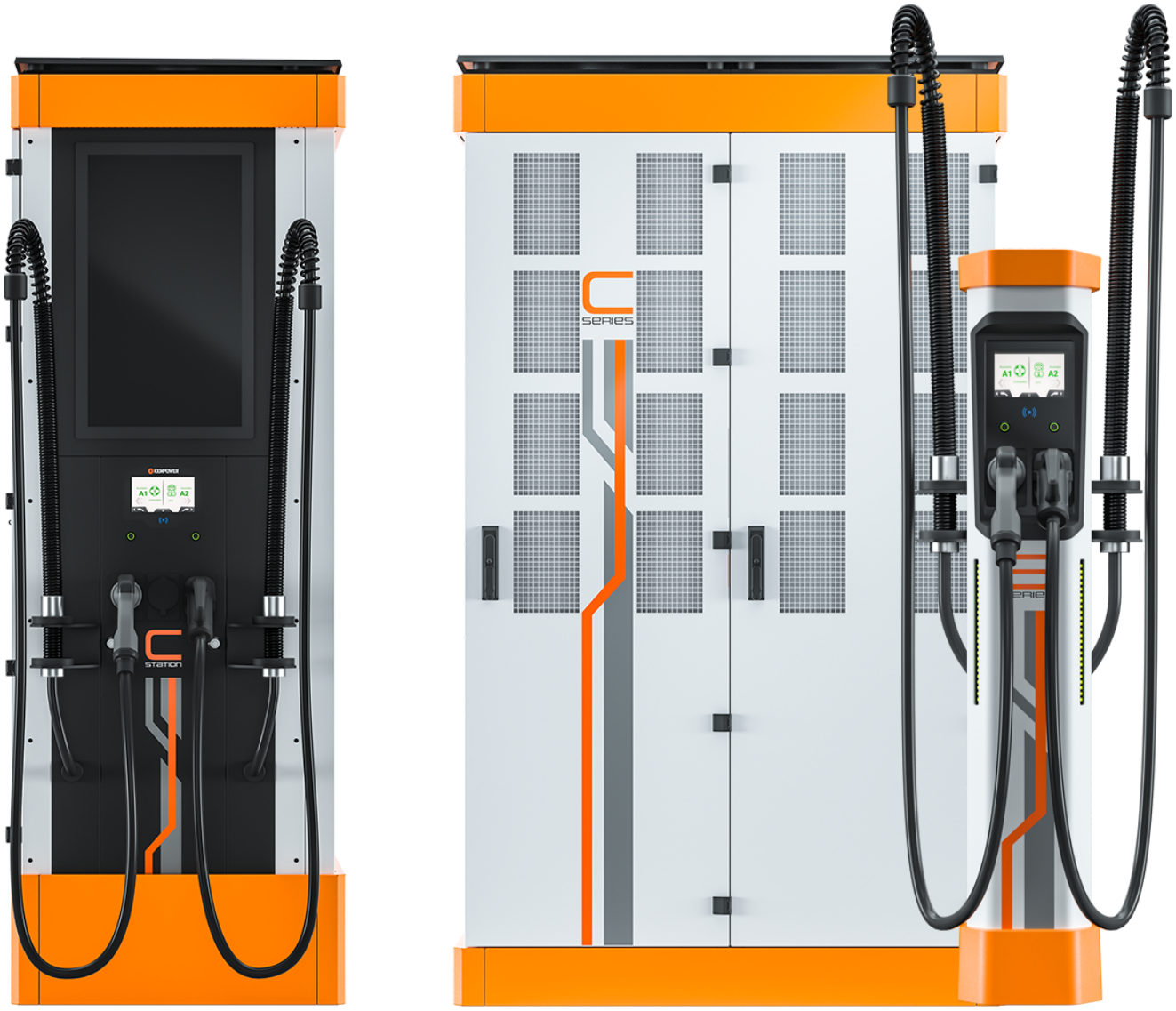
C-Station, C-Series, S-Series

Charging System



OPERATING MANUAL

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1 IMPORTANT SAFETY INSTRUCTIONS

1.1 General

SAVE THESE INSTRUCTIONS.

This manual contains important safety instructions for the C-Station, C-Series and S-Series, that shall be followed during installation, operation and maintenance of the unit.

Items in the manual that require particular attention in order to minimize damage and harm are indicated with the below symbols. Read these sections carefully and follow their instructions.

Table 1. Safety signs.

	**Note symbol**: Gives useful information to the user.
	**Mandatory symbol:** Describes a mandatory action.
	**Caution symbol**: Describes a situation that may result in damage to the equipment or system.
	**Warning symbol**: Describes a potentially dangerous situation. If not avoided, it will result in wounds or fatal injury.

1.2 Main risk factors

Warning! Do not turn OFF the charger if charging is ongoing as it may cause issues to the vehicle. Follow user guide instructions for correct ending of the charging.

Warning! Only qualified service personnel are allowed to carry out maintenance or installation work.

Warning! Only an authorized electrician is allowed to carry out electrical work.

Warning! Never release the charging cable from your hand when moving it to or from the vehicle to prevent damaging the plug or vehicle. After charging place the plug back onto its holder.

Caution! Do not use the device before it is properly installed and approved for use on the site in question.

Caution! Always follow local and general safety regulations and procedures.

Caution! Do not use any pressure washing devices or compressed air to clean the device.

Warning! Before opening or removing hatches, doors or cover plates, turn the main switch to OFF position, turn off the power supply and wait about 2 minutes before continuing. Ensure that the device is not energized before continuing.

Warning! Disconnecting the C-Series Charging Power Unit does not cut the AC supply to the AC Satellite!

1.3 Operational Safety

- It is mandatory to read this operating manual and follow its instructions.
- The charging voltage is not present at the charging connector pins when the device is not charging.
- Any electrical work on the charging unit is only allowed to be carried out by an authorized electrician.

Important notes for safe use 

- Straighten any loops in the cables.
- Do not wrap the cables around the body.
- Make sure that faulty and damaged cables and charging connectors are changed immediately as they can cause risk of electical shock or fire.
- The cable, plugs and other electric devices may be installed or replaced only by an authorized electrician.
- In case of any abnormal behavior of the equipment, such as smoke coming from the CPU during normal use, stop the use instantly, turn the charger off and contact a MANUFACTURER service representative to arrange an inspection.

1.4 Environment

- The device shall be installed in a location whereas the ingress protection (IP) classification and ambient operating conditions are within the limits to that of the device.
- Do not expose the device to high temperatures, as this may cause damage to the device.
- If possible, the charger unit should be mounted in such a location that protects it from direct sunlight to prevent overheating and ageing of the technical parts.
- Make sure the airflow to and from the CPU is unrestricted.

2 INTRODUCTION

2.1 Disclaimer on products and services

Disclaimer

While every effort has been made to ensure that the information contained in this guide is accurate and complete, no liability can be accepted for any errors or omissions. MANUFACTURER reserves the right to change the specification of the product described at any time without prior notice. Do not copy, record, reproduce or transmit the contents of this guide without prior permission from MANUFACTURER.

2.2 Notice

This manual provides information on the MANUFACTURER's charging station and may refer into one or more standards that may generally apply to charging systems.

Such a reference does not always equal that all of the MANUFACTURER solutions adopt that standard.

On the component level the reader should refer to the component specifications for the particular components.

MANUFACTURER may have one or more patents or pending applications protecting the intellectual property rights mentioned on this operating manual.

All of the information in this manual is subject to change without notice and should not be constructed as a commitment by MANUFACTURER. This manual is originally written in English. Other language versions are translated from that document and MANUFACTURER cannot be held liable for errors in translation.

MANUFACTURER assumes no responsibility for any errors that may appear in the charging system if local rules and demands have been neglected. In no event shall MANUFACTURER be liable for direct, indirect, special, incidental or consequential damages of any nature or kind arising from the use of this manual, nor shall MANUFACTURER be liable for incidental or consequential damages arising from use of any software or hardware mentioned in this manual.

2.3 Warranty

The warranty Period is defined in purchase Agreement. Warranty is related to delivered product (parts) only. Any other material, labor, accommodation and traveling costs are not included. See more detailed information in the MANUFACTURER warranty terms and conditions.

MANUFACTURER's Charging System delivery typically consists one DC cabinet and Satellite posts with connectivity Plug or integrated C-Station. Charging hardware and software together with power grid, data communication network, various electric vehicles, charging operators and users comprises a complex entity. Neither supplier liability nor warranty does not include any consequential damages, see warranty and disclaimer on products and services.

Consumable parts, like cables and connectors are not included in the warranty.

2.4 Manufacturer

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3 DEVICE

3.1 Charging system

Due to the modular design of the Charging Power Unit (CPU) and flexibly located Satellite posts, charging service sites can be customized to provide the best possible charging result according to your application. Each CPU cabinet provides up to 200 kW of charging power from four power modules into one or up to eight charging plugs on Satellite posts.

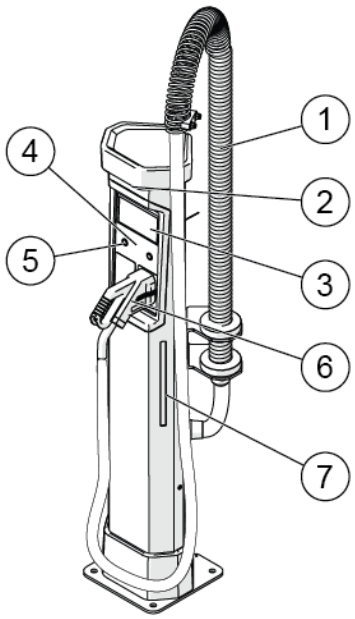
Features:

- Charging Power Unit for fixed installation.
- Maximum output power 200 kW (or optionally 4x40 kW).
- Output voltage 500 V or 800 V (depending on the power module used).
- CPU can distribute power to a maximum of eight satellite posts.
- Satellite posts with CCS1, CCS2, ChaDeMo and Type 2 AC charging plugs available.
- Satellite posts feature 7" touch screen with on-screen user guidance.
- User authentication via RFID (Radio-Frequency Identification) on each Satellite post. The function can be switched on or off.
- Internet cloud connection via built-in Wi-Fi and mobile data (3G/4G) connection.
- Charge status LED indicators on each Satellite post.

Charging system is designed for a stand-alone operation with minimal maintenance and communication to the back-end system. All functions are enabled when online.

3.2 S-Series

S-Series is operated from a Satellite post, which may be assembled with different combination of charging plugs/socket.



1. Charging cable support system
2. Welcome light
3. Touch screen user interface
4. RFID reader
5. Function buttons (2)
6. Charging plugs and plug holders (1 – 2)
7. Status light bars (2)

Figure 1. Main points of the satellite post.

Depending on selected Satellite post, one or two charging cable support system springs are providing cable support that prevents cable from touching the ground, when the plug is in the holder.

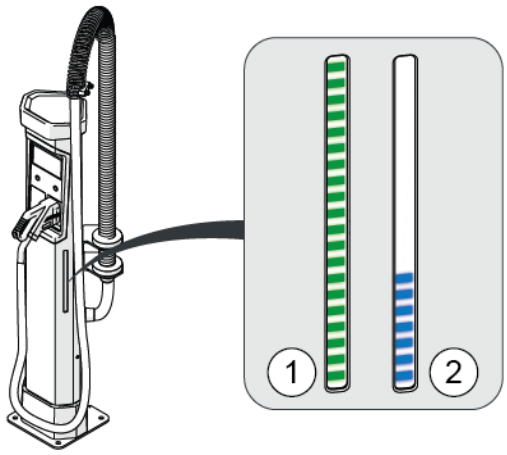


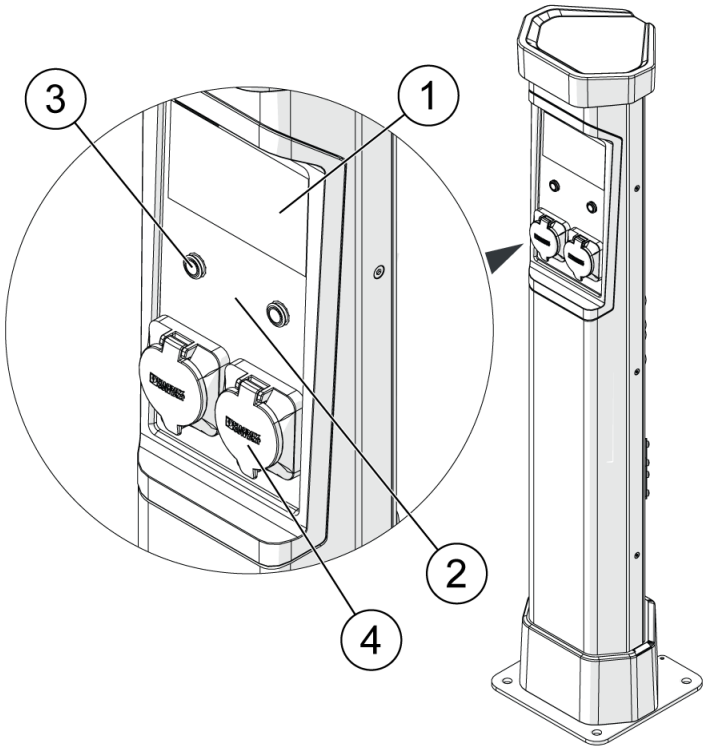
Figure 2. Charging status.

Status LEDs on the charge post indicate different states : Green- Charger ready to be used (1), Blue- Charging and state of charge (2), Red- Fault.

3.3 S-Series AC

Three types of S-Series AC Satellites are available:

- 2 x AC sockets.
- CHAdeMO on the left-hand-side and AC socket on the right-hand-side.
- AC socket on the left-hand-side and CCS2 on the right side.

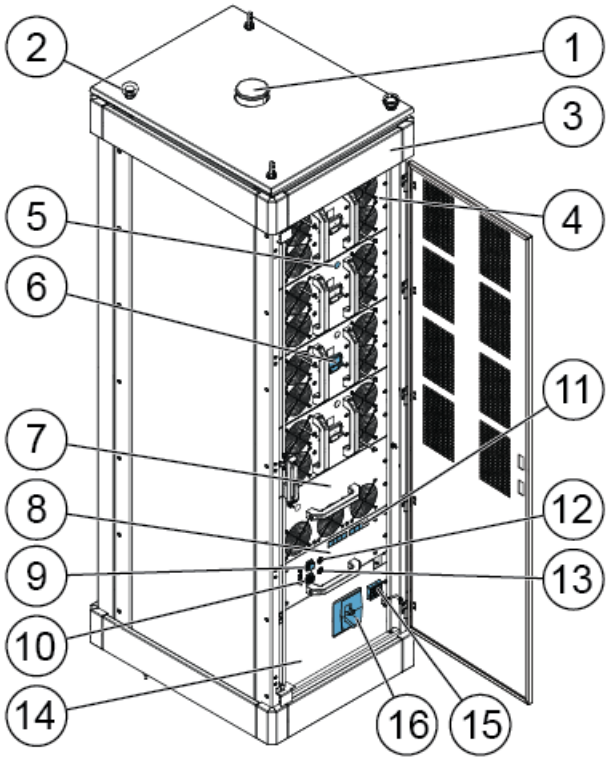


1. Touch screen user interface.
2. RFID reader.
3. Function buttons (2).
4. AC plug holders (1–2).

Figure 3. AC Satellite.

3.4 C-Series

The C-Series, also known as "cabinet". The Charging Power Unit (CPU) consists typically 1 – 4 power modules, 0-1 Dynamic Power Module, Control module and Mains module which are fitted into racks of the cabinet.



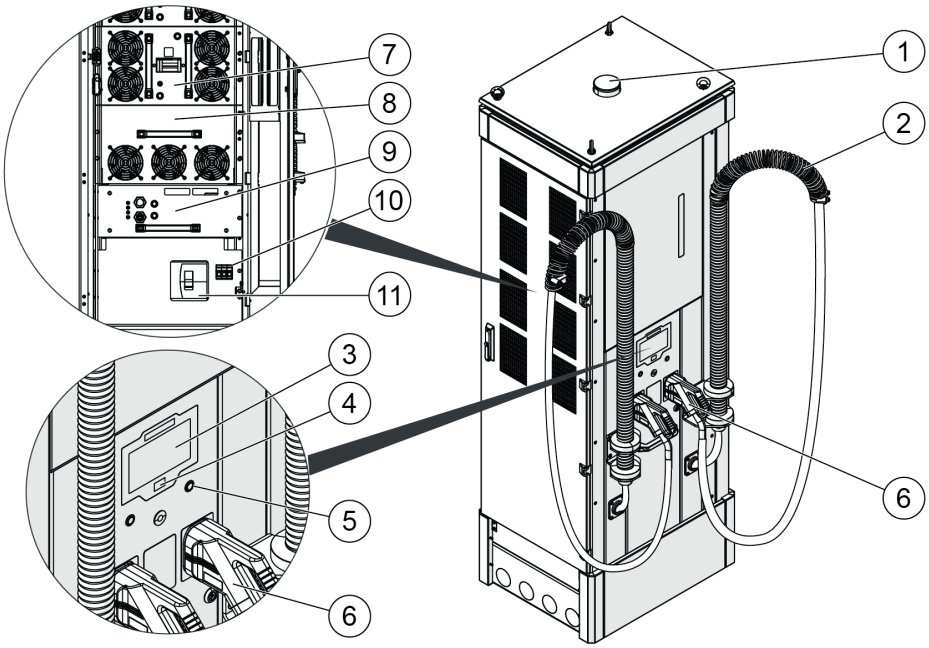
1. 3G/GSM Antenna
2. Lifting lugs (4 pcs.)
3. Cooling outlet
4. Power module 1 – 4
5. Power module channel status indicator
6. Power module circuit breaker
7. Power distribution module (optional)
8. Control module
9. ETH 1 (Eth RJ-45)
10. USB
11. ETH 1 - 8 to Sat/Cab (Eth RJ-45) to Satellite posts
12. Reset
13. Spare

14. Main switch front cover plate
15. Aux power circuit breaker
16. Main circuit breaker

Figure 4. Main points of the cabinet.

3.5 C-Station

C-Station charging system consists one or two charging outlets.



1. 4G antenna
2. Charging cable support system
3. Touch screen user interface
4. RFID reader
5. Function buttons (2)
6. Charging outlets 1 - 2 plug and plug holder
7. Power modules 1 - 4
8. Place for power distribution module
9. Control module
10. MCB Auxiliary
11. Main circuit/overload breaker

Figure 5. Main points of the C-Station.

Cable support system spring is providing cable support that prevents cable to touch the ground when the plug is on the holder.

3.6 Connector types

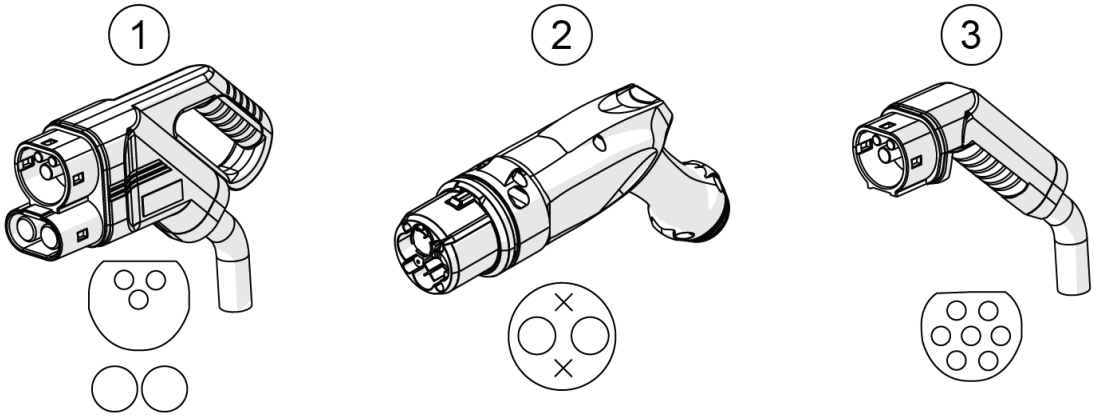


Figure 6. 1 = CCS (Type 2), 2 = CHAdeMO, 3 = Type 2

4 OPERATING INSTRUCTIONS

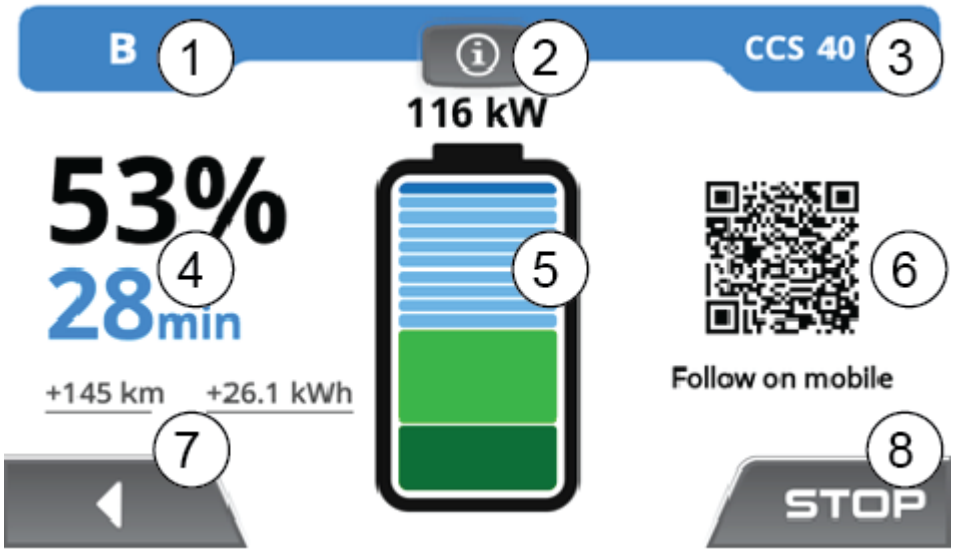
4.1 User Interface

On each Satellite post the touch screen provides user interface.

The touch screen has seven main active fields.

1. Charging start procedure status. The different steps of the charging initialization are shown in here.
2. Satellite post ID and status e.g. S1, status colors Green (ready), Blue (charging), Red (fault).
3. RFID activated. Show tag.
4. Charging protocol.
5. Activity button.
6. Info button.
7. Stop button (requires authorization when authorization is activated).

Figure 7. Start view of the touch screen.



1. Satellite post ID
2. Info
3. Charging protocol and available charging power
4. Battery SoC, charged energy and remaining time
5. Battery SoC (press battery for more detailed info)
6. QR code for mobile following
7. Activity button
8. Stop

Figure 8. The touch screen has seven main active fields that change during each session.

4.2 Charging of electric vehicle

Prior to start DC charging the user needs to authorize charging session of the selected Satellite post. Authorization can be based RFID card or tag.

Charging session

1. Select the correct charging plug that is appropriate to your vehicle.
2. Attach the plug to the vehicle and ensure that the charging plug is properly inside the socket.
3. User indentification (if enabled).

4. Charging initialization starts automatically in CCS charging. Start button must be pressed in CHAdeMO charging.

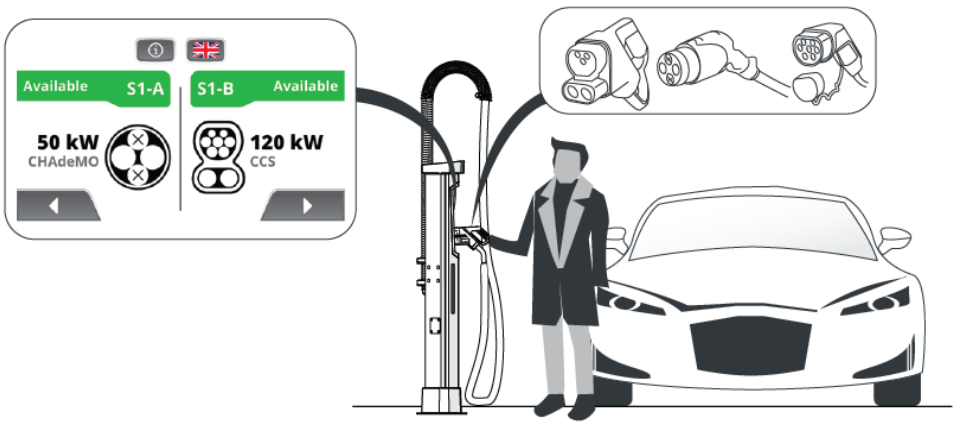


Figure 9. Using the Satellite post.

5. Follow the Satellite post's on-screen instructions.
   The charging status can be seen with smartphone by scanning QR-code from touch screen.

   Once the authorization is completed, the session starts automatically as the handshake procedure between vehicle and the charger is finished. 4-step "donut - indicator" indicates safety steps on the touch screen.

   1st step; cable is in vehicle locked.

   2nd step; communication has been established - vehicle communicates with the charger.

   3rd step; isolation test starts - safety checks starts.

   4 th step; isolation test passed - safety checks completed and charging session starts.

6. You may follow the charging progress with your smartphone by scanning the QR-code from the charger display. Touch screen may indicate SOC level, how much energy was delivered, an estimate of the range, and charging time. The charging status is indicated on appropriate side of the Satellite post on the light bars.

7. If the charging sequence is interrupted the charging stops into fault status by indicating appropriate side of the Satellite post in red color (until connector is disconnected) and the display also red background color on top indication bar.

8. Ending of the charging sequence can be due to following.

   Battery is full - charging ends automatically when SOC level of the battery has been achieved.
   User presses stop button on the display or physical button below the display. Stop requires authorization when activated.
   Note that a new charging session requires plug to be disconnected.

9. Return the charging plug to its holder. The Satellite post indicator LED's changes blue color to green and it is ready to start charging again. Charging session information remains on the touch screen for 10 more seconds.

4.3 Adaptive EV Charging

Each Charging Power Unit (CPU) consist of 1-12 power modules, with 2 independent power channels on each module and optional dynamic module that can route the power channels in any order to a maximum of eight charging outputs. To utilize full potential of each DC charger, dynamic power management is one of the key elements on Adaptive EV charging.

Compared to the traditional static charging, Adaptive EV charging can benefit from re-routing the power channels even during each charging session. It enables true flexibility to DC charging and improved OPEX as charging service power levels can also be adjusted to match with real-time energy price level as well as to eliminate possible power peaks in advance.

The S-series and C-station with Adaptive EV charging systems offer two options to manage power channels:

- democratic
- arrival priority.

4.3.1 Adaptive EV charging with democratic approach

On the democratic power management, each charging output is granted with 25 or 50 kW from the beginning of each charging session, thus on an empty charging area, the first vehicle receives maximum power until next vehicle starts to charge. That starting power level is depending on the number of power modules versus number of charging outputs and their charging cable sizes.

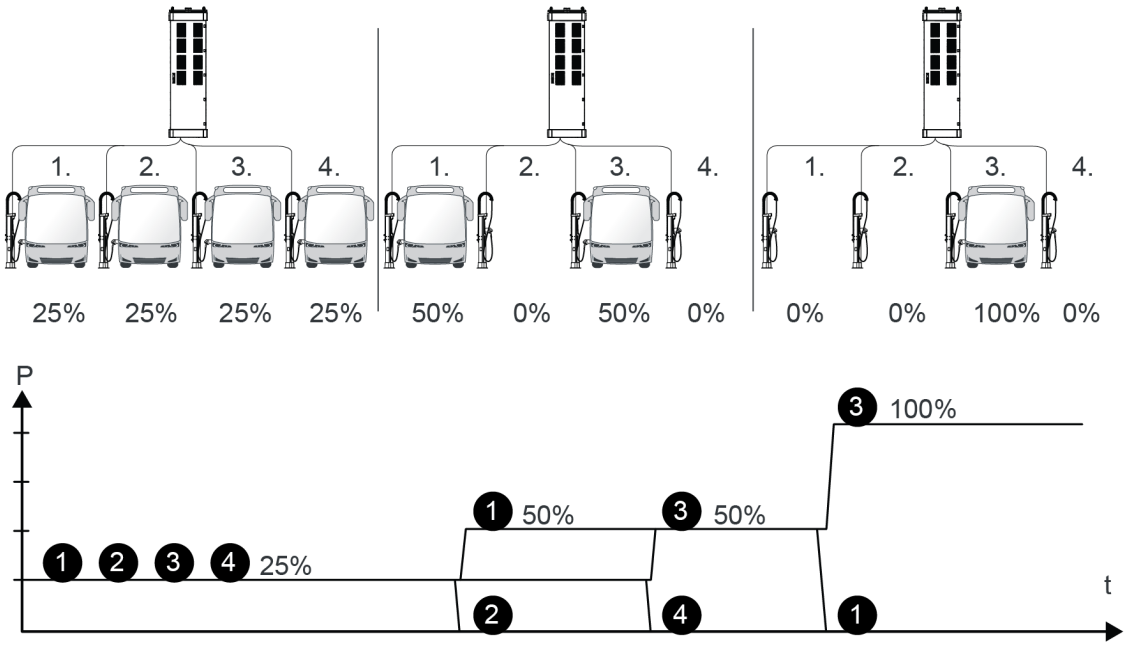


Figure 10. A simplified example of democratic power management.

On a simple case - at the beginning as all EVs are charging on outputs 1-4, each EV receives 25% of the cabinet's charging power. When the EVs on outputs 2 and 4 end charging, remaining charging power 50% is available and is routed to EVs on outputs 1 and 3 (both receives +25%).

When the EV on output 1 ends charging the remining power (50%) is routed to the EV at output 3 if it can accept more power it will receive 100%. Depending on charging application the dynamic power management - routing of charging power works both ways. Charging power is also reduced when more vehicles are plugged for charging.

On such a democratic power management when the CPU has 200 kW maximum power and four outputs, as if the first EV is able to receive the charge at 150 kW power level it starts at that level. As if the next EV also demands 150 kW both EVs receive only 100 kW. And when the third arrives the power is split into three equal parts to 3 x 50 kW where 50 kW is booked to reserve. And when the fourth EV arrives it will receive the remaining 50 kW charging power.

4.3.2 Adaptive EV charging with arrival priority approach

On the arrival priority power management, the first arriving EV is granted with maximum charging power from the beginning to the end of its session. Arrival priority power management in turn targets on getting the first vehicle ready as fast as possible to free capacity for the next vehicles arriving and to minimize charging queues. The highest starting power level is depending on the charging points output capacity and maximum charging power level that the EV can accept and on the charging system power capacity.

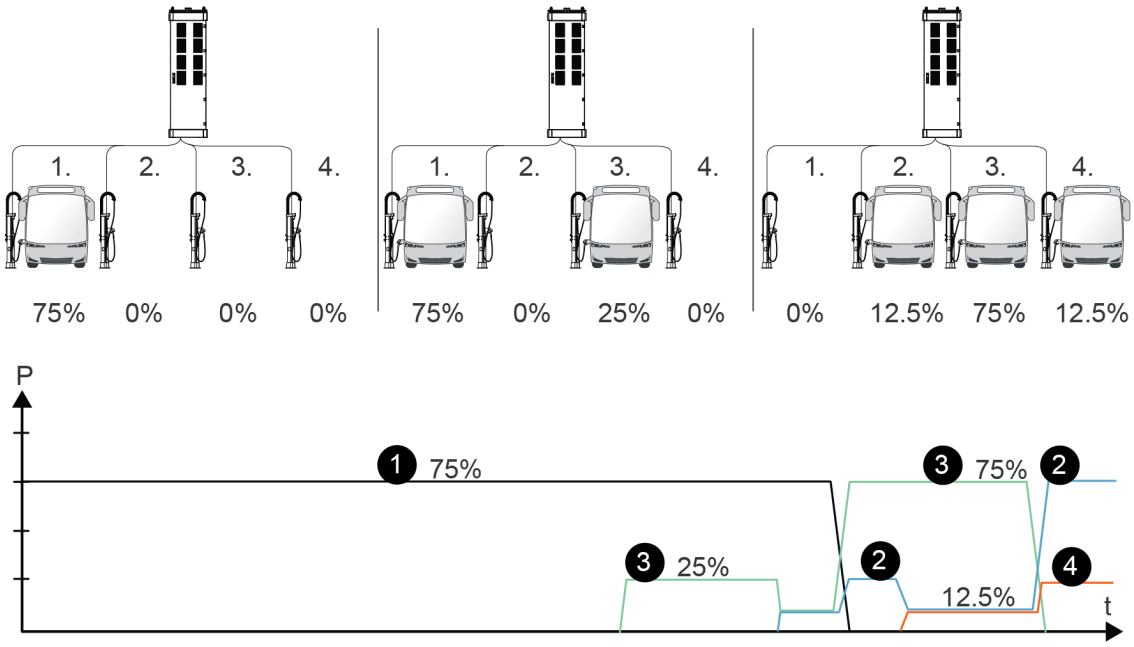


Figure 11. A simplified example of arrival priority power management.

On a simple case - at the beginning as the first EV starts to charge at 75% (150 kW), when the next EV starts to charge at output 3 it receives 25% (50 kW). As the third driver starts to charge on output 2 the first arrived still receives 75% and second and third receive only 12.5% (25 kW each). By the time the first EV ends its charging session, that power is first routed to output 3 and remaining 25% (50 kW) to output 2. When the fourth EV starts to charge, charging power is divided to half to two single channels (25 kW) for both 2 and 4 outputs. And as the EV on output 3 ends its session that power is routed to EV on outputs 2 (75%) and 4 (25%).

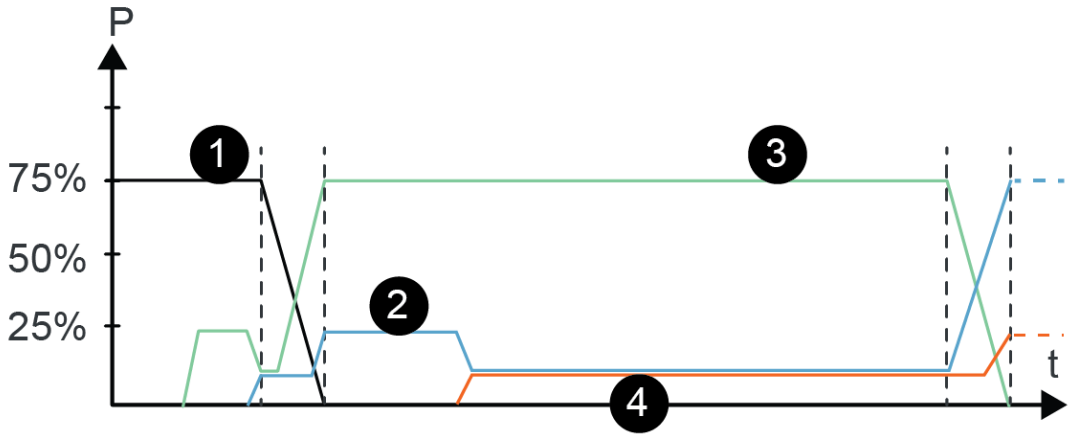


Figure 12. When the EV that arrived earliest ends its charging session, power channels are re-routed to remaining EVs on arrival priority order.

In both power management cases, democratic and arrival priority, when there is free power for charging available the CPU communicates with each vehicle and offers additional power. During that communication, each EVs BMS confirms if additional power level is acceptable. After that asynchronous conversation, a selected number of power channels are re-routed to specific EVs.

4.4 Derating of the system in hot conditions

Each electric component is subject to derating in hot conditions. In case of heatwave, transformers and charging power units are subject to derating to protect themselves. Should the ambient temperature increase and demand on charging be at high level, charging power levels are automatically decreased.

5 MECHANICAL DRAWINGS

5.1 Satellite post

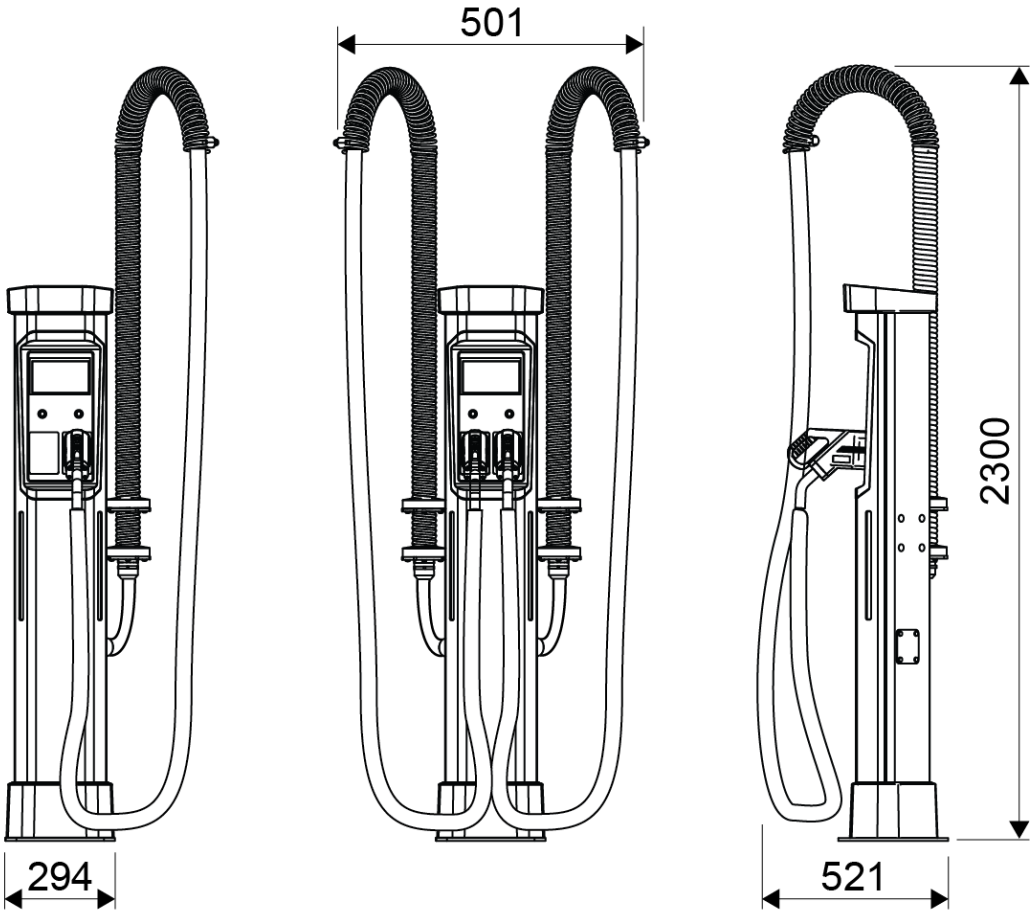


Figure 13. Dimensions of one and two charging connectors.

5.2 CPU C501/C801

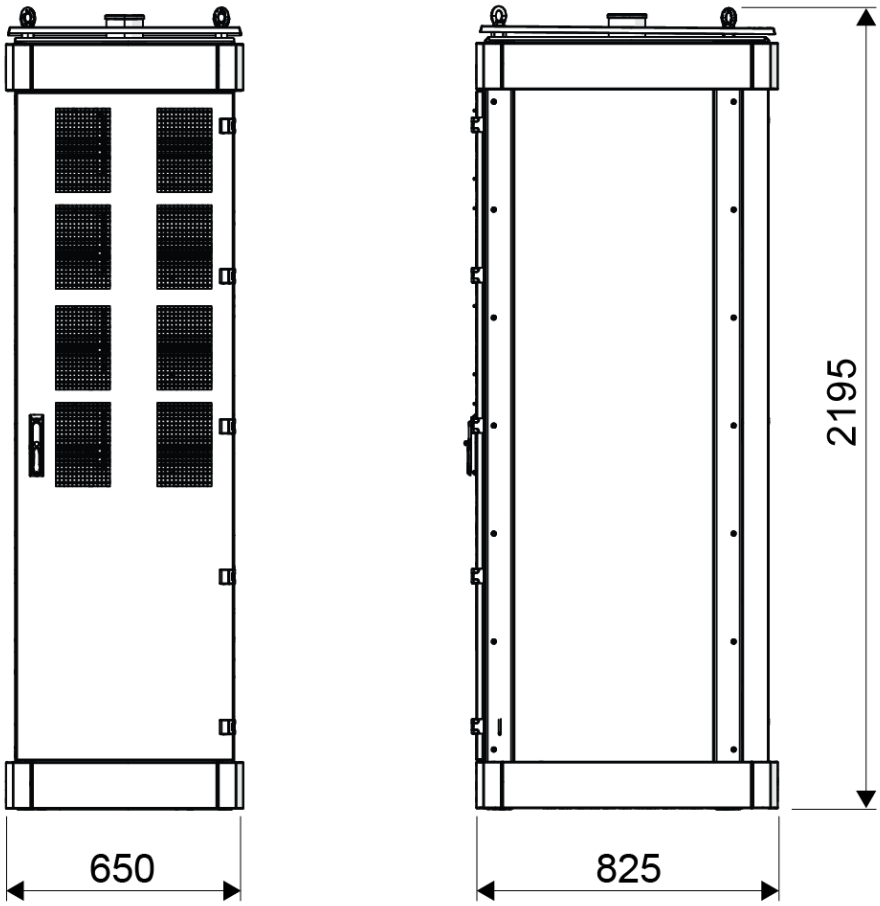


Figure 14. CPU C501/C801

5.3 CPU C502/C802

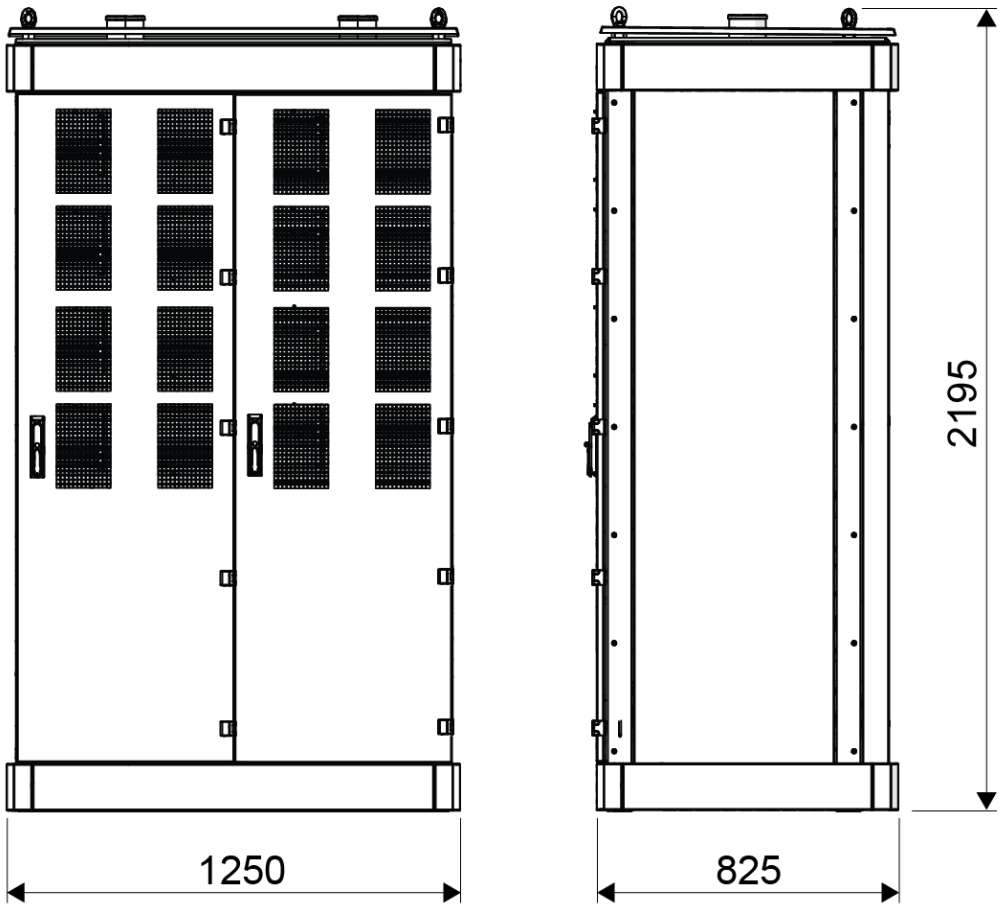


Figure 15. CPU C502/C802.

5.4 CPU C503/C803

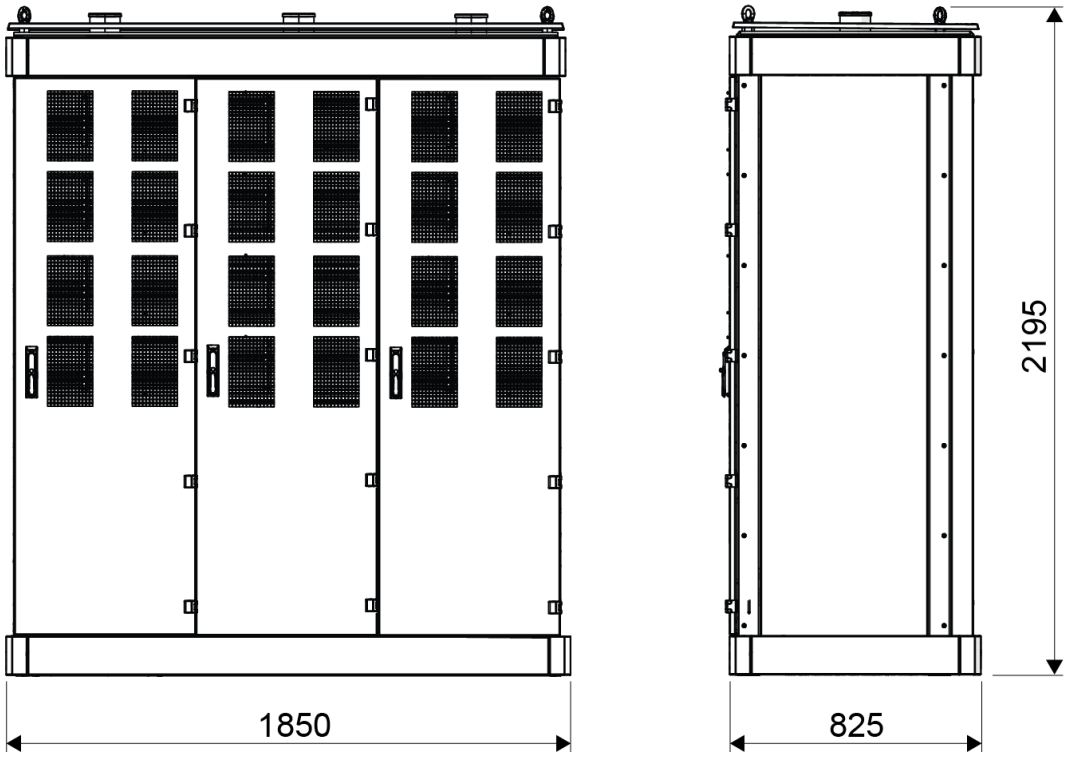


Figure 16. CPU C503/C803.

5.5 C-Station

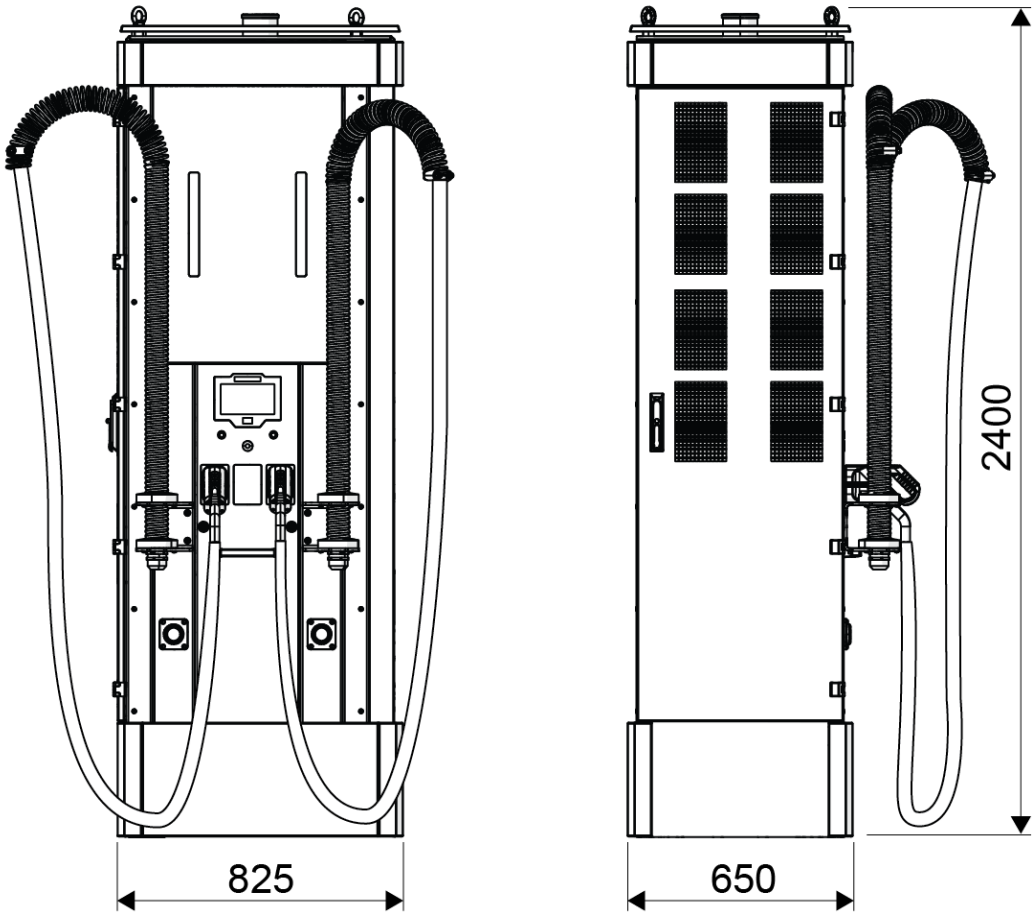


Figure 17. Dimensions.

6 TECHNICAL SPECIFICATIONS

Table 2.

Feature	Description	Value		
Input	AC power connection (without transformer (multivoltage option))	3~, 380...480 V (+/-10%)		
	Nominal input current	262 A	524 A	786 A
	Input frequency	50...60 Hz		
	Power factor (@ full load)	0.94		
	Efficiency	94 % @ nominal output power		
Output	Maximum output power	160 kW	320 kW	480 kW
	Maximum output current (@ 800 V)	240 A	2x 240 A	3x 240 A
	Output voltage range with 500 V module	150...500 V		
	Output voltage range with 800 V module	200...800 V		
General	Charging cable length	5m / 7 m		
	Charging connection type	CCS1 , CCS2 , CHAdeMO		
	Protection class	IP54		
	Operation temperature	-40 ... +60 °C *note derating limitation		
	Maximum humidity	< 95% relative humidity		
	Cooling	Power cabinet forced air, satellite free air		
	Height (without optional steel foundation)	Cabinet 2150 mm Satellite 2300 mm		
	Dimensions (DxW), ca. (without transformer (multivoltage option))	650 x 825 mm	1250 x 825 mm	1850 x 825 mm
	Weight (CPU cabinet), approx. (without transformer (multivoltage option), see datasheets)	400 kg	800 kg	1200 kg
	Weight (Satellite)	60-100 kg (depending of number of cables & options)		
	User interface	ON/OFF switch, two function buttons, 7" touch screen, RFID reader		
	Network connection type	Wireless 3G/4G/LTE, WiFi, Ethernet		

7 GLOSSARY

AC = Alternative Current

BEV = Battery Electric Vehicle – fully electric vehicle

BMS = Battery Management System – battery controller

CPU = Charging Power Unit

CSO = Charging Service Operator – Charging provider

DC = Direct Current

Dia = Diameter

EV = Electric Vehicle – generic term for electric vehicles

ICE = Internal Combustion Engine – diesel/petrol/gas powered engine

MCB = Miniature Circuit Breaker – fuse, current overload

PTA = Public Transportation Authority - cities

PTO = Public Transportation Operator – bus operator

PHEV = Plug-in Hybrid Electric Vehicle – both ICE and electric driven

QR-code = Quick response code

RCD = Residual Current Device – safety

RFID = Radio-frequency identification

SOC = State Of Charge – battery's charging level

UI = User interface

VCCU = Vehicle Charge Control Unit

VMS = Vehicle Management System – car computer

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DESIGN FROM FINLAND

MADE IN FINLAND

CE

KEMPOWER
Defining charging