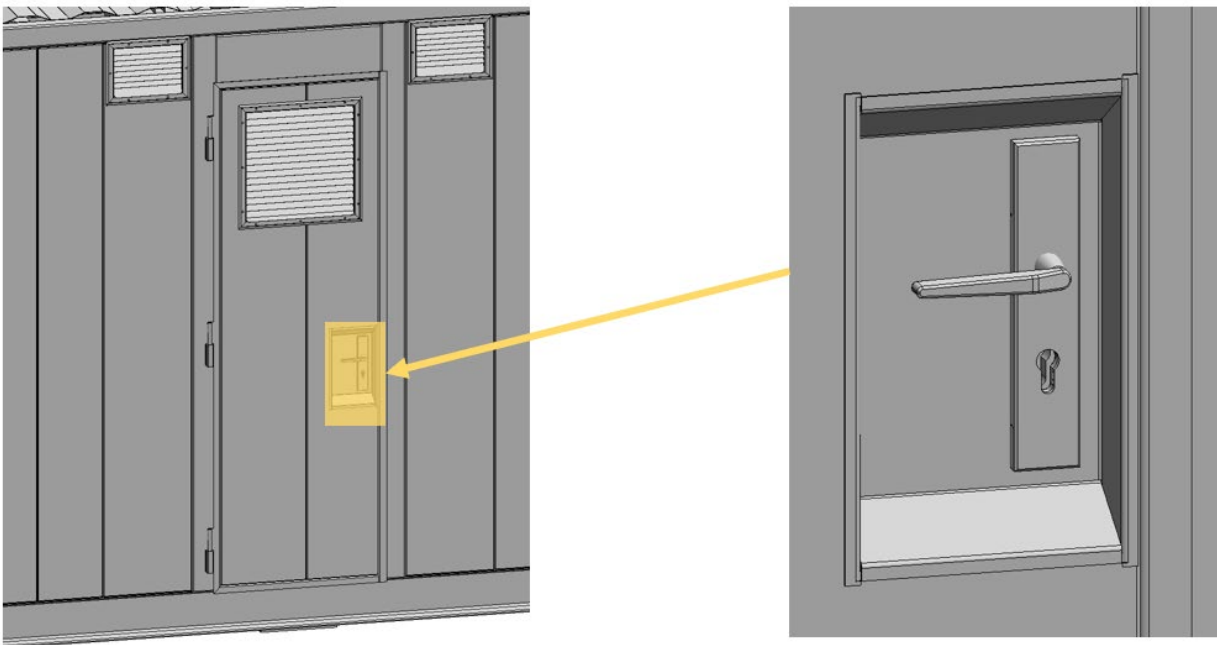


Figure 17: 3D view of the door lock of Service Room - C0

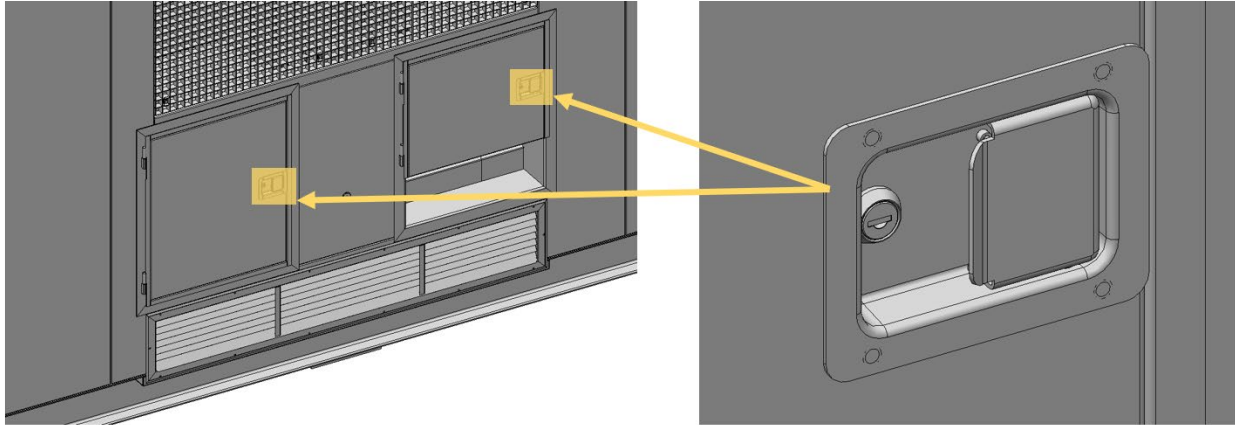


Figure 18: 3D view of the door lock of the Power Entry panel and MCB and door - C1 and C2

3.6 Internal doors and locks

The internal doors are all similar cabinet doors. The doors are locked with a standard cabinet door lock. The doors can be opened with an industry standard 'Double-bit key. A set of keys is supplied with the product. Please see the type of key in the picture below.



Figure 19: Reference image of the Double-bit cabinet door key

The related cabinet doors are in the service room C0. Please see the cabinets' location in the below.

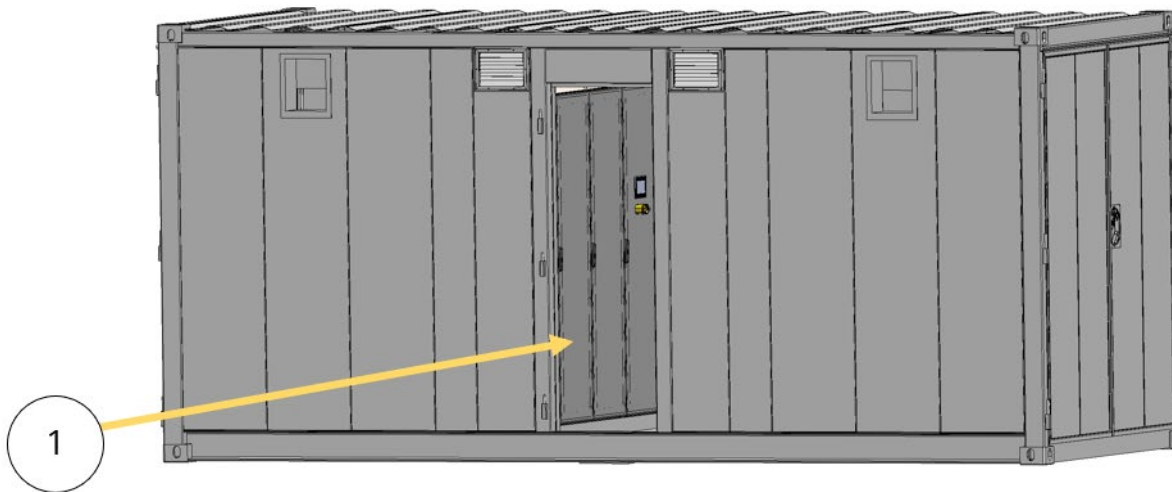


Figure 20: 3D view of the product, looking towards C5.1, C5.2 and C4

Item	Location	Description
1	C0	Location of cabinet C5.1 C5.2 and C4

Table 9: Location of C5.1, C5.2 and C4 cabinet

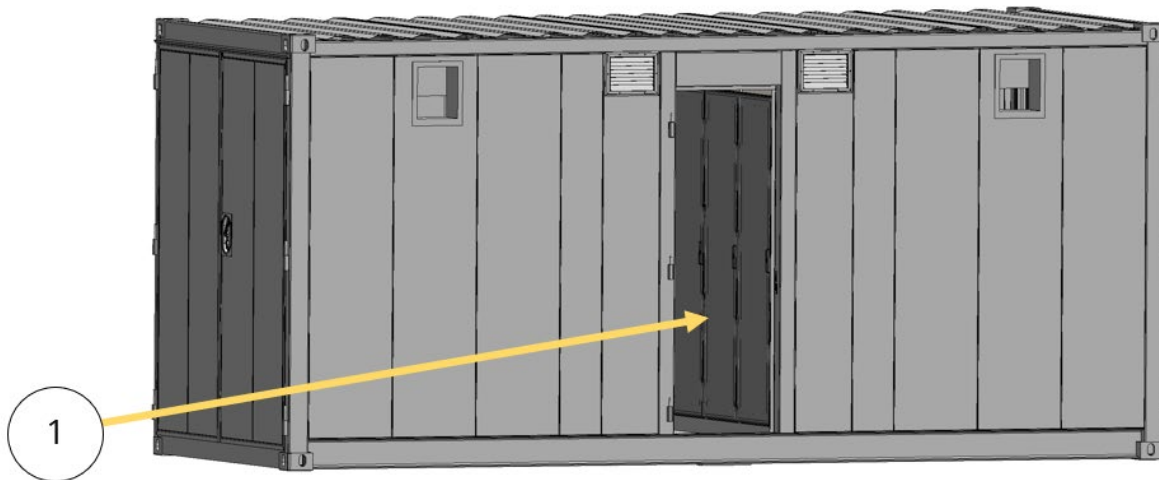


Figure 21: 3D view of the product, looking towards C6.1, C6.2 and C3

Item	Location	Description
1	C0	Location of cabinet C6.1 C6.2 and C3

Table 10: Location of C6.1, C.6.2 and C3 cabinet

3.7 Control cabinet C4 and power distribution C3

The cabinets that contain either 230Vac or 24Vdc distribution are identified on below images. These cabinets may be accessed during operation. Control cabinet C4 is only supplied by 24Vdc, including the room lighting and fire suppression system. Power distribution cabinet C3 is the distribution of 230Vac that feeds the HVAC units, DC pre-charge circuit and power electronic forced air-cooling fans.

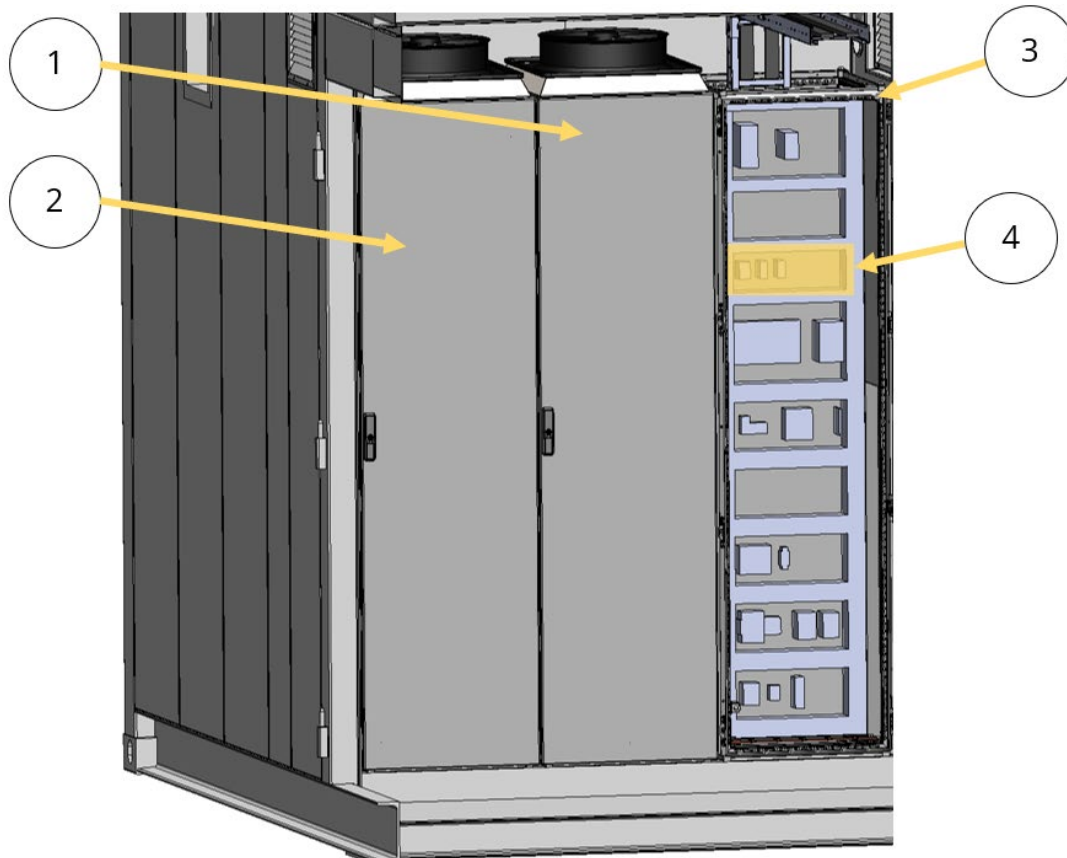


Figure 22: 3D view of C4, C5.1 C5.2 cabinets

Item	Location	Description
1	C5.2	Location of the DC/DC converters
2	C5.1	Location of the DC/DC converters
3	C4	Identifies the 24Vdc distribution and control panel
4	C4	Yellow marked identifies the 24Vdc fuse holders

Table 11: Identification of cabinet location - C4 side detail

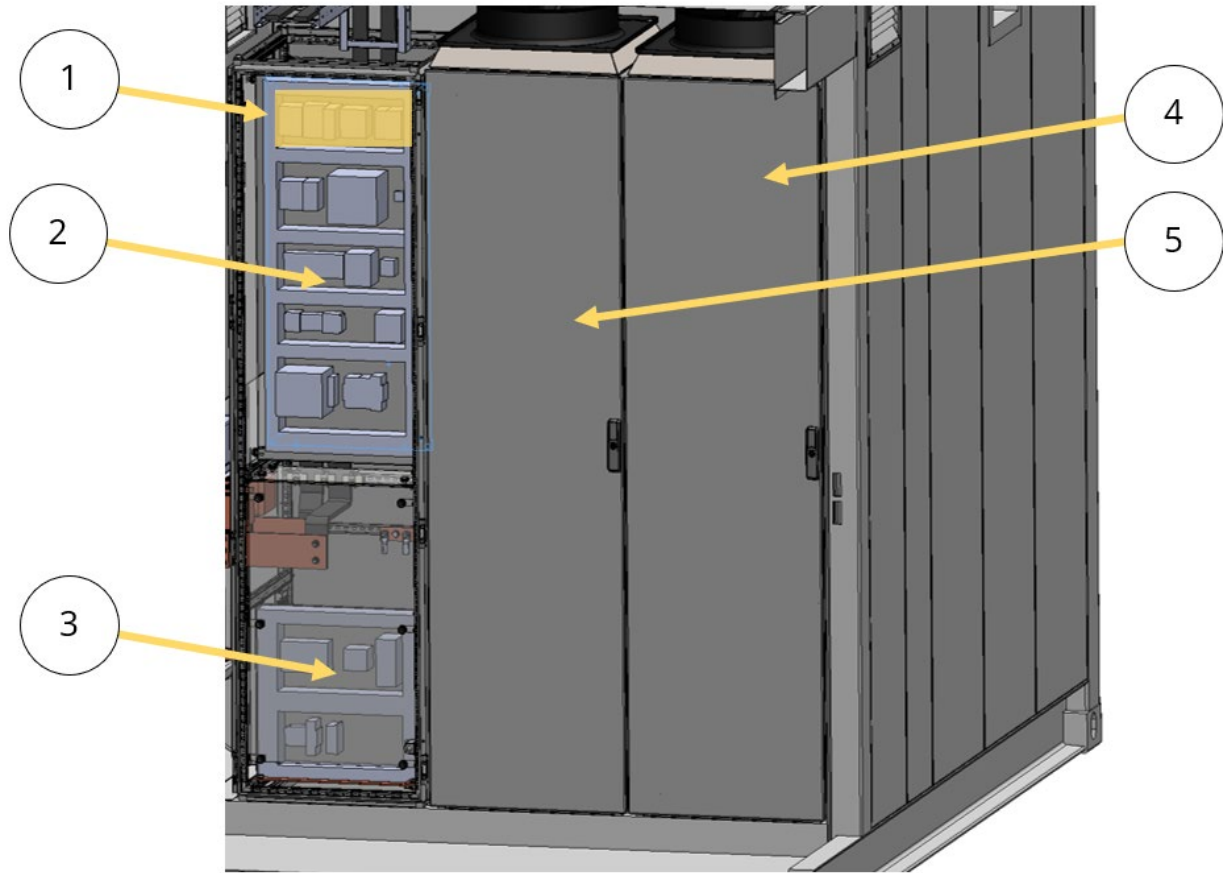







Figure 23: 3D view of C3, C6.1 C6.2 cabinets

Item	Location	Description
1	C3	Yellow marked identifies the 230Vac circuit breakers
2	C3	Identifies the 230Vac distribution panel
3	C3	Location of the Automatic Fire Suppression System
4	C6.2	Location of the DC/DC converters
5	C6.1	Location of the DC/DC converters

Table 12: Identification of cabinet location – C3 side detail

3.8 Protective covers

	<p>DANGER!</p> <p>Danger to life due to high voltage!</p> <p>In case of fault, high voltage may still be present on the product. Touching energized parts leads to death or severe injury.</p> <ul style="list-style-type: none"> ▪ Obey all safety instructions when working on the product.
 	<p>WARNING!</p> <p>Risk of injury due to improper condition of the product!</p> <p>Incorrect troubleshooting can lead to serious bodily injury or property damage.</p> <ul style="list-style-type: none"> ▪ Wear suitable personal protective equipment for all work on the product. ▪ Have troubleshooting performed by persons who have the knowledge described in Section Target Audience. ▪ If the displayed error cannot be eliminated locally, please contact customer service.
	<p>WARNING!</p> <p>Risk of injury and property damage due to mechanical hazards.</p> <p>There is risk of injury or damage to property if mechanical parts are handled carelessly.</p> <ul style="list-style-type: none"> ▪ Moving parts: doors slamming shut ▪ Removing protective covers ▪ Sharp edges
	<p>NOTICE</p> <ul style="list-style-type: none"> ▪ Do not remove the protective covers without authorization. The protective covers should remain in place unless service or maintenance is strictly required. ▪ The safety signs, cabinet identification signs and housing lifting instructions must remain permanently attached to the product. ▪ It is forbidden to cover or obstruct any ventilation openings. Refer to the product layout for information on the location of the ventilation openings.

**NOTICE**

The manufacturer assumes no liability and warranty for any damage caused by unauthorized modifications.

The product has protective covers to guarantee a safe operation and prevent injuries and damage to the product. These protective covers and their locations are shown in below images.

The service room cabinets are equipped with protective covers, with IP50 rating. The room can be observed during operation, even when the door cabinets are open. However, the door cabinets must always remain closed when inspection is done. In case the protective covers are to be removed the IP rating is IP00. The protective covers should not be removed during operation.

The Battery rooms do not have protective covers, therefore these room should not be observed or accessed during product operation. Always maintain the doors closed and locked to ensure safety and prevent damages to the product. The IP rating of the battery rooms while the doors are opened is IP10. A battery module or battery string always carries a DC voltage also when the product is completely OFF.

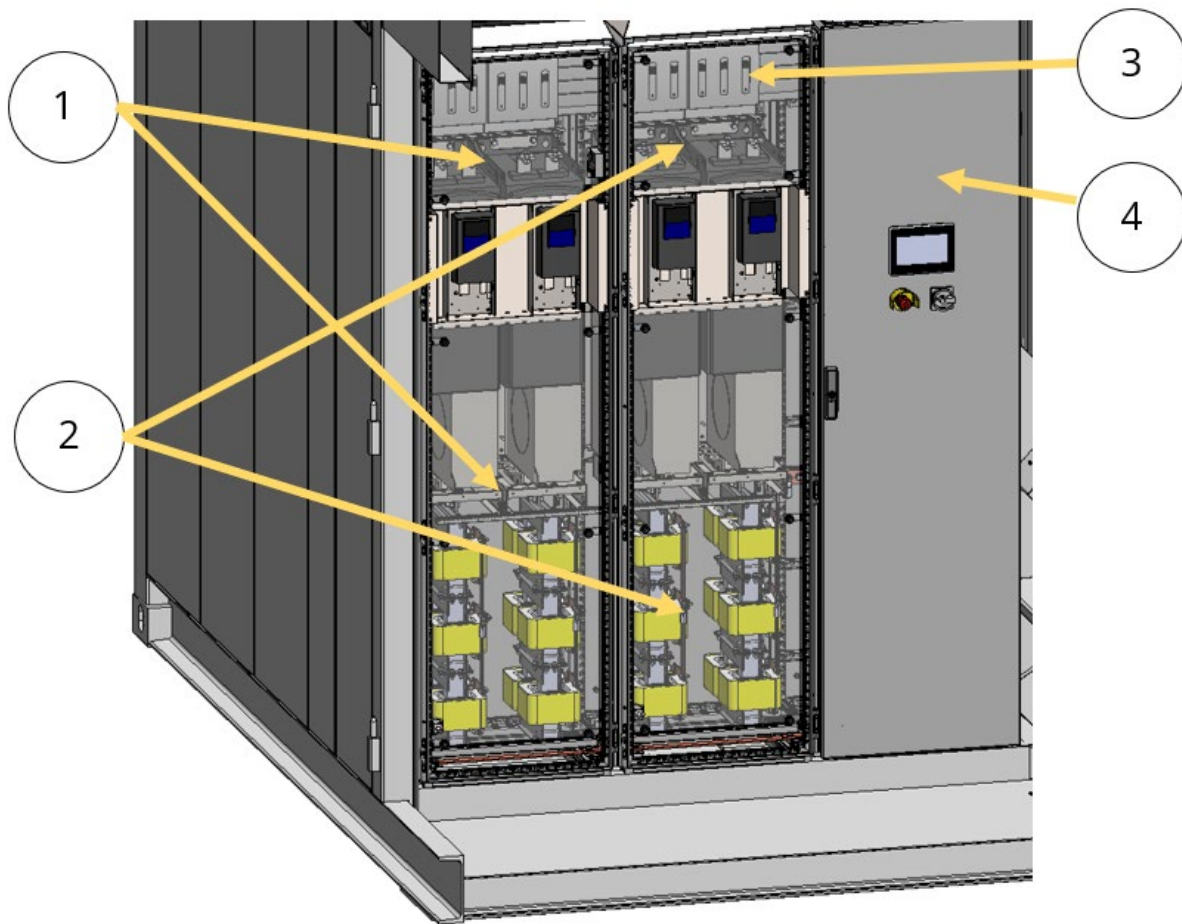


Table 13: 3D view identifying the protective covers of C5.1 and C5.2

Item	Location	Description
1	C5.1	Protective cover behind the cabinet doors
2	C5.2	Protective cover behind the cabinet doors
3	C5.1 and C5.2	Location of the DC fuse holders between DC/DC converters and DC-Link
4	C4	Location of cabinet C4

Table 14: Location of protective covers - C4 side

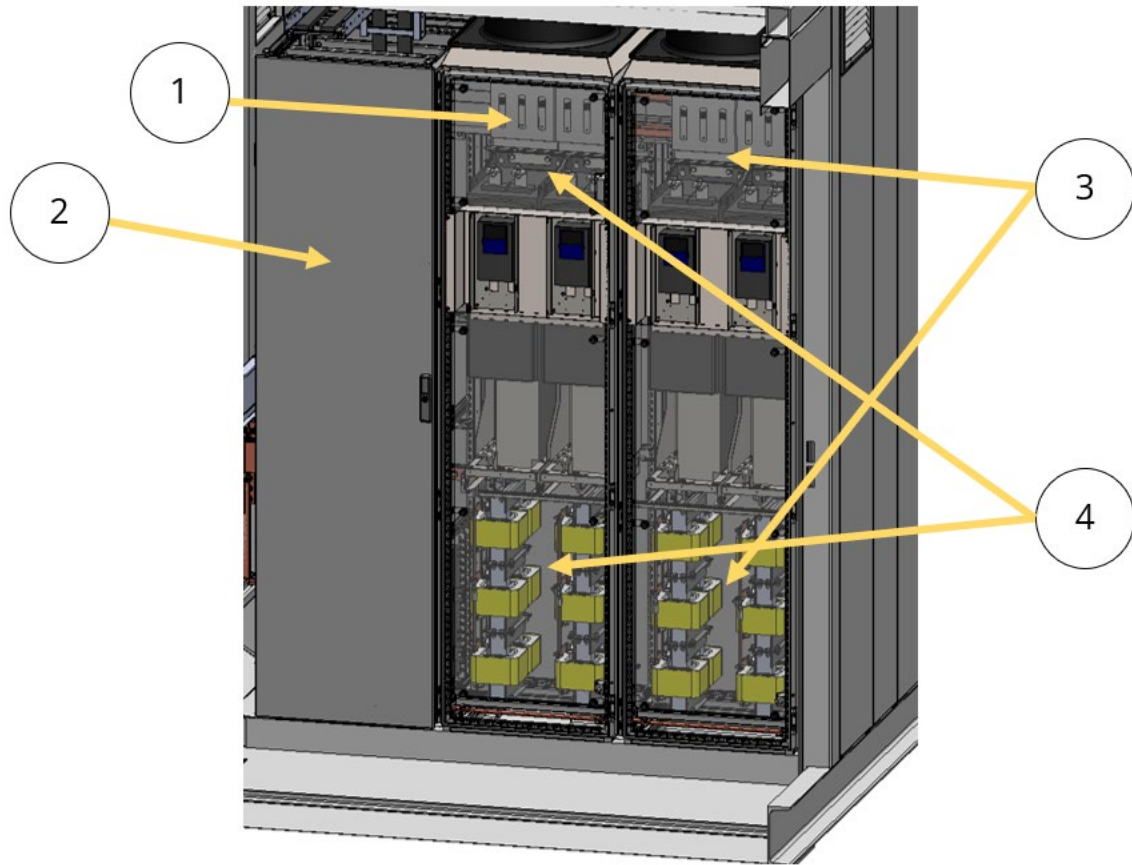


Table 15: 3D view identifying the protective covers of C6.1 and C6.2

Item	Location	Description
1	C6.1 and C6.2	Location of the DC fuse holders between DC/DC converters and DC-Link
2	C3	Location of cabinet C3
3	C6.2	Protective cover behind the cabinet doors
4	C6.1	Protective cover behind the cabinet doors



Table 16: Location of protective covers - C3 side


4 Transportation and lifting


Transportation of the product should be carried out with the proper equipment and following the safety measures as indicated on this chapter.



Prior to lifting and transportation it is important to do a visual check of the product. The operator must:

- Ensure the system is OFF;
- Ensure all the cabinets doors are properly closed and locked;
- Ensure all access doors are properly closed and locked;
- Ensure there are no loose items or material inside the product;
- Ensure all documentation is ready (see below);
- Ensure that the site where the product will be delivered is ready for placement.

 	<p>WARNING!</p> <p>Danger to life or to the product due to falling objects!</p> <p>The product can fall or tip over if transported incorrectly, which may cause damage to the product and result in serious injury or death.</p> <ul style="list-style-type: none"> ▪ Wear suitable personal protective equipment for all work on the product. ▪ Transport the product with persons who have knowledge as described in section Target Audience; ▪ Only transport the product using suitable transport facilities with sufficient load bearing capacity; ▪ Lift the product in an upright position; ▪ Do not stand under suspended loads; ▪ If the lifted or suspended load falls over, falls or sways, there is a risk of crushing; ▪ Vibration or careless or hasty lifting and transport can cause the product to tip over or fall. This can result in death or serious injury; ▪ Comply with all national transportation standards and regulations; ▪ Always transport the product as close as possible to the floor; ▪ Avoid fast or uneven movement during transport; ▪ Always maintain a sufficient safety distance from the product during transportation.
---	--

	<p>NOTICE</p> <p>Perform the lifting and transport of the product by trained and authorized persons, who have the appropriate qualifications.</p>
---	--

	<p>NOTICE</p> <p>The manufacturer accepts no liability for damage caused through not complying with the terms of lifting and transport.</p>
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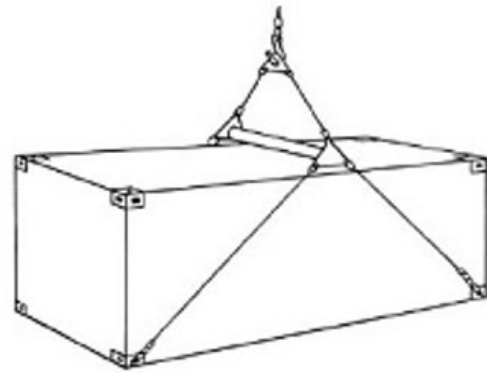
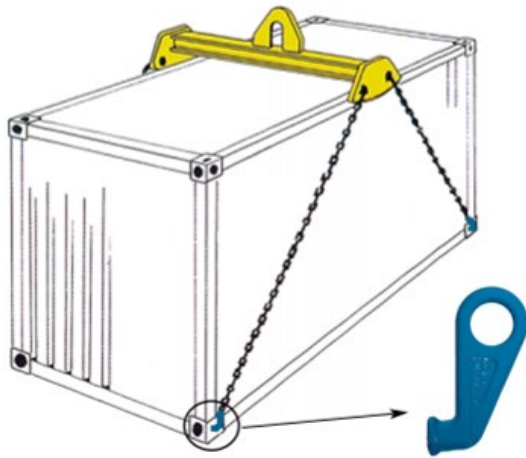
	<p>NOTICE</p> <p>Follow the lifting and transport guidelines of the manufacturer:</p> <ul style="list-style-type: none"> ▪ Do not stack the product; ▪ Do not bump the product into other objects; ▪ Do not bump the product into the surface; ▪ Mind that the surface to position the product is flat; ▪ Position the product on all 4 corners when on the surface.
 <p>DO NOT STACK</p>	

4.1 Lifting

The product can be lifted using the corner castings located at the bottom of the product as indicated in the images below. The equipment used for lifting the product should be able to handle the specifications of the product in terms of measurements and weight as indicated below.

Description	Parameter
Dimensions (L x H x W in mm)	6.300 x 2.900 x 2.440
Weight	Approx. 23.000 kg
Volume of the product	44,6 m ³
Volume of dangerous goods	9,7 m ³
Transport class	ADR 9 Packaging class II UN3841

Table 17: Product specifications for lifting and transport.



Bottom lift by means of transverse spreader, sling and hooks, shackles or lugs. Slings should be angled at not less than 45° nor more than 60° to the horizontal.

Figure 24: Example of lifting the product

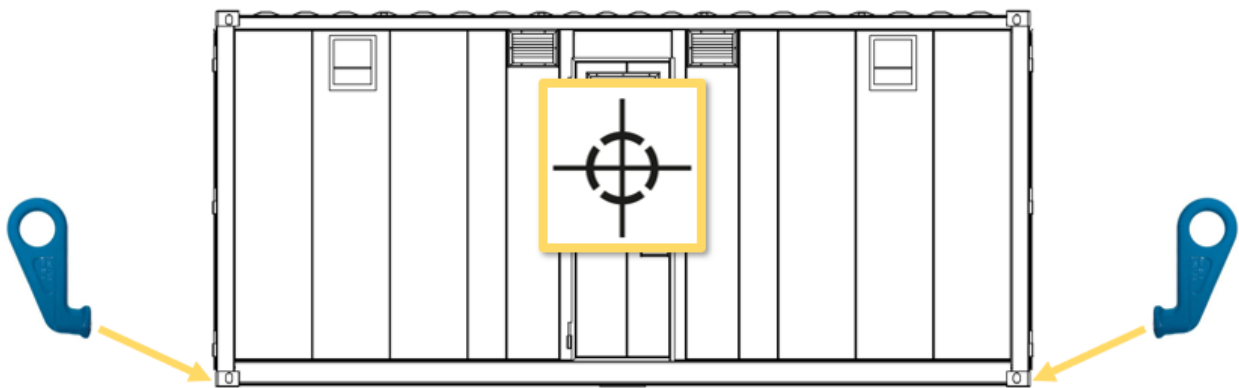


Figure 25: Lifting suggestion and indication of Centre of Gravity



Figure 26: Example of a lifting job

4.2 Transport

The EnergySkid can be transported with a low loader trailer or a regular trailer that meets the right total permissible transport height taking the product height into account. See table 8 for the product specifications.

It is advised to fix the product to the trailer with lashing chains as the example below.

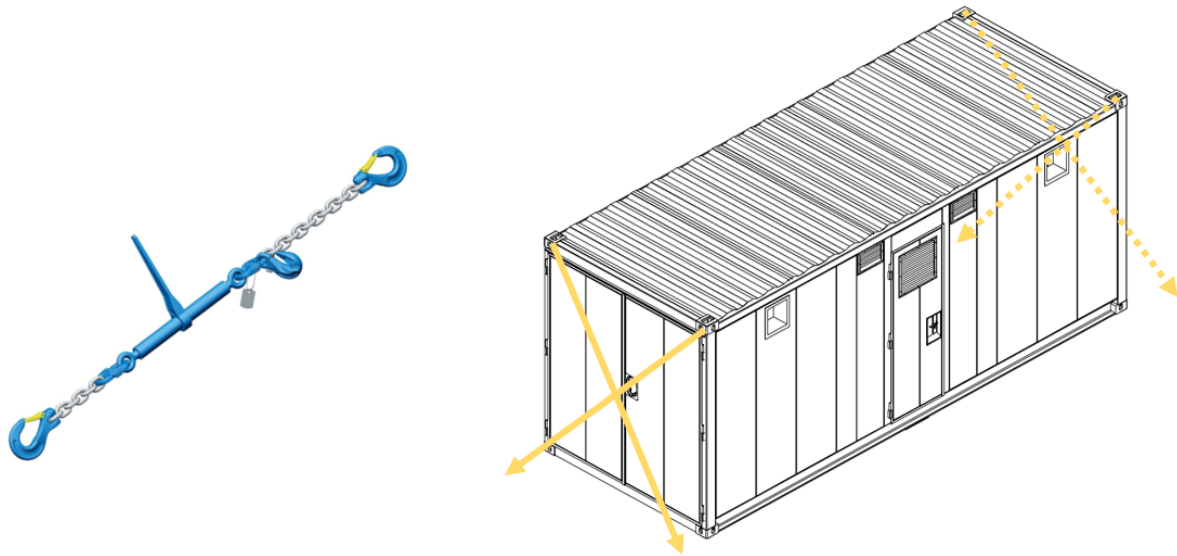


Figure 27: 3D view as example to fix the product to the trailer with lashing chains

Due to the nature and contents of the product, the transportation requires to be labelled as transport of dangerous goods, therefore a dangerous goods form is required as well as a CRM transportation document. The required forms are to be found the appendix. Some examples below:



Figure 28: Example of lashing chains on the product

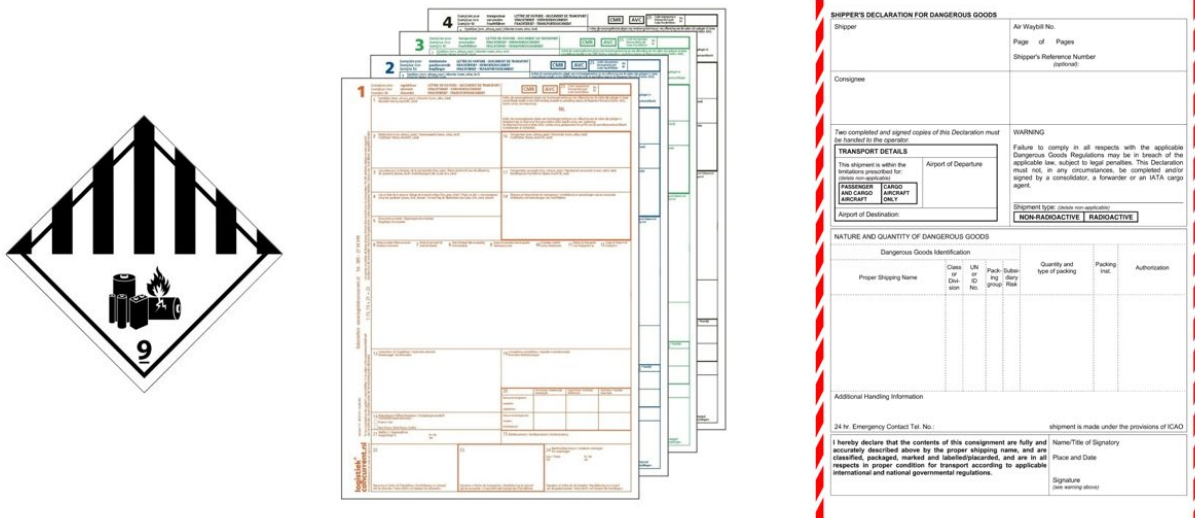


Figure 29: Example of ADR 9 label, CMR document and Dangerous Goods Declaration

Item	Check
Properly fixed the product to the trailer in line with guidelines or better	<input type="checkbox"/>
ADR 9 labels are applied and visible on the product	<input type="checkbox"/>
CMR transport documentation is filled in	<input type="checkbox"/>
Dangerous Goods Declaration is filled in	<input type="checkbox"/>

Table 18: Check list for shipment of the product

4.3 Delivery

After the product has been delivered the user must check that there is no damage on the product before starting with the installation. Below the basic checks to perform after delivery:

Item	Check
Damage on the housing and components	<input type="checkbox"/>
Excessive dirt inside the service room (C0) and battery rooms (C7, C8)	<input type="checkbox"/>
Check on visual signs of moisture	<input type="checkbox"/>
Check vent holes, these holes should not block from any dust or other items.	<input type="checkbox"/>



Table 19: Checklist after the product has been delivered


5 Installation

After transport and delivery, the product needs to be installed according to the procedures and measures below.

5.1 Safety during installation

Approved installers must perform the installation. In preparation, make sure the installation site is suitable. A sufficiently solid base and shielding from external mechanical shocks are required. Before installation, please inspect the system.

 	<p>DANGER!</p> <p>Danger to life due to high voltage!</p> <p>Touching live parts can result in death or serious injury due to electric shock.</p> <ul style="list-style-type: none">▪ Wear appropriate personal protective equipment for all work on the product.▪ Before you work on the product, check if it is disconnected externally and safeguarded against reconnection.▪ Make sure a ground connection is provided before you start the installation.▪ Do not remove, alter, or adjust protection or security devices, either temporarily or permanently.▪ Observe that after completion of work all protective covers are mounted.
--	---

	<p>WARNING!</p> <p>Possible danger situation due to incorrect placement!</p> <ul style="list-style-type: none">▪ In connection with the heat generated and for safe access to the system, a minimum distance of 3 meters should be maintained around the container housing to create sufficient space around the system. Do this, for example, by using demarcation tape.▪ Position the entire container system correctly at six points so that it is completely stable.▪ Make sure the surface is suitable to carry the weight of the product.
---	---

5.2 Placing the product

The product must be positioned on at least 4 points, on a surface that is suitable to support the weight. To ensure there is enough space for accessing the system, a minimum distance of 3 meters must be kept around the system. No equipment or vehicles may be located or operated within this distance from the system. All air vents should be completely free.

Comply with the following to ensure a proper placement:

- Make sure the surface is suitable for the product weight and size;
- Make sure the surface is level;
- Place the product on 4 corner points;
- Once positioned apply risers to support the middle points, so that the product is positioned on 6 points.

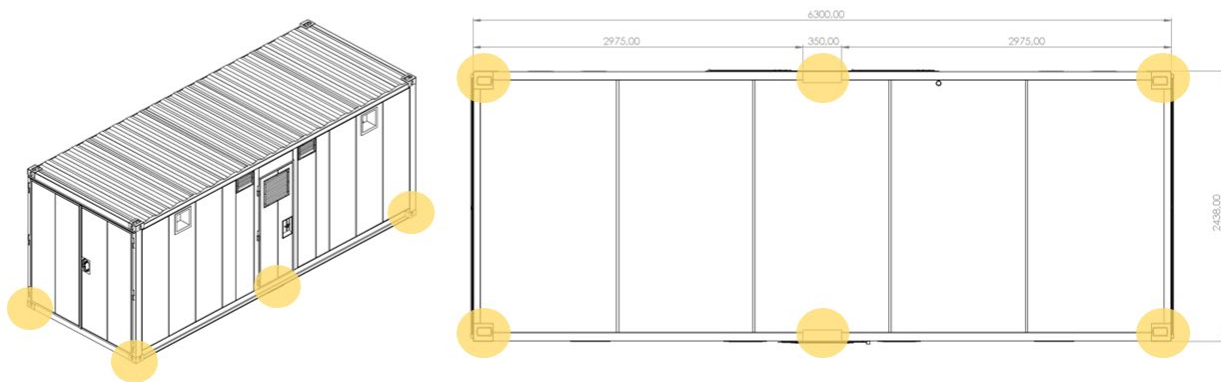


Figure 30: 2D and 3D view of positioning example










	<p>WARNING!</p> <p>The product housing is stiff!</p> <p>A slight difference in the surface can result in hovering corner points. Avoid this as all times to prevent stress on the housing.</p>
--	--



Figure 31: Example of improper - non-levelled placement with hovering corner points

5.3 Required cabling for installation

In preparation for commissioning, the following cables need to be in place and connected to the product. These cables are mandatory for proper and full operation of the product. The installer is responsible for selecting the suitable cable and cross section. Below table contains commonly used cables and (minimum required) cross sections.

Cable	Plug type	Plug identification	Use
4 x H07RN-F power cables 1 x 240 mm ²	T8 Source		PE of the product – [Only for Mobile]
4 x H07RN-F power cables 1 x 240 mm ²	T8 Source		+/+ Positive line of DC Link output
4 x H07RN-F power cables 1 x 240 mm ²	T8 Drain		-/- Negative line of DC Link output
4x 5G1,5 multicore cable - Outdoor	Han-A 4P+PE male		Communication line per DC link output – [Only for Mobile]
1 x CAT5A Ethernet cable	RJ-45		Modbus TCP Communication with AC/DC converter
1 x CAT5A Ethernet cable	RJ-45		OPTIONAL - Modbus TCP Communication with AC/DC converter
1 x CAT5A Ethernet cable	RJ-45		Modbus TCP Communication with external energy meter on the AC side of the AC/DC converter or customer main point of connection (e.g., Main Meter).
1 x CAT5A Ethernet cable	RJ-45		Modbus TCP Communication for remote control. Please consult the manufacturer to make sure all the requirements are in place.
3 x grounding cable	M12 cable lug		Grounding to the container housing on the earthing rods.






1 x 18G0,5 multicore cable	Han 16-B male		External communications.
1 x fire resistance cable 2x2x0,5	Han-A 4P+PE male		External fire panel communication.
1 x H07RN-F 5G6	32A CEE – 5 pins		Auxiliary power of the product
1 x 3G2,5 multicore cable	15 CEE – 3 pins		Power supply to UPS battery charger – [Only for Mobile]
1 x fire resistance cable 2x2x0,5	Han-A 3P+PE male		External emergency button

Table 20: Cable and connection list for the product

5.4 Apply auxiliary power to the product

Once all the cables are installed the installer needs to measure the isolation value ('Megger') of the power connection lines prior to connecting. The product contains safety hardware that makes it impossible to execute a successful isolation measurement with the power connection lines connected.

Once the power connection lines are measured and the connections are made voltage on the auxiliary power plug can be applied. This will power up the system controls and protections. Once the auxiliary power is supplied, the product can be monitored remotely, and the emergency systems are active.




5.5 Installation checklist


Item	Check
Product positioned proper and levelled	<input type="checkbox"/>
All required cables are connected as listed in table	<input type="checkbox"/>
Auxiliary power supplied	<input type="checkbox"/>
Call with Time Shift Commissioning Team for confirmation of the connected system controls and protections.	<input type="checkbox"/>



Table 21: Installation checklist

6 Commissioning

Once the installation has been completed, the commissioning of the product can take place. The commissioning is to be carried out by the manufacturer or an external party appointed by the manufacturer. The goal of commissioning is to leave the product ready for operation according to the specific use case.

  	<p>DANGER!</p> <p>Danger to life due to electric shock!</p> <p>Missing protective cover in the power unit and DC distribution can cause damage to property or personnel.</p> <ul style="list-style-type: none">▪ Do not touch live parts.▪ Make sure that all protective covers are mounted after you finish the installation work.▪ Before you work on the product, check if it is disconnected externally and safeguarded against reconnection.
---	---

	<p>WARNING!</p> <p>Danger to life due to incorrect installation!</p> <p>If the product is not installed correctly, it may get damaged and person near the product may get seriously injured or killed.</p> <ul style="list-style-type: none">▪ Carry out the installations as described in Section Installation to make sure that operation is safe.
---	--

 	<p>NOTICE</p> <p>Damage to the product due to incorrect commissioning!</p> <p>Incorrect commissioning can damage the product.</p>
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6.1 Preparing Commissioning

Before commissioning takes place, complete all the installation works and steps mentioned in the Installation chapter.

6.2 AFFS commissioning

As part of commissioning works, the automatic fire suppression system will be tested between the manufacturer and the customer and/or installation site. This might require interfacing with the site fire panel and trigger a test alarm. The procedure shown in the appendix will be followed.

6.3 Warranty period

Once the commissioning has been finalised, the warranty period is started.

6.4 Post-commissioning issues

If any issues should arise after commissioning, the service agreement is leading, and the operator and manufacturer should follow the guidelines stated on this document.

Note that there is a chapter on “Troubleshooting” further on this operating manual. Please refer to this chapter for more information on basic troubleshooting of the product.

7 Site Acceptance Test

After commissioning and once the system is ready to operate on the installation site, a Site Acceptance Test (SAT) is to be carried out between the manufacturer and the operator. The SAT intends to show and proof the operator that the system is ready for handover and that the product is properly operating. The SAT procedure and tests to be carried out can be found in the appendix.

After the SAT has been finalized and signed by both the manufacturer and the operator, the handover of the product takes place.

7.1 Key hand-over


After the SAT has been completed, the handover of the keys will be done, and an overview of the keys will be provided to the customer. The key overview and handover document can be found on the appendix.



8 Operation

The operation of the product aims to facilitate the use of the product to the operator and at the same time maximize its performance.

The product has multiple interfaces, control modes and operating modes. This chapter will guide the operator through each of these differences as well as provide general guidance to safe operation of the product.

8.1 Safe Operation

	<p>DANGER!</p> <p>Danger to life from electric shock if the product is not closed!</p> <p>If the product is not installed correctly, it may cause damage to the product and result in serious injury or death to persons near the product.</p> <ul style="list-style-type: none">▪ Carry out the installations as described in the Installation section to make sure that operation is safe.▪ Make sure that commissioning has been completed.
---	---

 	<p>NOTICE</p> <p>Perform all operation on the product with authorized personnel. The parts behind the cover plates and the doors that are opened with tools cannot be accessed by operators.</p> <ul style="list-style-type: none">▪ Please read this operating manual before using the product.▪ Pay attention to supplementary documents to operating instructions.
--	---

8.2 User Interface and control place

The product has multiple ways to interface with it. The operator should be aware of all interfaces as well as of the different control modes. An interface is a way to read and or write information from and to the product. A control place is the way the product is controlled, by a certain interface.

As an example, an operator can interface with the product via a remote TCP connection (interface). At the same time, a local operator can control the product via the local HMI. The local HMI will inform the local operator that the product is operated by a remote operator. The remote operator (via Modbus TCP) must read the Control Place in the corresponding Modbus register. Control places can overrule each other, except for the maintenance switch. The remote operator (via Modbus TCP) can take over control from a local operator (HMI). The other way around, a local operator can take over control from a remote operator.

In case a local operator toggles the maintenance switch to maintenance mode, all the remote controls are blocked. When the product is in maintenance mode all interfaces are forced to 'read only'.

When a control place is selected, the operator of that control place can 'write' commands or send commands to the product. Other connected interfaces are still able to execute 'read' commands or read information from the product. In this way, only one operator can execute 'write' commands to the product.

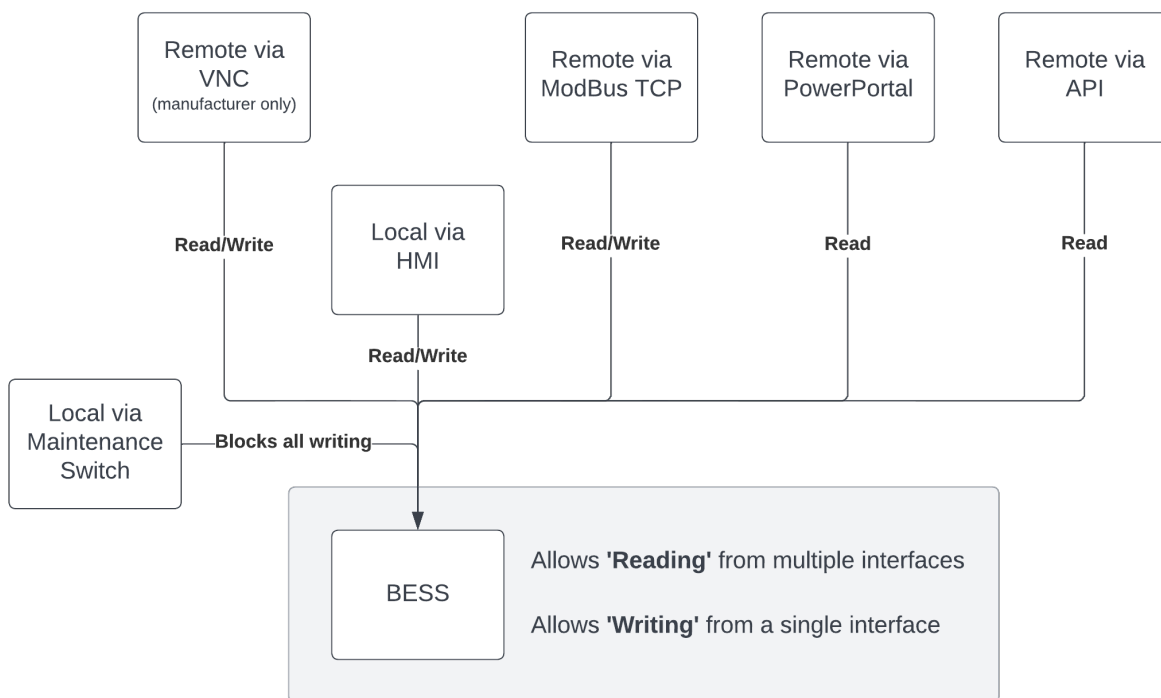


Figure 32: Diagram of the types of user interfaces

Interface	Description	Read commands	Write commands
Modbus TCP	If an external connection is made with the product, remote control via Modbus TCP is possible. Please refer to the Modbus Protocol Manual for detailed explanation of this interface.	Remote via TCP	Remote via TCP
HMI	The HMI provides basic system status information and is meant for basic monitoring and operating purposes.	Local via HMI	Local via HMI
Remote via VNC (manufacturer only)	The manufacturer is able to remote connect to the product for service, maintenance and/or software related purposes.	Remote via VNC (manufacturer only)	Remote via VNC (manufacturer only)
Remote via PowerPortal	Operators can access real-time product and operating data via portal.timeshift.nl	Remote via portal.timeshift.nl	Optional – consult manufacturer
Remote via API	Operator can access similar real-time product and operating data via an API. Consult manufacturer for this option.	Remote via API	N/A

Table 22: Different user interfaces of the product

Control Place	Description
Modbus TCP	Remote connection via Modbus TCP to Read and Write commands to operate the product
HMI	Local interface to read statuses and operate the product
Remote via VNC (manufacturer only)	Remote connection via VNC for the manufacturer to inspect for service, maintenance and/or software related purposes.
Maintenance Mode	Local switch for operators to maintain the product

Table 23: Control modes of the product

8.3 Local control places

In the service room (C0) on cabinet door C4 the HMI is positioned above the Emergency Button and Maintenance switch.

The operator can use the HMI for local control purposes. The main purpose of the HMI is providing the operator with basic control and monitoring information. Dependent on the use case, hardware and/or agreements the operator can turn the product ON and OFF, view grid parameters, battery status, and temperature readings. Detailed information about operating the product via the HMI is available in a separate HMI manual.

Authorized operators can use the HMI for service and maintenance purposes via a password secured account.



Figure 33: Example of HMI views informing the operator about the control place

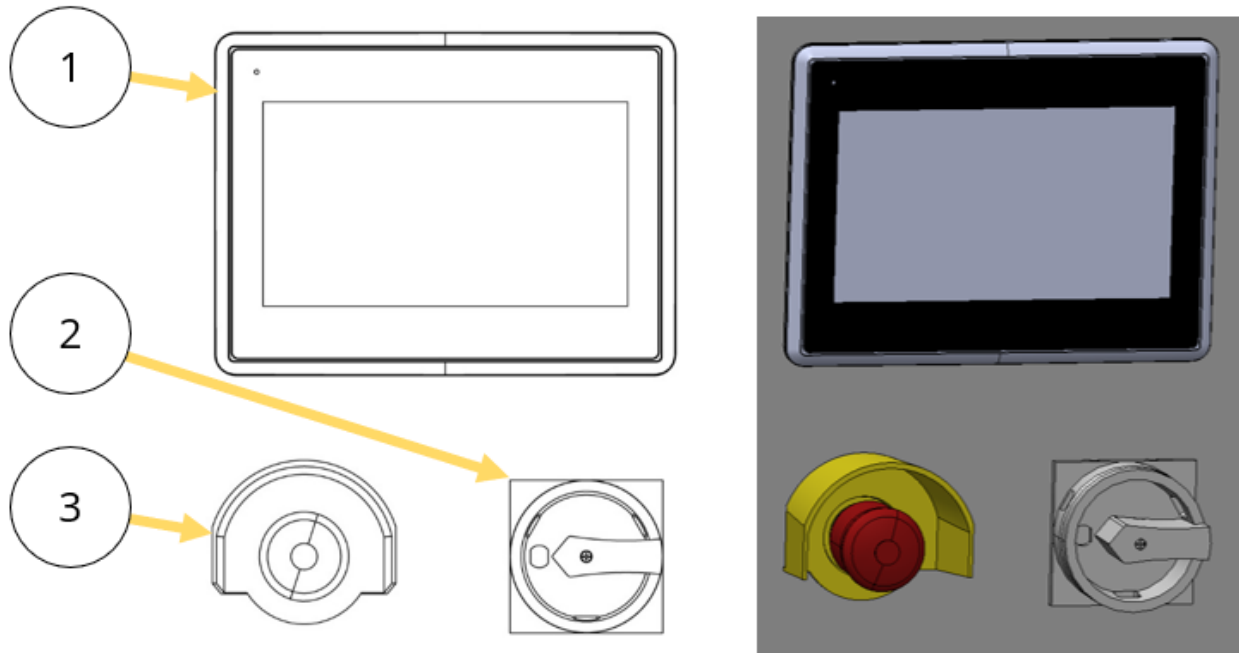


Figure 34: 2D and 3D view of the HMI, Emergency button and Maintenance switch

Item	Description
1	HMI panel
2	Maintenance switch
3	Emergency Button

Table 24: Component overview of HMI, Estop and Maintenance switch

8.4 Remote control places

The operator is able to interface with the product via Modbus TCP via a dedicated ethernet port on the product entry panel C1. The product has 4 RJ-45 ports available. The port on the bottom right is dedicated for remote Modbus TCP as marked in the figure.

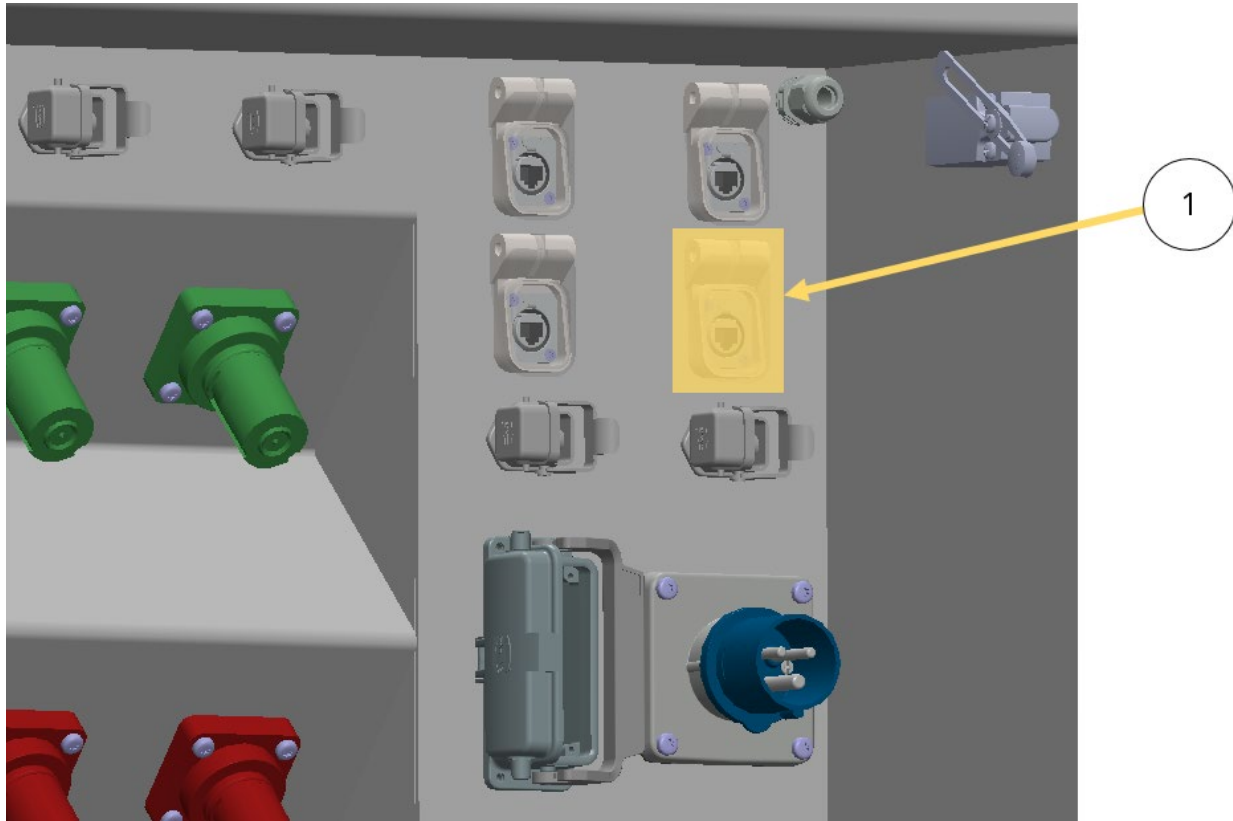


Figure 35: 3D view of Power Entry Panel - RJ-45 ethernet connection for Modbus TCP interface

Item	Description
1	RJ-45 ethernet connection for Modbus TCP interface

Table 25: Socket location for Modbus TCP interface

The operator should provide its own internet gateway and assign an IP address to the product. The product will then be accessible via that IP address and port 502. Further details are available in the Modbus TCP Manual.

The Modbus TCP Manual is available as a separate document. This document is an extension on this operating manual when Modbus TCP is a required control place for the use case. Operators using the Modbus TCP control place should also be aware of this operating manual as the Modbus TCP Manual does not explain the product operating principles. A list of the Modbus registers is provided in the appendix.

8.5 Operating modes

The product has 4 operating modes. Each operating mode has its own principles and limits. These operating modes require an AC/DC converter to be connected. The available operating modes are:

- Grid mode
- FCR mode (100 MHz)
- FCR mode (200 MHz)
- Island mode (optional based on the installed AC/DC converter and/or product)

Listed in below tables describes the different principles of the operating modes

Operating mode	Description
Grid mode	This mode requires a stable grid connection and is by default 'Grid following'. It will follow the grid that is provided and listen to external power setpoint commands. It will stop operating at grid failure.
FCR mode (100 MHz)	This mode operates based on Grid Mode and has a Frequency Containment Reserve droop pre-programmed of 100 MHz. It will provide full power with a grid frequency change of 100 MHz both directions. This mode listens to power setpoints to maintain State of Charge based on the operators' requirements.
FCR mode (200 MHz)	This mode operates based on Grid Mode and has a Frequency Containment Reserve droop pre-programmed of 200 MHz. It will provide full power with a grid frequency change of 200 MHz both directions. This mode listens to power setpoints to maintain State of Charge based on the operators' requirements.
Island mode	This mode is by default 'Grid forming' and will form a grid at start-up or synchronize to a grid that is provided. This mode is also used to black start an island grid. This mode is commonly used in a micro grid with other generators such as diesel generators, wind, solar and loads. The AC/DC inverter will maintain and stabilize the island grid during operation as highest priority. To ensure reliable performance it is recommended to operate the battery within 10-95% boundaries. It will operate autonomous and requires a controllable energy source to maintain battery State of Charge in reliable boundaries.

Table 26: Operating mode description

8.6 Start the product

The operator should be aware of the start-up procedure of the product. It is common to operate the product from a remote controller. Modbus register 150 represents the different stages the system proceeds through while starting up. The remote operator should make this information visible to monitor on. More details on this can be found in the appendix.

When the 'System ON' command is provided, the product will start its pre-charge sequence prior to starting the individual battery strings, the DC/DC converters and AC/DC converter. This process takes about 2 minutes. Below process diagram shows the procedure.

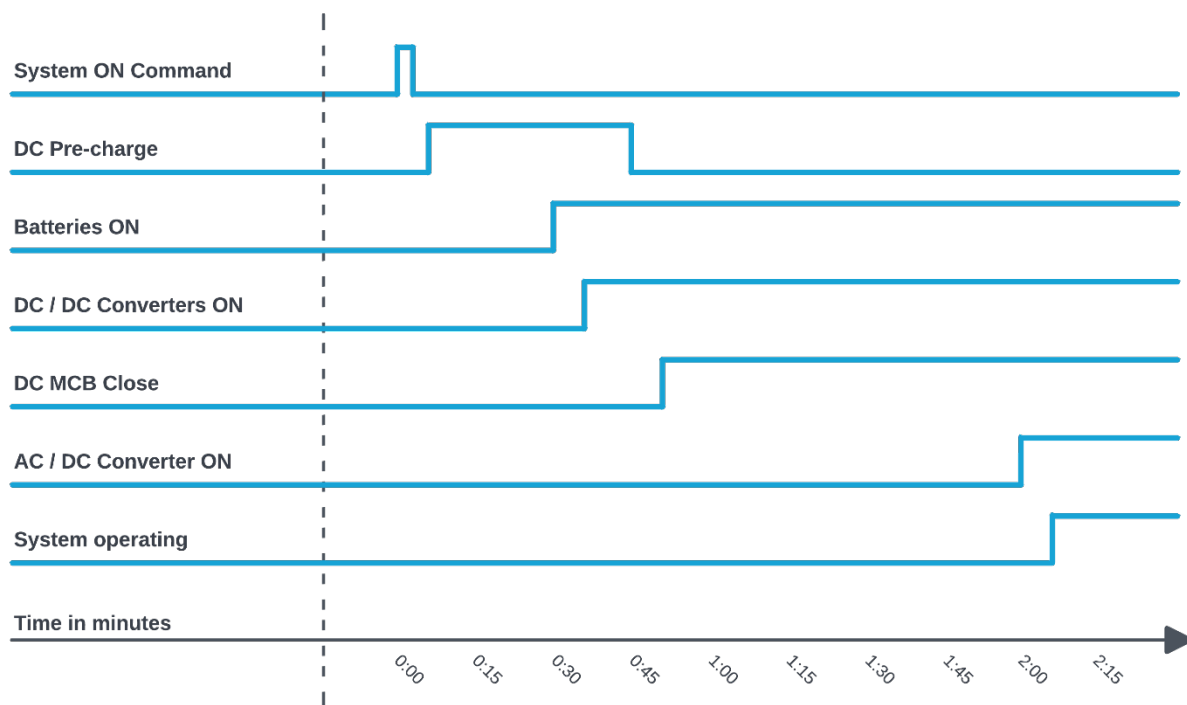


Figure 36: Process diagram of the 'System ON' Command - starting the product

Once the product reports 'Operating' energy can be transferred and thus power setpoints will be accepted. The product can deliver its full power over a limited range of State of Charge. The product ideally operates between 10 and 90% SOC. Power derating may start when operated outside of these boundaries, although related to temperature and individual battery string statuses. The available power of the product can be monitored and taken into control loop logic for external controllers via a dedicated Modbus register 'Available Charge Power' and 'Available Discharge Power'. If the internal power electronics or batteries are not able to perform at a requested point, the available charge or discharge power will represent this by a lower number than nominal specified.

When the limits are close to 0 kW, the product controller will not execute power setpoints into the requested direction, until the value is passed by 10% of its nominal power again. Please find the Modbus register in the appendix.

Power will be derated in the following situations.

- The SOC is >95%
- The SOC is <5%
- Battery temperature is >40 degrees Celsius
- Battery temperature is <10 degrees Celsius
- Power electronics temperature is >40 degrees Celsius
- In the case that multiple battery strings or power electronics stopped due to an error

8.7 Performance

The operator should be aware of the topology of the product. The 'double step conversion' results in a stable, redundant operation although it comes with generous losses if not managed well. The product controller has a few optimisation algorithms in place to manage the individual converters so that the efficiency is as high as possible. By understanding the reason of this topology, the operator can decide between a fast response time vs overall efficiency.

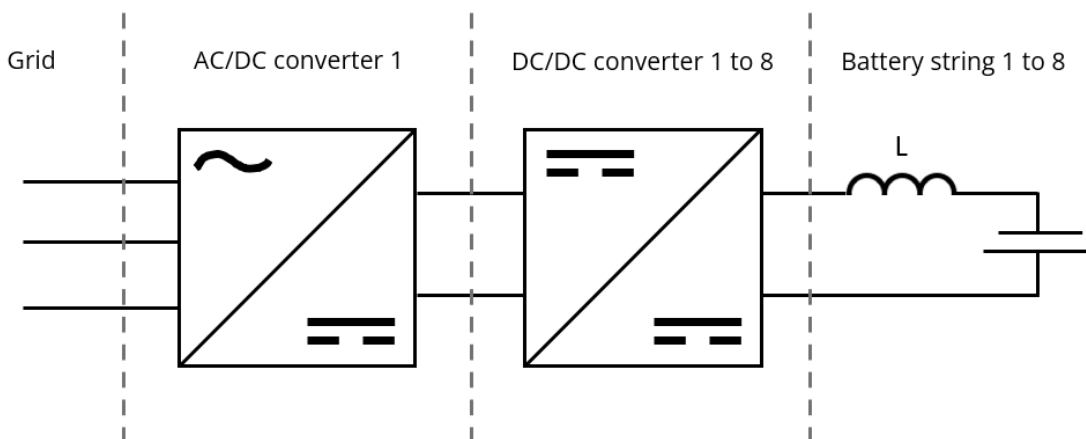


Table 27: Schematic diagram of double step conversion

If the product has basic optimisation logic running, the response time of the hardware are in the range of 200 ms between receiving an AC power setpoint and execution of the ramp-up.

If the product has advanced optimisation logic running, the response time of the hardware are in the range of 500 ms between receiving an AC power setpoint and execution of the ramp-up.

- Idle losses in basic optimisation are in the range of 3,5 kW
- Idle losses in advanced optimisation are in the range of 1 kW
- If basic optimisation is running the efficiency can be between 60% and 85% AC-DC-AC.
- If advanced optimisation is running the efficiency can be maintained between 80 and 85% AC-DC-AC.

The product has a power efficiency optimum that is use case specific as the AC/DC converter power rating may vary per site. The DC/DC converter as well as the linked battery string might also have its preferred operating areas. Therefore, it is recommended to consult the manufacturer to fine tune the product towards the use case to meet the highest possible efficiencies at the required performance levels.

The power curves show a 'one-way' efficiency, thus AC/DC → DC/DC → battery. This value needs to be multiplied by itself to generate the estimated round-trip efficiency 'AC-DC-AC'. Although this is theoretically and based on manufacturer and test environment data. During commissioning and Site Acceptance Testing these values are measured to get the site-specific results.

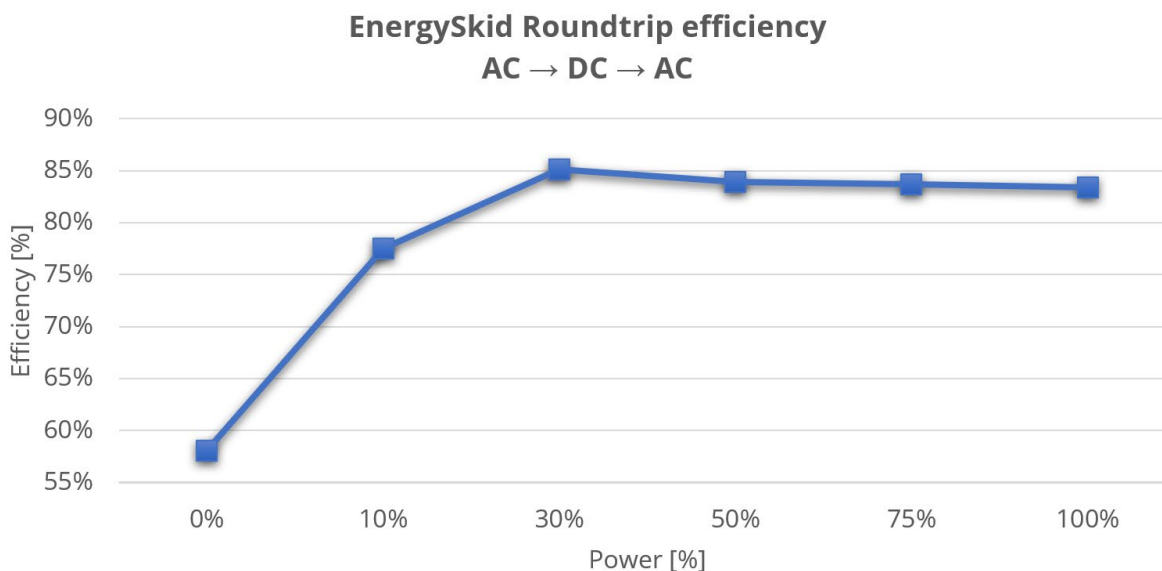


Figure 37: Roundtrip efficiency of the product at different power rates.

8.8 Intended use

The product is mainly designed to be a stable reliable Frequency Response or Island Mode battery. The product is less suitable for 1C charge and discharge over the full range of the State of Charge. As not all battery strings are of the same age, and in some cases not from the same make. The performance of all strings together varies over the length of the product State of Charge. It is key for the operator to understand this concept. Once understood, the operator will understand the benefits of having 'the option' to charge individual battery strings at different times, during operation. This 'strategy' is discussed in the next chapter.

All internal control logic has been designed to execute the above mentioned (preferred) uses cases at best. Since the product utilises second life batteries, the product controller has to cope with different performing battery strings, all acting together as one battery. In the abovementioned use cases, the product controller chooses priority on the battery string that are most suitable executing that specific action. This logic, as earlier referred to as the 'Advanced Optimisation' is switching between battery strings, utilising the best string for the job. At higher power demands, all battery strings are enabled. At lower power demands, only one or a few battery strings are enabled. This results potentially in slight differences in individual State of Charge, making a full charge or discharge (from 0-100%) not always possible at full power. This is caused by limitations of individual battery strings that differ slightly from each other.

As an example, during a Frequency Response operating mode, when the grid is demanding to charge energy into the battery, the 'Advanced optimisation' logic prioritises the battery strings that have a lower State of Charge compared to the other. And when the grid is demanding a discharge of energy out of the battery, the logic prioritises the battery strings that have a higher State of Charge compared to the other strings. This 'self-balancing' mechanism has been proven successful and energy efficient in practice over a number of years now.

8.9 Operating strategies

The manufacturer expect the operator to understand the difference in operating 'strategies'. Due to the nature of the product, utilizing second life batteries requires cooperation between the operator and manufacturer fine tuning the setup keeping the following in mind:

- Utilize individual strings (efficiency) or all at the same time (response time);
- Basic or Advanced optimisation algorithm;
- Response time or efficiency balance in general;
- Scope of controlling and State of Charge management.

8.10 During operation

The operator should be aware of the different parameters during operation. The operator may also rely on the product controller that makes sure the product will operate in safe operating conditions.

Although the product relies on an external controller as well to maintain the State of Charge within the expected boundaries. Also, the product may run into errors or is blocked from operation due to external factors. Therefore, its recommended that the operator at least is always aware of the following Modbus parameters:

Modbus register	Register Name
150	System State
200	System SOC
250	Active power setpoint
252	Reactive power setpoint
262	Available/Allowed charging power
264	Available/Allowed discharging power
30000 (range)	Main meter readings

Table 28: Minimum modbus registers for monitoring


A full list of Modbus registers is provided in the appendix.



During the product operation it is important to maintain close monitoring to ensure the product is performing according to the specifications. The operator should:

- Follow all the safety instructions and measures
- Be aware of warning/error messages
- Map the MB register properly to see its operating state and the different states
- Never operate the BESS outside its limits as indicated in the name plate and in the Datasheet.

- The operation of the product requires external logic on SOC management and power setpoints, the asset will follow. An unattended BESS which is idling for long time will go to IDLE mode or OFF if not controlled. A manual reset is then required.

Always operate the product with closed doors.

	<p>DANGER!</p> <p>Danger to life due to high voltage!</p> <p>In case of fault, high voltage may still be present on the product. Touching energized parts leads to death or severe injury.</p> <ul style="list-style-type: none">▪ Obey all safety instructions when working on the product.
---	--

 	<p>WARNING!</p> <p>Risk of injury due to improper condition of the product!</p> <p>Incorrect troubleshooting can lead to serious bodily injury or property damage.</p> <ul style="list-style-type: none">▪ Wear suitable personal protective equipment for all work on the product.▪ Have troubleshooting performed by persons who have the knowledge described in Section Target Audience.▪ If the displayed error cannot be eliminated locally, please contact customer service.
---	--

9 Troubleshooting

In case the system presents issues or there are problems with its operation, this will be reported on:

- Message log by means of an error or warning indicating the specific problem
- Via the HMI where it is indicated if batteries, inverters, or grid are in error or unavailable.
- Via Modbus TCP communication via the corresponding registers (See Modbus TCP manual).

9.1 Product controller message log

The product controller provides a detailed message log for monitoring and troubleshooting purposes. Via the message log, the operator can get information on:

- Status of the product and its components (both hardware and software)
- Ongoing sequences/actions on the product and its components.
- Errors and warnings.

For traceability and troubleshooting purposes, each message log is accompanied by a timestamp and a unique message ID, this way a complete history of what has happened in the system can be obtained. In the example below, a message is shown indicating that the control mode has been changed to HMI control.

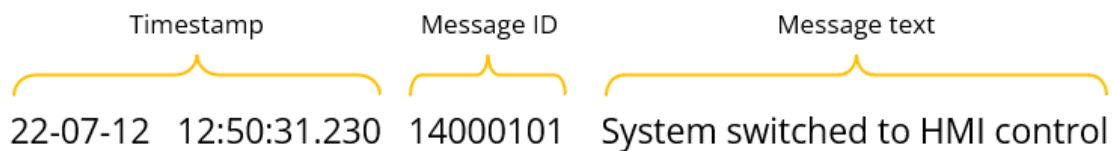



Figure 38: Message log example.

9.2 Common issues and recommended actions

	<p>NOTICE</p> <p>Contact the manufacturer if a problem occurs that is not mentioned here or the operator cannot solve.</p>
---	---


Below a list of the most common issues and its potential corrective actions. For more complex problems, or if the issues persist after performing the corrective actions, please follow the service agreement to report the issue to the manufacturer.


Common issues and potential corrective actions:

- 1) Grid trip
 - a. If the system was turned off unexpectedly, make sure the trip has been stable
 - b. Contact the manufacturer to check system status.
- 2) Battery strings are in error state
 - a. Make sure SOC of the system is within the boundaries (See chapter on Operation).
 - b. If the SOC has gone below limits, a manual reset might be required. Contact the manufacturer.
- 3) Emergency mode is enabled
 - a. See chapter “Resolve and Emergency Stop”

9.3 Resolve an emergency stop

If the system goes into emergency mode, the system will immediately stop and the system will be turned OFF. When the system is in emergency mode, it will not be operatable until the emergency stop has been resolved and reset.

	<p>WARNING!</p> <ul style="list-style-type: none"> • Only an authorized person resets an emergency stop. • Do not resolve an emergency stop until the emergency has been resolved and it is safe to operate the product again.
---	---

	<p>NOTICE</p> <p>Refer to the chapter on Safety for more information on safety measures in case of an emergency.</p>
---	---




An emergency stop can be triggered by the following actions:



- Manual press of the Emergency Button in Service Room C0.
- Manual press of the Emergency Button externally connected by the customer via interface panel C1.
- Via the AFSS due to a smoke or high temperature detection.

After authorization has been received to clear the emergency stop from the site manager and the product owner:

1. If the emergency button in the Service Room C0 was pressed, the button needs to be pulled out.
2. If the external emergency button was pressed, clear this button by following the local guidelines.
3. The emergency stop needs to be reset on the product controller. This can be done via:
 - a. HMI
 - b. Modbus TCP (register 11, refer to the additional Modbus TCP manual for more information)
 - c. Remote via VNC (manufacturer only).
4. Note that if the emergency stop was activated due to the AFSS activation, the manufacturer needs to confirm and authorize the emergency stop resolved after performing a general check of the product.

10 Service and Maintenance

  	<p>DANGER!</p> <p>Danger to life due to electric shock!</p> <p>Missing protective cover in the power unit and DC distribution can cause damage to property or personnel.</p> <ul style="list-style-type: none"> ▪ Do not touch live parts. ▪ Make sure that all protective covers are mounted after you finish the maintenance work. ▪ Before you work on the product, check if it is disconnected externally and safeguarded against reconnection.
---	--

 	<p>NOTICE</p> <p>Damage to the product due to incorrect service and maintenance!</p> <p>Incorrect commissioning can damage the product.</p>
--	--

Any service or maintenance job should be carried out by the manufacturer or an authorized party by the manufacturer.

A general inspection is recommended to be done on a yearly basis. This inspection should cover the basic preventive actions and could help prevent serious damage or malfunction of the product. For an in-depth service and maintenance works, the service agreement should be consulted.

10.1 Preparation for service and maintenance

The maintenance switch is intended to ensure safety during any maintenance procedure and should always be used when performing yearly inspections, maintenance, or repair work on the product. If you activate this switch (toggle to MAINTENANCE), the operator makes sure that the product cannot be operated in any way, local or remote. Once the maintenance switch is toggled to OPERATING again, Local or Remote-control commands are accepted again.

Before beginning any maintenance procedures, the operator must make sure that the product is turned OFF, as the maintenance button is NOT an emergency nor STOP button.

Dependent on the use case and hardware setup, either the STOP command to turn OFF the product can be triggered via the HMI or via Remote.

If the system requires maintenance, use the maintenance switch. This is located next to the emergency stop (see figure 29 for reference). The OFF position puts the system into maintenance mode, which means that the system cannot be operated. The ON position switches the system to operating and the control mode in Remote.

10.2 Annual check

The regular annual check intends to cover:

- General cleanliness of the product
- State of the product and its components
- Visible damage on the product
- Safety items are in place and working properly.

An annual checklist can be found on the appendix. This checklist can be followed and checked during the annual check. The results should be sent to the manufacturer together with photos in case necessary to the email address as mentioned on Customer Service chapter.

10.3 Spare parts

To prevent long downtimes, partial or total system shutdown and long services times, it is highly recommended to have a few spare parts onsite. Below you can find a list of such spare parts. Contact the manufacturer for supply of these spare parts.

Quantity	Name of part	Location	Check
2	Fuse NH2 gL/gG 400A	C5 & C6	<input type="checkbox"/>
2	Fuse 10x38 gPV 10A	C3	<input type="checkbox"/>
1	Fuse <u>DIII</u> gL/gG 25A	C3	<input type="checkbox"/>
1	String controller	C7 & C8	<input type="checkbox"/>
10	Fuse 5 x 20 6.3 A T (50F1-6, 51F1,3,4,6, 52F1,3,4,6)	C4	<input type="checkbox"/>

Table 29: Recommended spare parts.

10.4 Torque list




Below a list is provided of the torque points allocated in service room (C0) for the reference of the operator.

Part	Location	Torque
+C1-10X2/-10X2.1/-10X3	C1 – C2	12Nm
+C1-11X2/-11X2.1/-11X3	C1 – C2	12Nm
+C1-12X2/-12X2.1/-12X3	C1 – C2	12Nm
+C1-13X2/-13X2.1/-13X3	C1 – C2	12Nm
+C2-1Q1	C2	70Nm
+C5-20U1/20U5/21U1/21U5	C2	25Nm
+C6-22U1/22U5/23U1/23U5	C2	25Nm
+C5-20L1/20L5/21UL/21UL	C5,C6	15Nm
+C6-22L1/22L5/23L1/23L5	C5,C6	15Nm
+C5-20F1/20F5/21F1/21F5	C5,C6	8Nm
+C5-20F1/20F5/21F1/21F5	C5,C6	20Nm
+C6-22F1/22F5/23F1/23F5	C5,C6	8Nm
+C6-22F1/22F5/23F1/23F5	C5,C6	20Nm
+C3-2X1	C5,C6	2Nm
+C3-2X1	C5,C6	2,5Nm
+C3-2X5	C5,C6	20Nm
+C3-2X6	C5,C6	20Nm
+C4-2X1	C5,C6	20Nm
Earth point outside	Earthing rods	12Nm

Table 30: Torque list

11 Decommissioning

Have certified approved operators perform the decommissioning. Before decommissioning takes place, the system must be disconnected externally. For removing the product from the site, follow the instructions and measure on the chapter on “Transport and Lifting”.

  	<p>DANGER!</p> <p>Danger to life due to electric shock!</p> <p>Before working on the product, make sure that the entire system is fully disconnected from any grid or voltage, and that no power is running.</p> <ul style="list-style-type: none">▪ Do not touch live parts.▪ Before working on the product, check if it is disconnected externally and safeguarded against reconnection.▪ Wear suitable personal protective equipment for all work on the product.▪ Missing protective cover in the power unit and DC distribution can cause injury to personnel.
---	--

12 EC Declaration of conformity

EC DECLARATION OF CONFORMITY

Company **Time Shift B.V** with location at **Hydrograaf 27A, 6921RS, Duiven, The Netherlands** declare in their sole responsibility that the product EnergySkid, a containerized battery energy storage system in all its versions, to which this declaration of conformity applies, conforms to these standards and stated technical documentation:

- Product documentation of Time Shift B.V.
- IEC 60204-1
- IEC 61439

Product Serial Number: EMSXXX –[STATED ON NAME PLATE]

Date of issue: DD-MM-YYY –[STATED ON NAME PLATE]

Time Shift B.V
Casper Scheltinga
Founder and Director

13 Customer Service

If you have any questions about the product, please contact our customer service.

Company address : Time Shift BV
Hydrograaf 27 A
6921 RS Duiven
The Netherlands

Telephone : +31 85 065 37 82

E-mail : service@timeshift.nl

Internet : www.timeshift.nl

Customer service : Monday to Friday from 8:30 AM to 5:00 PM (CET).

Availability

14 Appendixes

List of Appendixes

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Appendix 14.1 Site Acceptance Test



EnergySkid - Site Acceptance Test

Product Commissioned	
Customer	
Date of SAT:	
Place of SAT:	
Time Shift engineers present during SAT:	
Customer employees present during SAT:	

Test	Pass criteria	Remarks	Result (OK/NOK)
General			
Visual Inspection <ul style="list-style-type: none"> • Container • Doors • Battery rooms 	<ul style="list-style-type: none"> • General control on quality, paint, rust, doors closing/opening correctly. 		
Documentation	<ul style="list-style-type: none"> • SLD, AFSS commissioning, SAT and manual documents are provided, key acceptance form. 		
Safety			
Automatic Fire Suppression System	<ul style="list-style-type: none"> • Refer to the AFSS commissioning document. 		

Emergency button <ul style="list-style-type: none"> Internal External 	<ul style="list-style-type: none"> When system is ON and the emergency button is pushed, the system is immediately turned OFF (DC and AC side). Emergency reset puts BESS in normal operation again. 		
BESS operation			
Start BESS	<ul style="list-style-type: none"> BESS is in grid mode. AC and DC sides are both operating. 		
Stop BESS	<ul style="list-style-type: none"> BESS is stopped properly Both DC and AC side are turned off. 		
Ramp up from 0 kW to 1000 kW	<ul style="list-style-type: none"> Increase setpoints by 100kW until 1000kW is achieved. Decrease setpoints by 100kW until 0kW is achieved. Meter readings on AC side. 		
Ramp down from 0 to -1000 kW	<ul style="list-style-type: none"> Increase setpoints by 100kW until -1000kW is achieved. Decrease setpoints by 100kW until 0kW is achieved. Meter readings on AC side. 		
Capacity Test			
Note: This test is done before the official SAT and during the SAT the results are shared to customer. Below the steps to be followed.			
Charge BESS via scheduler to SOC of 100% with 200kW.	<ul style="list-style-type: none"> Final SOC of 100% with defined charging power. 		

Discharge BESS via scheduler to SOC of 0% with 200 kW.	<ul style="list-style-type: none"> Final SOC of 0% with defined discharge power. 		
Charge BESS via scheduler to SOC of 30% with 200kW	<ul style="list-style-type: none"> Final SOC of 30% with defined charging power. 		
Roundtrip efficiency	<ul style="list-style-type: none"> Report roundtrip efficiency. 		
BESS capacity	<ul style="list-style-type: none"> Report BESS capacity 		

Final SAT Pass or Fail:**General Remarks:****Latest date for adjustments and corrections:**

Note 1: After this SAT is accepted by both parties, a set of keys will be delivered to the customer. The Key acceptance form must be signed by both parties.

Note 2: A separate commissioning document for the AFSS should be followed and signed by both parties.

SAT approval		
Company		
Name		
Date		
Signature		

Appendix 14.2 AFSS Commissioning



EnergySkid AFSS Commissioning

Automatic Fire Suppression System

Product Commissioned	
Customer	
Date of Commissioning:	
Place of Commissioning:	
Commissioned by:	
Accepted by:	

Room & Test	Pass criteria	Result (OK/NOK)
Service Room (C0) <ul style="list-style-type: none"> Smoke Detector 	Slow whoop comes on	
	1 st SMS is received	
	BESS Estop is triggered	
	Signal external party	
Battery room (C7) <ul style="list-style-type: none"> Smoke Detector High temperature 	Slow whoop comes on	
	1 st SMS is received	
	BESS Estop is triggered	
	Fire alarm comes on	
	2 nd SMS is received	
	After 10s, LED ON - representing extinguisher	

Battery room (C8) <ul style="list-style-type: none"> • Smoke Detector • High temperature 	Slow whoop comes on	
	1 st SMS is received	
	BESS Estop is triggered	
	Fire alarm comes on	
	2 nd SMS is received	
	After 10s, LED ON - representing extinguisher	

Remarks

Contacts to receive SMS during emergency:	
Name	Phone number

AFFS Commissioning acceptance approval	
Company	
Name	

Date	
Signature	

Appendix 14.3 Keys acceptance form



Keys acceptance form

By signing this form, the customer accepts the proper delivery of the keys for the DC20ft STAT system. By signing this form, the customer agrees to adhere to the guidelines listed below.

The table below shows the key number and the corresponding door which it opens. You can find the labels in the doors matching the labels in the keys.

Label	Corresponding door
C0	Service room door
C1	Power entry panel door <i>Note: This key is delivered with the transportation of the DC20ft. It is required to connect the auxiliary power.</i>
C2	Main DC circuit breaker cabinet door
C7	Battery room #1 door
C8	Battery room #2 door

Guidelines for keys use:

- Access to C0, C2, C7, and C8 is strictly forbidden unless access has been granted by the owner of the system.
- Access to these areas represents danger to life due to electric shock and high voltage
- Access to these areas can cause damage to the product due to mishandling.

Date: _____

Received by: _____

Signature: _____

Provided by: _____

Signature: _____

Appendix 14.4 Dangerous goods form

MULTIMODAL DANGEROUS GOODS FORM

This form may be used as a dangerous goods declaration as it meets the requirements of SOLAS, chapter VII, regulation 4; MARPOL, Annex III, Regulation 4.

1 Shipper/Consignor/Sender	2 Transport document number										
	3 Page No	of	4 Shipper's reference								
			5 Freight Forwarder's Reference								
6 Consignee	7 Carrier (to be completed by the carrier)										
		SHIPPER'S DECLARATION I hereby declare that the contents of this consignment are fully and accurately described below by the Proper Shipping Name, and are classified, packaged, marked and labelled/placarded and are in all respects in proper condition for transport according to the applicable international and national governmental regulations.									
8 This shipment is within the limitations prescribed for:- (Delete non Applicable) <table border="1" style="width: 100%;"> <tr> <td style="width: 50%; text-align: center;">Passenger and Cargo Aircraft</td> <td style="width: 50%; text-align: center;">Cargo Aircraft Only</td> </tr> </table>		Passenger and Cargo Aircraft	Cargo Aircraft Only	9 Additional handling information 24-hour emergency contact number +31 6 41226851							
Passenger and Cargo Aircraft	Cargo Aircraft Only										
10 Vessel	11 Port/Place of loading Duiven, NL										
12 Port/Place of discharge	13 Destination										
<table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 25%;">14 Shipping Marks</th> <th style="width: 45%;">*Number and kind of packages: description of goods</th> <th style="width: 15%;">Gross mass (kg)</th> <th style="width: 15%;">Net</th> </tr> </thead> <tbody> <tr> <td>mass (kg)</td> <td>Cube (m³)</td> <td></td> <td></td> </tr> </tbody> </table>				14 Shipping Marks	*Number and kind of packages: description of goods	Gross mass (kg)	Net	mass (kg)	Cube (m ³)		
14 Shipping Marks	*Number and kind of packages: description of goods	Gross mass (kg)	Net								
mass (kg)	Cube (m ³)										

15 Container identification number / vehicle registration no.	16. Seal number(s)	17 Container / Vehicle size & type	18 Tare mass (kg)	19 Total gross mass (including tare) (kg)
CONTAINER/VEHICLE PACKING CERTIFICATE I hereby declare that the goods described above have been packed/loaded into the container/vehicle identified above in accordance with the applicable provisions ** MUST BE COMPLETED AND SIGNED FOR ALL CONTAINER / VEHICLE LOADS BY PERSON RESPONSIBLE FOR PACKING / LOADING		21 RECEIVING ORGANISATION RECEIPT Received the above number of packages/containers/trailers in apparent good order and condition, unless stated hereon: RECEIVING ORGANISATION REMARKS:		
20 Name of Company	Haulier's Name	22 Name of company (OF SHIPPER PREPARING THIS NOTE)		
Name/status of declarant	Vehicle Registration No.	Name/status of declarant		
Place and Date	Signature and date	Place and date		
Signature of declarant	DRIVER'S SIGNATURE	Signature of Declarant		

*** DANGEROUS GOODS**

You must specify: UN No., Proper Shipping name, hazard class, packing group, (where assigned), marine pollutant and observe the mandatory requirements under applicable national and international governmental regulations. For the purposes of the IMDG Code see 5.4.1.4

** For the purposes of the IMDG Code see 5.4.2.

This form is reproduced from IMDG code (amendment 37-14), Chapter 5.4 – Documentation, Page 275

Appendix 14.5 ADR Label



Appendix 14.6 Modbus register list

This list is part of the Modbus TCP manual and is present for user reference. Before using these registers, please refer to the separate Modbus TCP manual.

Power setpoints are sent to the product via a remote TCP connection (See chapter on remote control places).

For sending power setpoints to the product, it is important to understand the sign convention for charging and discharging the product as well as for how this will be reflected on the energy meter readings, below an example to clarify:

- For writing and reading active and reactive power setpoints via Modbus:
 - Active power
 - To charge with 100 kW, the setpoint is = -100 kW
 - To discharge 100 kW, the setpoint= 100 kW
 - Reactive power
 - To absorb 100 kVAr, the reactive power setpoint is = -100 kVAr
 - To inject 100 kVAr, the reactive power setpoint is = 100 kVAr
- The energy meter will read and report:
 - Active power
 - Charging with 100 kW, the reading will be = 100 kW
 - Discharging 100 kW, the reading will be = -100 kW
 - Reactive power
 - Absorbing 100 kVAr, the reading will be = 100 kVAr
 - Injecting 100 kVAr, the reading will be = -100 kVAr

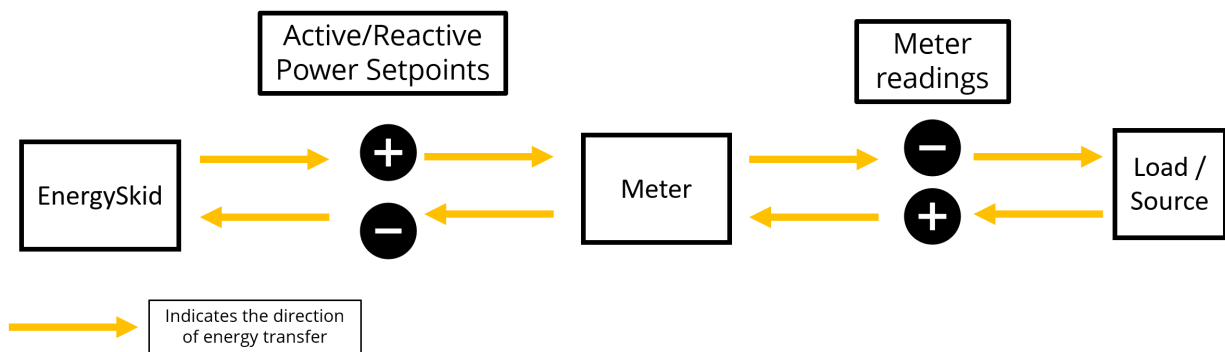


Figure 39: Flow of power and the corresponding sign convention on setpoints and energy meters.

The first section of the list below contains the writable registers for controlling the BESS. They may also be referred to as holding registers. It is also possible to read from these registers, but some are reset to zero after writing a value as explained in the remarks. The remaining input registers are read-only.

The list is divided into sections relating to the purpose of the registers. These sections consist of:

- **Control Parameters.** These registers are for controlling the BESS.
- **System Status Parameters.** These registers describe the system in general and provide basic component alarms.
- **Performance Status.** These registers describe the current performance and settings of the system.
- **IO Statuses.** These registers provide the readings from the digital input/outputs such as doors and movements sensors.
- **Temperatures.** These registers provide the readings from the temperature sensors located throughout the system.
- **AFFS.** These registers provide the status of the fire extinguishing system.
- **HVAC.** These registers provide the HVAC settings and controls.
- **Batteries / BMS.** These registers provide the readings from the BMS and battery strings.
- **Main Meter.** These registers provide the readings from the main energy meter.
- **Meters 1-10.** These registers provide the readings from the any additional sub-meters.

Control Parameters

Control Parameters (39-99)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
40	2	16-bit integer	Operation Mode	Writing one of the values shown below will set the BESS in the specified operating mode. 0 = off, 1 = FCR 200 mHz, 2 = Grid mode, 3 = Island mode	3, 6, 16
41	2	16-bit unsigned integer	System ON	Start the system (=connect the batteries and start the inverters) by writing a "1" to this address. Will read as 0.	3, 6, 16
42	2	16-bit unsigned integer	System OFF	Stop the system (=stop the inverters and disconnect the batteries) by writing a "1" to this address. Will read as 0.	3, 6, 16
47	2	16-bit unsigned integer	System Standby	Inverter is DC connected. System can be started without precharge delay. Activated by writing a "1" to this address. Will read as 0.	3, 6, 16
50	2	16-bit unsigned integer	Enable peak shave	Start peak shaving on the main grid connection. Is activated by writing a "1" to this address and deactivated by writing a "0".	3, 6, 16
51	4	32-bit floating point	Peak shave import	Define the peak shave value in Amps, when importing power from the grid.	3, 6, 16
53	4	32-bit floating point	Peak shave export	Define the peak shave value in Amps, when exporting power to the grid.	3, 6, 16
55	4	32-bit floating point	Constant power setpoint [kW]	Power setpoint in [kW] >0 is exporting to the grid <0 is importing from the grid If a higher setpoint is sent than the available discharge power, this will be clipped to max available discharge power. The same for charging.	3,6,16

57	4	32-bit floating point	Reactive Power Setpoint (kVAr)	Reactive power setpoint in KVAR (only accepted in Grid mode) >0 is exporting to the grid <0 is importing from the grid If a higher setpoint is sent than the available discharge power, this will be clipped to max available discharge power. The same for charging.	3,6,16
91	2		User Output 1	User-defined output 1. Is activated by writing a "1" to this address and deactivated by writing a "0". Other values have no effect.	3, 6, 16
92	2		User Output 2	User-defined output 2. Is activated by writing a "1" to this address and deactivated by writing a "0". Other values have no effect.	3, 6, 16
93	2		User Output 3	User-defined output 3. Is activated by writing a "1" to this address and deactivated by writing a "0". Other values have no effect.	3, 6, 16
94	2		User Output 4	User-defined output 4. Is activated by writing a "1" to this address and deactivated by writing a "0". Other values have no effect.	3, 6, 16
95	2		User Output 5	User-defined output 5. Is activated by writing a "1" to this address and deactivated by writing a "0". Other values have no effect.	3, 6, 16
96	2		User Output 6	User-defined output 6. Is activated by writing a "1" to this address and deactivated by writing a "0". Other values have no effect.	3, 6, 16
97	2		User Output 7	User-defined output 7. Is activated by writing a "1" to this address and deactivated by writing a "0". Other values have no effect.	3, 6, 16
98	2		User Output 8	User-defined output 8. Is activated by writing a "1" to this address and deactivated by writing a "0". Other values have no effect.	3, 6, 16
99	2		User Output 9	User-defined output 9. Is activated by writing a "1" to this address and	3, 6, 16

				deactivated by writing a "0". Other values have no effect.	
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System status parameters

System status parameters (100-199)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
100	10	string	System name	ASCII string of max. 10 characters containing parameter System_name as declared in ems.ini. If the text contains less than 10 characters, the remaining bytes are filled with zeroes.	4
105	10	string	EMS build version	ASCII string of max. 10 characters. If the text contains less than 10 characters, the remaining bytes are filled with zeroes.	4
110	10	string	Control script version	ASCII string of max. 10 characters. If the text contains less than 10 characters, the remaining bytes are filled with zeroes.	4
115	30	string	EMS serial number	ASCII string of max. 30 characters. If the text contains less than 10 characters, the remaining bytes are filled with zeroes.	4
130	4	32-bit floating point	Enom	Parameter Enom in kWh as declared in ems.ini	4
132	4	32-bit floating point	Pnom	Parameter Pnom in kW as declared in ems.ini	4
134	2	16-bit integer	AC/DC inverters	# of declared AC/DC inverters	4
136	2	16-bit integer	DC/DC inverters	# of declared DC/DC inverters	4
138	2	16-bit integer	Battery strings/BMS's	# of declared battery strings/BMS's	4
150	2	16-bit integer	System State	0 = Off 10 = Start Pre-charge DC-Link 12 = Pre-charge fault 19 = DC-Link successfully pre-charged 20 = Start battery 30 = Start DC/DC converter	4

				<p>39 = Internal DC-Link ready</p> <p>40 = Start External DC-link</p> <p>41 = Matching DC-link with expected devices</p> <p>49 = External DC-Link ready</p> <p>50 = Start AC/DC inverter</p> <p>55 = Request inverter on</p> <p>56 = Pre-charge</p> <p>57 = DC-connected</p> <p>58 = AC-connected</p> <p>59 = Run</p> <p>100 = Operating</p>	
151	2	16-bit integer	Operation Mode	<p>Same as register 40, but for reading only.</p> <p>0 = off,</p> <p>1 = FCR 200 mHz,</p> <p>2 = Grid mode,</p> <p>3 = Island mode</p>	4
152	2	16-bit integer	System Warning	Any system level warning. 0 = No warning. 1 = Warning.	4
153	2	16-bit integer	AC/DC Inverter Warning	Warning in any AC/DC inverter. 0 = No warning. 1 = Warning.	4
154	2	16-bit integer	DC/DC Inverter Warning	Warning in any DC/DC inverter. 0 = No warning. 1 = Warning.	4
155	2	16-bit integer	BMS Warning	Warning in any BMS. 0 = No warning. 1 = Warning.	4
156	2	16-bit integer	System Error	Any system level error. 0 = No error. 1 = Error.	4
157	2	16-bit integer	AC/DC Inverter Error	Error in any AC/DC inverter. 0 = No error. 1 = Error.	4
158	2	16-bit integer	DC/DC Inverter Error	Error in any DC/DC inverter. 0 = No error. 1 = Error.	4
159	2	16-bit integer	BMS Error	Error in any BMS. 0 = No error. 1 = Error.	4

Performance status

Performance status (200-299)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
200	2	16-bit unsigned integer	System SOC	State of Charge of the whole system expressed as a percentage of the actual capacity. Scaled value: 10000 corresponds to 100%.	4
202	2	16-bit unsigned integer	Enable peak shave	0 = peak shaving not enabled; 1 = peak shaving enabled.	4
203	4	32-bit floating point	Peak shave import	Peak shave value in Amps, when importing power from the grid.	4
205	4	32-bit floating point	Peak shave export	Peak shave value in Amps, when exporting power to the grid.	4
250	4	32-bit floating point	Active power setpoint	Active power as measured by the main meter in kW >0 is importing from the grid <0 is exporting to the grid	4
252	4	32-bit floating point	Reactive power setpoint	Reactive power as measured by the main meter in kVAr. >0 is importing from the grid <0 is exporting to the grid	4
262	4	32-bit floating point	Available/Allowed charging power	Available charging power in [kW] based on BMS converted from the allowed charging current.	4
264	4	32-bit floating point	Available/Allowed discharging power	Available discharging power in [kW] based on BMS converted from the allowed discharging current.	4

IO statuses

IO statuses (300-599)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
302	2	16-bit unsigned integer	C0 DC/DC room Door status	A value of 0 = passive, 1 = active	4
303	2	16-bit unsigned integer	C0 DC/DC room PIR status	A value of 0 = passive, 1 = active	4
304	2	16-bit unsigned integer	C7 Battery room 1 Door status	A value of 0 = passive, 1 = active	4
305	2	16-bit unsigned integer	C8 Battery room 2 Door status	A value of 0 = passive, 1 = active	4
308	2	16-bit unsigned integer	C3 Cabinet Door status	A value of 0 = passive, 1 = active	4
309	2	16-bit unsigned integer	C4 Control cabinet Door status	A value of 0 = passive, 1 = active	4
310	2	16-bit unsigned integer	Emergency button status	A value of 0 = passive, 1 = active	4
311	2	16-bit unsigned integer	C5 DC/DC cabinet door	A value of 0 = passive, 1 = active	4
312	2	16-bit unsigned integer	C6 DC/DC cabinet door	A value of 0 = passive, 1 = active	4
381	2	16-bit unsigned integer	User Output status 1	A value of 0 = passive, 1 = active	4
382	2	16-bit unsigned integer	User Output status 2	A value of 0 = passive, 1 = active	4
383	2	16-bit unsigned integer	User Output status 3	A value of 0 = passive, 1 = active	4

384	2	16-bit unsigned integer	User Output status 4	A value of 0 = passive, 1 = active	4
385	2	16-bit unsigned integer	User Output status 5	A value of 0 = passive, 1 = active	4
386	2	16-bit unsigned integer	User Output status 6	A value of 0 = passive, 1 = active	4
387	2	16-bit unsigned integer	User Output status 7	A value of 0 = passive, 1 = active	4
388	2	16-bit unsigned integer	User Output status 8	A value of 0 = passive, 1 = active	4
391	2	16-bit unsigned integer	User Input status 1	A value of 0 = passive, 1 = active	4
392	2	16-bit unsigned integer	User Input status 2	A value of 0 = passive, 1 = active	4
393	2	16-bit unsigned integer	User Input status 3	A value of 0 = passive, 1 = active	4
394	2	16-bit unsigned integer	User Input status 4	A value of 0 = passive, 1 = active	4
395	2	16-bit unsigned integer	User Input status 5	A value of 0 = passive, 1 = active	4
396	2	16-bit unsigned integer	User Input status 6	A value of 0 = passive, 1 = active	4
397	2	16-bit unsigned integer	User Input status 7	A value of 0 = passive, 1 = active	4
398	2	16-bit unsigned integer	User Input status 8	A value of 0 = passive, 1 = active	4

Temperatures

Temperatures (700-799)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
704	4	32-bit floating point	C5 DC/DC cabinet 1 Left Top	Measured values in °C	4
706	4	32-bit floating point	C5 DC/DC cabinet 1 Left Bottom	Measured values in °C	4
712	4	32-bit floating point	C6 DC/DC cabinet 2 Left Top	Measured values in °C	4
714	4	32-bit floating point	C6 DC/DC cabinet 2 Left Bottom	Measured values in °C	4
724	4	32-bit floating point	C7 HVAC input	Measured values in °C	4
726	4	32-bit floating point	C7 HVAC output	Measured values in °C	4
716	4	32-bit floating point	C8 – HVAC output	Measured values in °C	4
718	4	32-bit floating point	C8 – HVAC output	Measured values in °C	4

AFSS

AFSS (800-999)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
800	2	16-bit unsigned integer	AFES Status	A value of 0 = passive, 1 = active	4
801	2	16-bit unsigned integer	AFES 1st notification status	A value of 0 = passive, 1 = active	4
802	2	16-bit unsigned integer	AFES 2nd notification status	A value of 0 = passive, 1 = active	4
803	2	16-bit unsigned integer	AFES Smoke C7 Battery room 1	A value of 0 = passive, 1 = active	4
804	2	16-bit unsigned integer	AFES Smoke C8 Battery room 2	A value of 0 = passive, 1 = active	4
806	2	16-bit unsigned integer	AFES Smoke C0 DC/DC Room	A value of 0 = passive, 1 = active	4

HVAC

HVAC (1000-1199)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
1000	2	16-bit unsigned integer	HVAC C7 Battery room 1 Status	0 = Off 1 =	4
1010	2	16-bit unsigned integer	HVAC C8 Battery room 2 Status	0 = Off 1 =	4

Batteries / BMS

Batteries / BMS (20000-29999)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
20400	20 x 2	16-bit unsigned integer	BMS ID / position number	As a number	4
20420	20 x 4	32-bit floating point	Maximum cell charge current	Maximum cell charge current	4
20460	20 x 4	32-bit floating point	Maximum cell discharge current	Maximum cell discharge current	4
20500	20 x 4	32-bit floating point	BMS Ah_nom	Nominal capacity of the string in Ah managed by a BMS in the order of declaration.	4
20540	20 x 10	16-bit unsigned integer	SOC String 1 to 16	Scaled value: 10000 corresponds to 100% of the actual capacity of the string.	4
20560	20 x 4	32-bit floating point	String voltage	Measured in V	4
20600	20 x 4	32-bit floating point	String current	Measured in A	4
20640	20 x 4	32-bit floating point	String average cell voltage	Measured in V	4
20680	20 x 4	32-bit floating point	String min cell voltage	Measured in V	4
20720	20 x 4	32-bit floating point	String max cell voltage	Measured in V	4
20760	20 x 4	32-bit floating point	String cell voltage deviation	Measured in V	4

20800	20 x 4	32-bit floating point	String average temperature	Measured in °C	4
20840	20 x 4	32-bit floating point	String min temperature	Measured in °C	4
20880	20 x 4	32-bit floating point	String max temperature	Measured in °C	4
20920	20 x 4	32-bit floating point	Allowed charge current	Measured in A	4
20960	20 x 4	32-bit floating point	Allowed discharge current	Measured in A	4

Main meter

Main meter (30000-30099)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
30000	40	string	kWh meter name	Block having a fixed length of 20 words (40 bytes) containing the text declared as the name of the main kWh meter. If the name contains less than 40 characters, the remaining bytes are filled with zeroes. If the name contains more than 40 characters, the remaining characters are ignored.	4
30020	20	string	kWh meter type	Block having a fixed length of 10 words (20 bytes) containing the text declared as the type of the main kWh meter. If the type contains less than 20 characters, the remaining bytes are filled with zeroes. If the type contains more than 20 characters, the remaining characters are ignored.	4
30030	10	string	reserved	"bus" is not relevant for the main meter.	4
30035	2	16-bit unsigned integer	kWh meter node number	Modbus node number of the main kWh meter.	4
30036	4	32-bit floating point	kWh meter reading: Active power	Measured in kW	4
30038	4	32-bit floating point	kWh meter reading: Reactive power	Measured in kVAr	4
30040	4	32-bit floating point	kWh meter reading: Apparent power	Measured in kVA	4

30042	4	32-bit floating point	kWh meter reading: Voltage L1-N	Measured in V	4
30044	4	32-bit floating point	kWh meter reading: Voltage L2-N	Measured in V	4
30046	4	32-bit floating point	kWh meter reading: Voltage L3-N	Measured in V	4
30048	4	32-bit floating point	kWh meter reading: Voltage L1-L2	Measured in V	4
30050	4	32-bit floating point	kWh meter reading: Voltage L2-L3	Measured in V	4
30052	4	32-bit floating point	kWh meter reading: Voltage L3-L1	Measured in V	4
30054	4	32-bit floating point	kWh meter reading: Current L1	Measured in A	4
30056	4	32-bit floating point	kWh meter reading: Current L2	Measured in A	4
30058	4	32-bit floating point	kWh meter reading: Current L3	Measured in A	4
30060	4	32-bit floating point	kWh meter reading: frequency	Measured in Hz	4
30062	4	32-bit floating point	kWh meter reading: Active power L1	Measured in kW	4
30064	4	32-bit floating point	kWh meter reading: Active power L2	Measured in kW	4
30068	4	32-bit floating point	kWh meter reading: Active power L3	Measured in kW	4
30070	4	32-bit floating point	kWh meter reading: Reactive power L1	Measured in kVAr	4

30072	4	32-bit floating point	kWh meter reading: Reactive power L2	Measured in kVAr	4
30074	4	32-bit floating point	kWh meter reading: Reactive power L3	Measured in kVAr	4
30076	4	32-bit floating point	kWh meter reading: Energy imported	Measured in kWh	4
30078	4	32-bit floating point	kWh meter reading: Energy exported	Measured in kWh	4
30080	4	32-bit floating point	kWh meter reading: Reactive Energy imported	Measured in kVArh	
30082	4	32-bit floating point	kWh meter reading: Reactive Energy imported	Measured in kVArh	
30095	2	16-bit unsigned integer	Setting PT1	Representing the voltage setting in the meter	
30096	2	16-bit unsigned integer	Setting PT2	Representing the voltage setting in the meter	
30097	2	16-bit unsigned integer	Setting CT1	Representing the current setting in the meter	
30098	2	16-bit unsigned integer	Setting CT2	Representing the current setting in the meter	
30099	2	16-bit unsigned integer	Setting reading place: Primary/Secondary	Representing the place of reading	

Meters 1-10

Meters 1-10 (30100-30899)					
Start address (decimal)	Bytes	Data Type	Register Name	Remark	Function code(s)
30100	10 x 40	string	kWh meter name	Blocks having a fixed length of 20 words (40 bytes) containing the text declared as the name of a kWh meter. The names are sorted in the order of the declarations, meaning that the first name starts from address 30000, the second one from address 30020 etcetera. If a name contains less than 40 characters, the remaining bytes are filled with zeroes. If a name contains more than 40 characters, the remaining characters are ignored.	4
30300	10 x 20	string	kWh meter type	Blocks having a fixed length of 10 words (20 bytes) containing the text declared as the type of a kWh meter. The texts are sorted in the order of declaration, meaning that the first one starts from address 34000, the second one from address 34010 etcetera. If a name contains less than 20 characters, the remaining bytes are filled with zeroes. If a name contains more than 20 characters, the remaining characters are ignored.	4
30400	10 x 10	string	kWh meter bus	Blocks having a fixed length of 5 words (10 bytes) containing the text "internAC", "internDC" etc. as described in par. 5.5 of the manual; in the order of declaration of the kWh meters.	

30450	10 x 2	16-bit unsigned integer	kWh meter node numbers	Modbus node number of each kWh meter, in the order of declaration.	4
30470	10 x 4	32-bit floating point	kWh meter readings: Active power	Measured in kW	4
30490	10 x 4	32-bit floating point	kWh meter readings: Reactive power	Measured in kVAr	4
30510	10 x 4	32-bit floating point	kWh meter readings: Apparent power	Measured in kVA	4
30530	10 x 4	32-bit floating point	kWh meter readings: Voltage L1-N	Measured in V	4
30550	10 x 4	32-bit floating point	kWh meter readings: Voltage L2-N	Measured in V	4
30570	10 x 4	32-bit floating point	kWh meter readings: Voltage L3-N	Measured in V	4
30590	10 x 4	32-bit floating point	kWh meter readings: Voltage L1-L2	Measured in V	4
30610	10 x 4	32-bit floating point	kWh meter readings: Voltage L2-L3	Measured in V	4
30630	10 x 4	32-bit floating point	kWh meter readings: Voltage L3-L1	Measured in V	4
30650	10 x 4	32-bit floating point	kWh meter readings: Current L1	Measured in A	4
30670	10 x 4	32-bit floating point	kWh meter readings: Current L2	Measured in A	4
30690	10 x 4	32-bit floating point	kWh meter readings: Current L3	Measured in A	4
30710	10 x 4	32-bit floating point	kWh meter readings: frequency	Measured in Hz	4

30730	10 x 4	32-bit floating point	kWh meter readings: Active power L1	Measured in kW	4
30750	10 x 4	32-bit floating point	kWh meter readings: Active power L2	Measured in kW	4
30770	10 x 4	32-bit floating point	kWh meter readings: Active power L3	Measured in kW	4
30790	10 x 4	32-bit floating point	kWh meter readings: Reactive power L1	Measured in kVAr	4
30810	10 x 4	32-bit floating point	kWh meter readings: Reactive power L2	Measured in kVAr	4
30830	10 x 4	32-bit floating point	kWh meter readings: Reactive power L3	Measured in kVAr	4
30850	10 x 4	32-bit floating point	kWh meter readings: Energy imported	Measured in kWh	4
30870	10 x 4	32-bit floating point	kWh meter readings: Energy exported	Measured in kWh	4

Appendix 14.7 Checklist for annual check



Checklist for Annual Check

Product checked (name and type)	
Serial No.	
Date of annual check:	
Place of annual check	
Person who performed the annual check:	

Item	Check OK/NOK	Remark
External area of the container.		
General control on quality, paint, and rust externally.		
Doors to access areas C0, C1, C2, C7 and C8 opening and closing properly, including locks.		
Waterproof sealing for doors to access areas C0, C1, C2, C7 in good conditions.		
Grill cover of the HVAC area.		
HVAC outdoor units and connections in good conditions.		
Fire alarm horn in good conditions.		
4G antenna in good conditions.		

Air inlets and outlets cleanliness and free of dust or other items.		
Service Room		
General cleanliness		
Rust (especial attention to access points from the outdoors)		
Excessive moisture present		
Odd smells.		
Cabinet doors in place and in good conditions, including locking.		
No damage on emergency button		
No damage on maintenance switch		
No damage on HMI		
Name plate still in place and in good conditions		
Signs and labels in place and in good conditions		
Protective covers for areas C1, C2, C3, C4, C5 and C6 are in place.		
Cleanliness inside cabinets C3, C4, C5 and C6.		
Moisture inside cabinets C3, C4, C5 and C6.		
Cabinets C3 and C4		
General visual check		
No visible damage on components.		
No changing color of bus bars		
No loose cables or wires		
Cabinets C5 and C6		
General visual check		

No visible damage on components.		
No changing color of bus bars		
No loose cables or wires		

NOTE: Include photos or diagrams in case it is required.

NOTE: Inform all the required stakeholders about the annual check.

General Remarks	
Service Actions required	Yes/ No
Next annual check date	
Signature	

15 Terminology

Abbreviation	Definition
A	Ampere
AC	Alternating Current
AFSS	Automatic Fire Suppression System
BESS	Battery Energy Storage System
BMS	Battery Management System
CB	Circuit Breaker
DC	Direct Current
EMS	Energy Management System
ESS	Energy Storage System
HMI	Human Machine Interface
HVAC	Heating, ventilation, and air conditioning
ICE	In Case of Emergency
IFC	International Fire Code
kW	Kilowatt
kWh	Kilowatt-hour
Li-ion	Lithium-ion
LOTO	Lockout Tagout
MCB	Motorised Circuit Breaker (DC circuit breaker)
MW	Megawatt
PCS	Power Conversion System
PEM	Power Entry Module
SOC	State of Charge
SOH	State of Health
V	Voltage/Volt

16 Notes

Thank you for choosing our products.
We hope you enjoy it!

Yours sincerely,
Time Shift