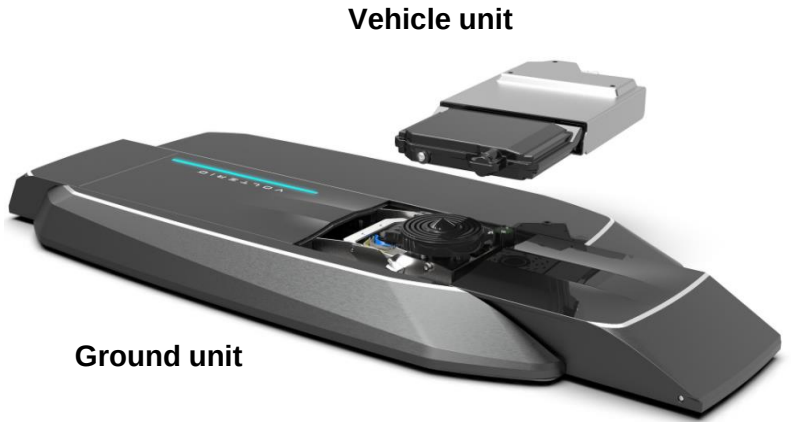
VOLTERIO – AUTOMATIC CONNECTION DEVICE

Conductive Hands-Free Charging System

AUTOMATIC CONDUCTIVE CHARGING SYSTEM

The ACD-U consists of

Ground Unit & Vehicle Unit



VOLTERIO // CONTINENTAL COLLABORATION PROJECT

background vs. foreground vs. sideground IP

AUTOMATIC CHARGING – USE CASES


Premium & volume OEMs


Robo taxis


E-Trucks

HPC

Comfort Charging for EVs and PHEVs

- Premium OEMs
- Volume OEMs (Home & Public Charging)

Autonomous Driving EVs

- Robo taxis
- Fleets; Automatic valet parking

Smart Grids & HPC

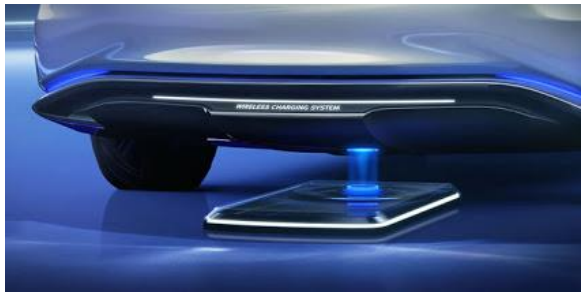
- Vehilce-to-grid, Peak-shaving, virtual power plants …

Industrial and Heavy-duty Vehicles

- Automated Container Terminals, Mining, …
- Urban Logistics, Electric Trucks, Electric Buses …

AUTOMATIC CHARGING - OVERVIEW

Automatic charging



Inductive

Side couplers (ACD-S)

Conductive

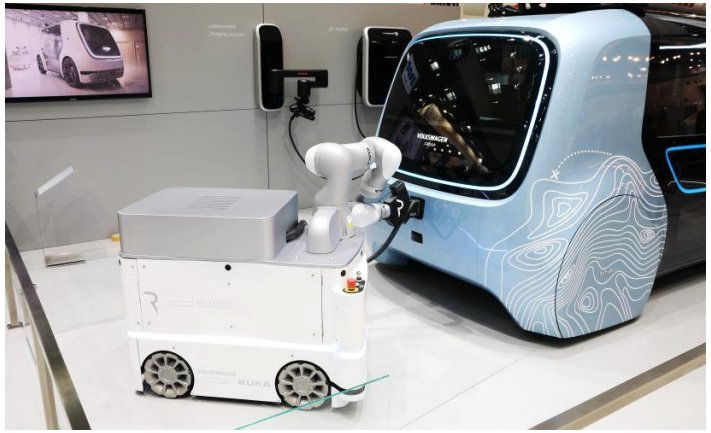
Underbody couplers

ACD-U

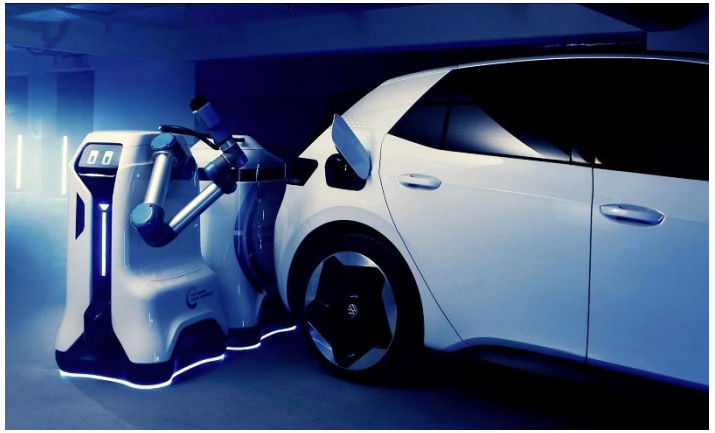
AUTOMATIC SIDE COUPLERS (Concept stage)

KUKA wall mounted robot

Tesla „snake charger“ concept



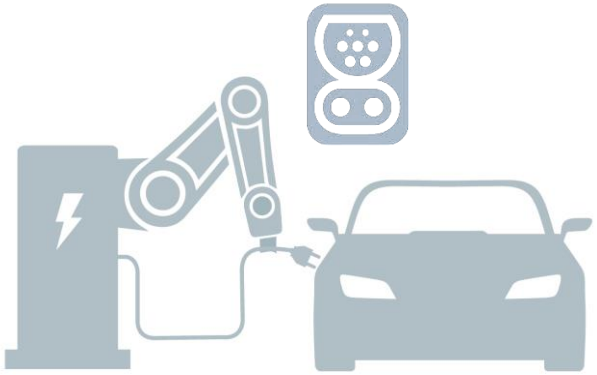
Volkswagen mobile CarLa robot (2018)



Volkswagen charging concept (2019)

Problems of ACD-S:

- **Requires complex robotics with „Six degrees of freedom“**
- **Complicated and precise positioning**
- **Huge space requirements**
- **Expensive robotics**

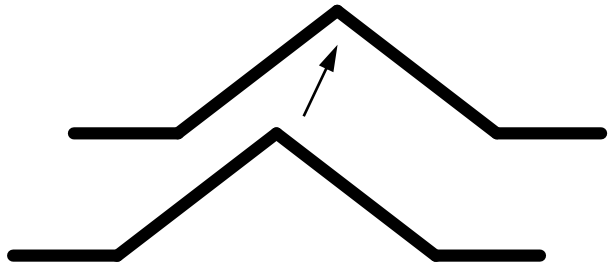


Connector with pins

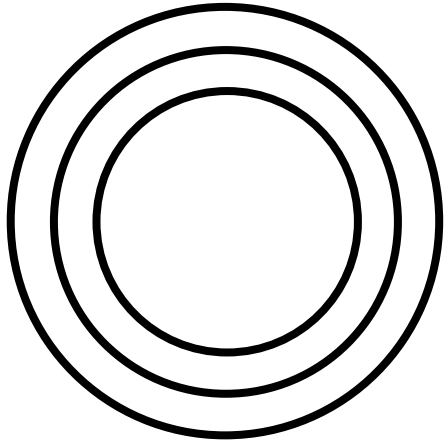
→ Not rotational symmetric

→ Not ideal for a robotic connection

IDEAL AUTOMATIC CONNECTION INTERFACE FOR ACD-U



→ Conical shaped Connector for Self-Centering



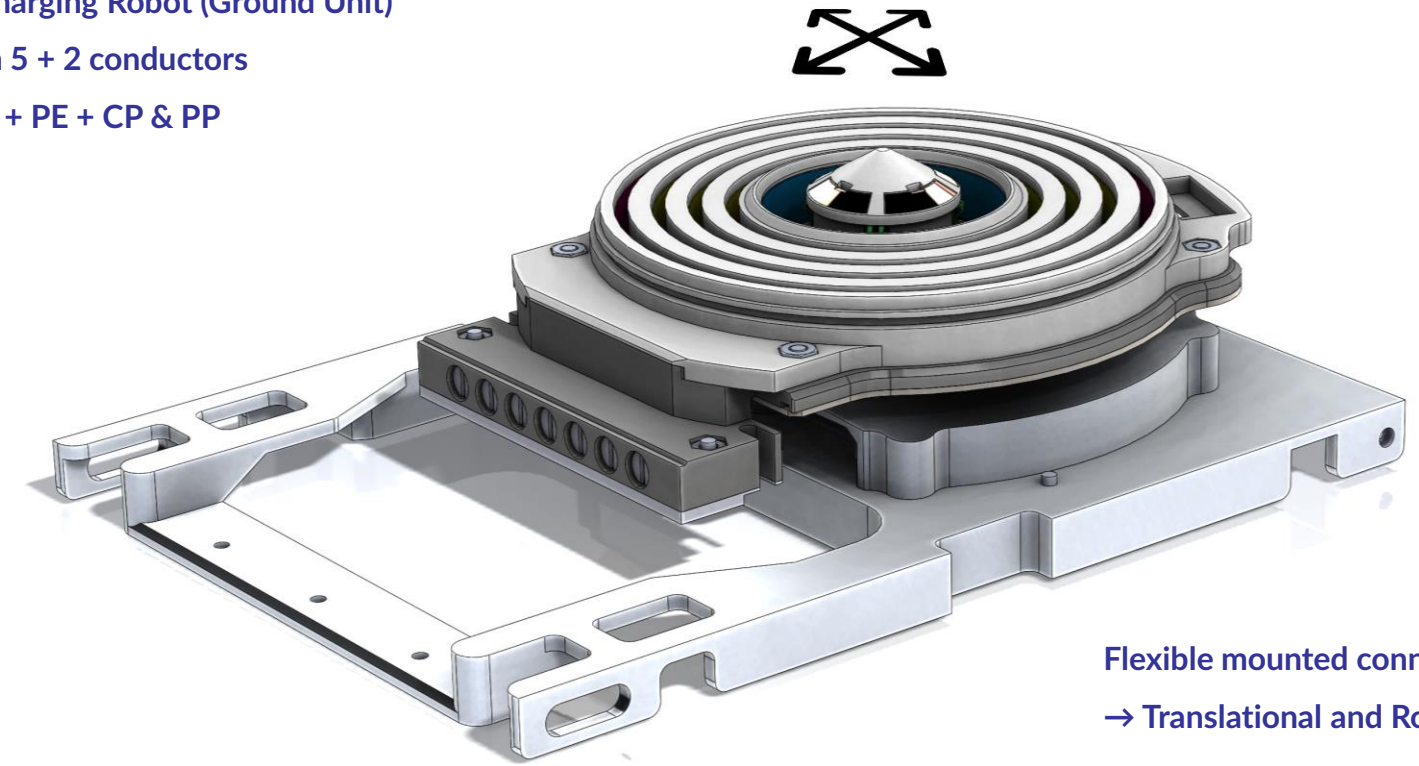
→ 360° Contacts instead of pins

360° SELF-CENTERING VOLTERIO CONNECTOR

Connector at the Charging Robot (Ground Unit)

→ Female part with 5 + 2 conductors

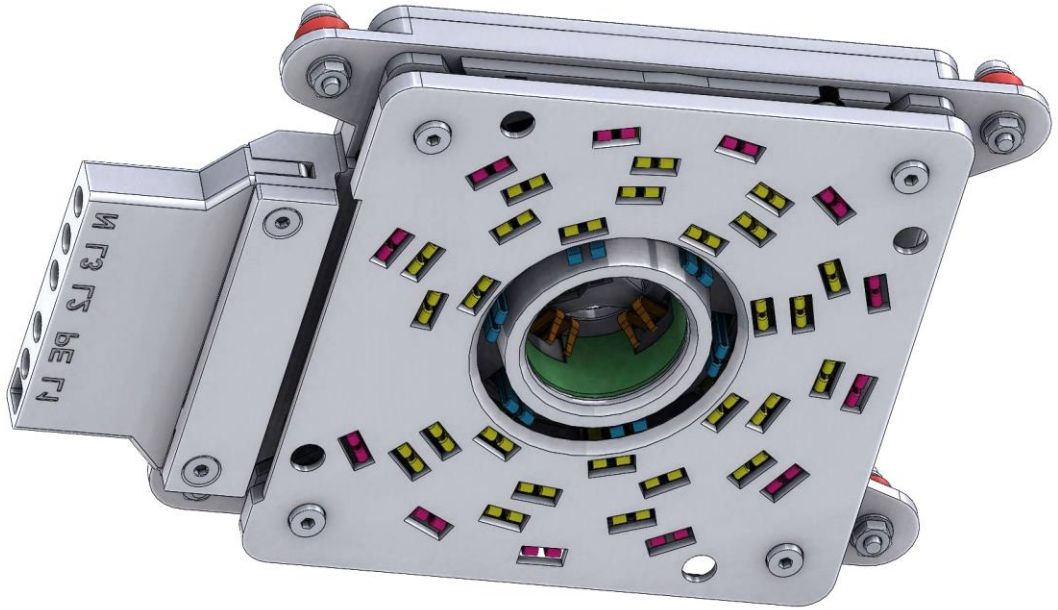
→ L1 + L2 + L3 + N + PE + CP & PP



Flexible mounted connector

→ Translational and Rotational

VOLTERIO CONNECTOR IN THE VEHICLE UNIT



Connector at the Vehicle Unit (97 x 97 x 18 mm)

→ Male Counterpart with moveable contact body

OEM REQUIREMENTS

Onboard (Vehicle Unit)

- Low cost, small packaging size (minimal height)
- Minimal complexity in the vehicle -> low development risk
- Easy homologation
- HV-safety due to multiple sealings

Offboard (Ground Unit)

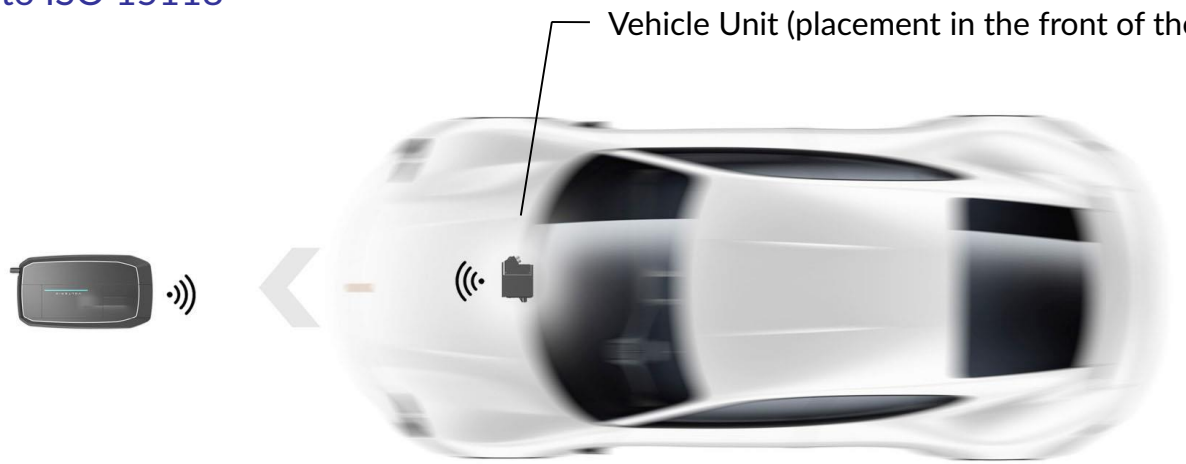
- No homologation required
- Robust, low cost 3-axis robot
- High charging capacity (AC & DC)
- HV-components completly sealed
- High contact quality
- Protected against dirt, moisture, corrosion

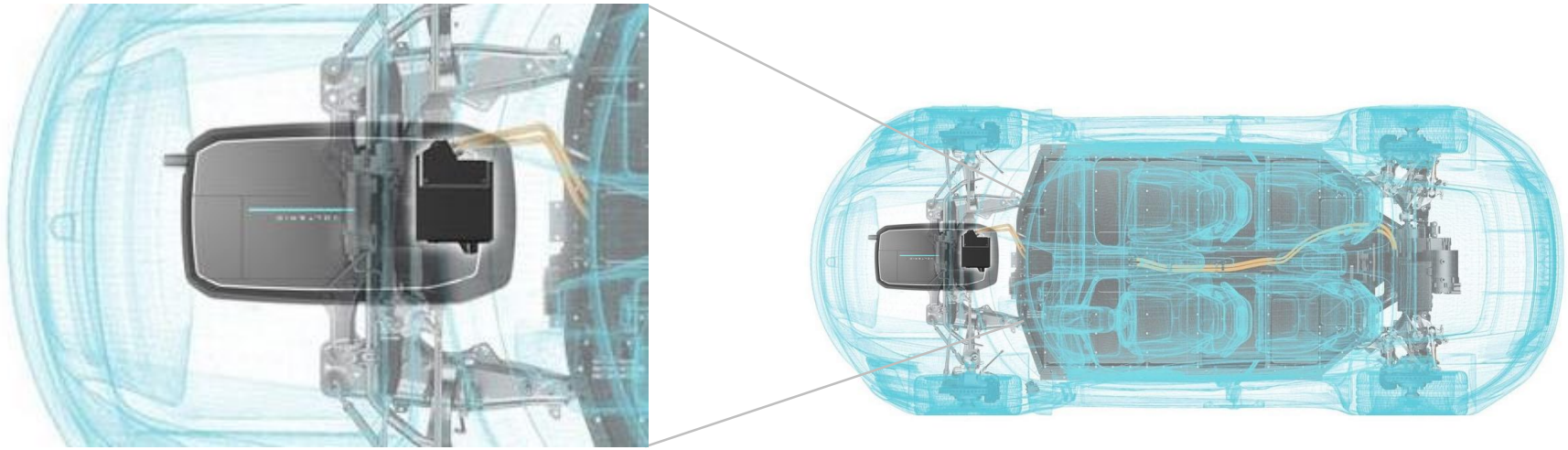
Vehicle Unit

Ground Unit (Charging Robot)

VEHICLE APPROACH

- WLAN Communication between VU and GU according to ISO 15118
- Pairing >5m, then guiding to the final parking position within the working area of the ACD





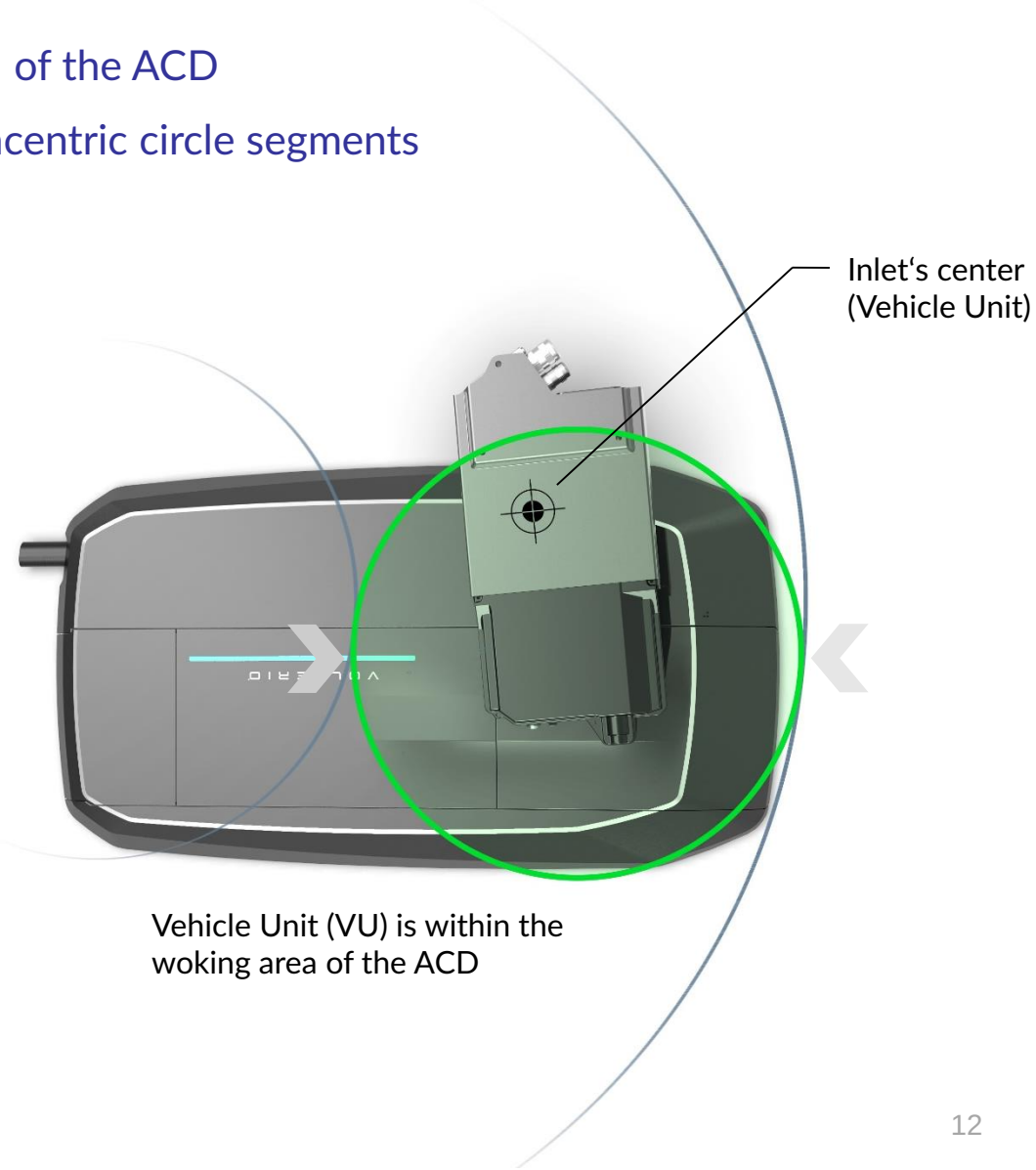
Final parking position for automatic connection

WORKING AREA OF THE CHARGING ROBOT

- Inlet‘s center of the vehicle unit must be within the working area of the ACD
- Theoretical working area can be described between the two concentric circle segments

  -> can be limited to the green circle (Ø > 400 mm)

Ground Unit (GU)
L 800 mm x W 420 mm x H 67 mm



Vehicle Unit (VU) is within the
woking area of the ACD

AUTOMATIC DOCKING - 1

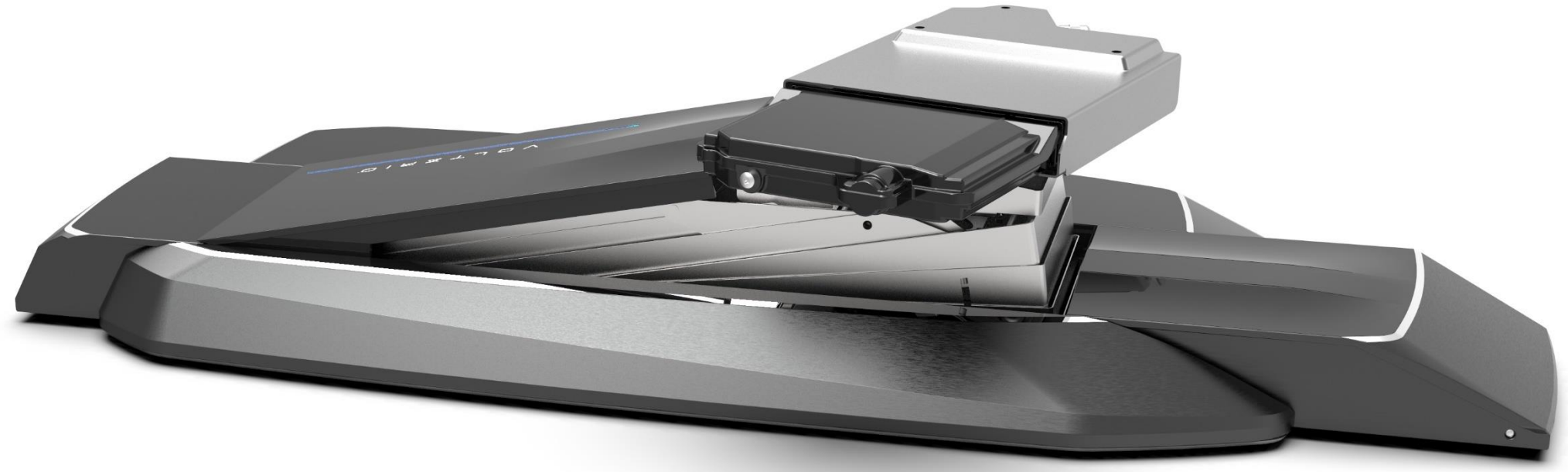
AUTOMATIC DOCKING - 2

Guided by the positioning system the robot moves forward until it reaches the right longitudinal position under the VU‘s Inlet

AUTOMATIC DOCKING - 3

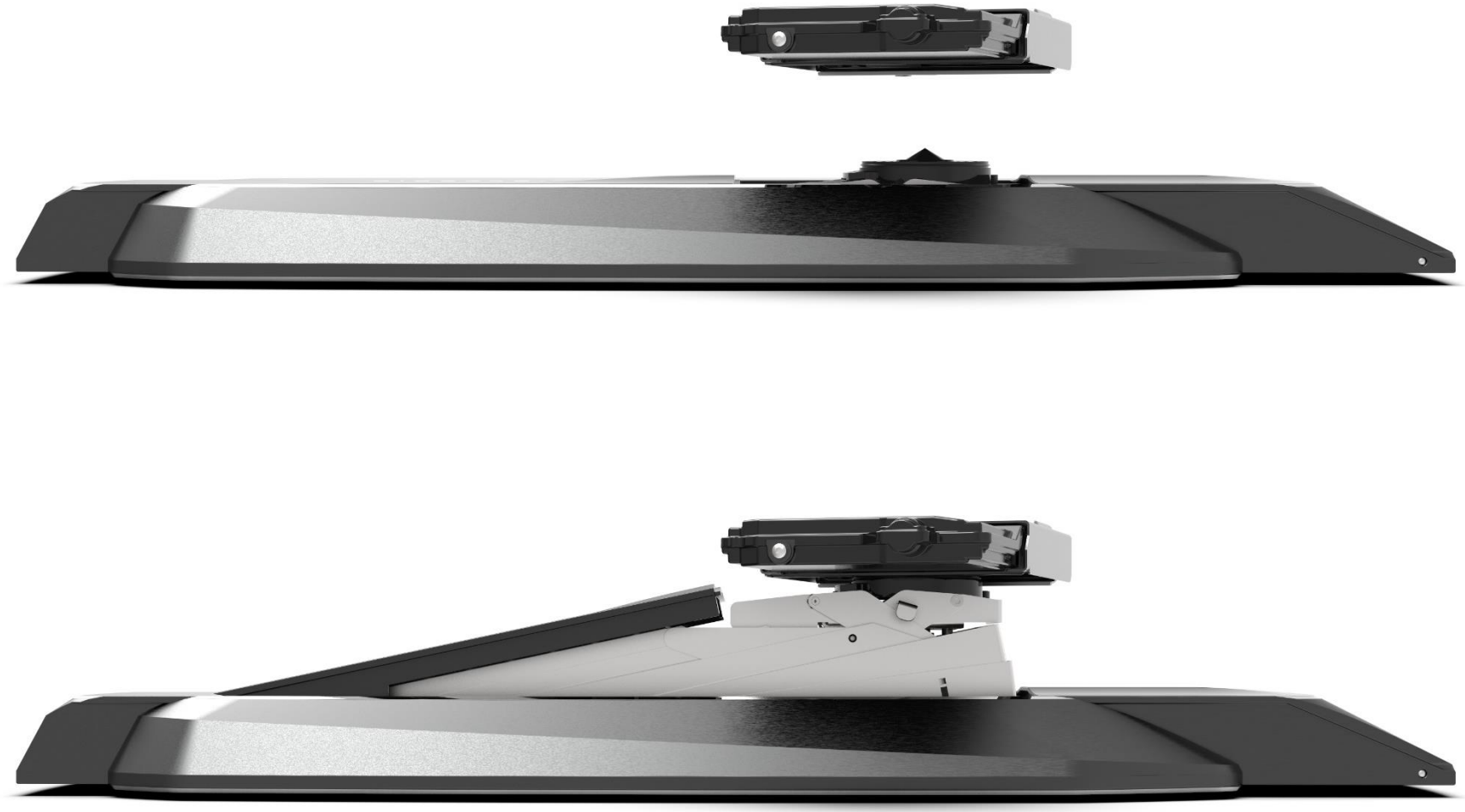
The entire robot rotates counter-clockwise until it reaches the the position straight under the VU‘s Inlet

AUTOMATIC DOCKING - 4

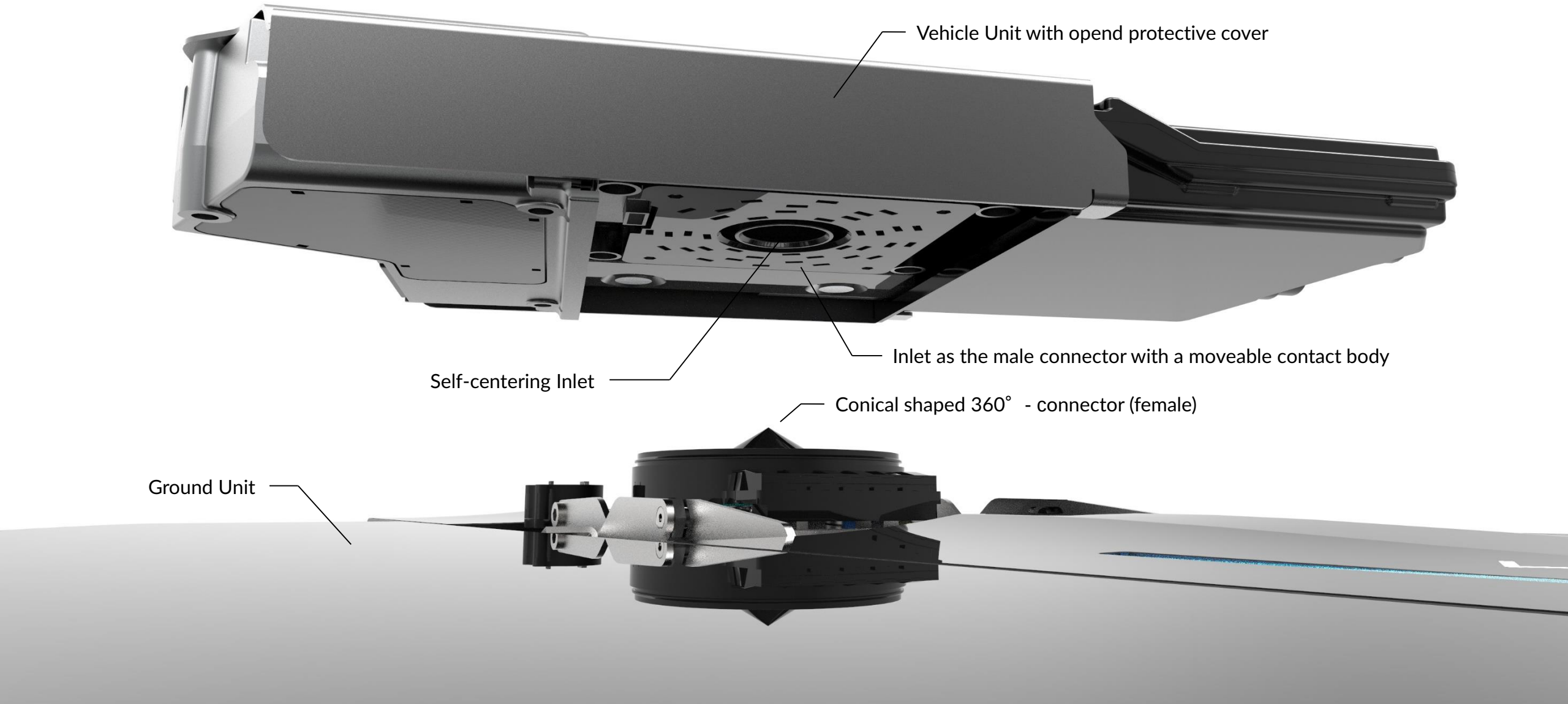


Charging starts automatically when docking is accomplished and a secure connection is ensured
Minimal underbody clearance for an automatic connection is <85 mm, maximal height for docking is 250 mm

DOCKING- SIDE VIEW

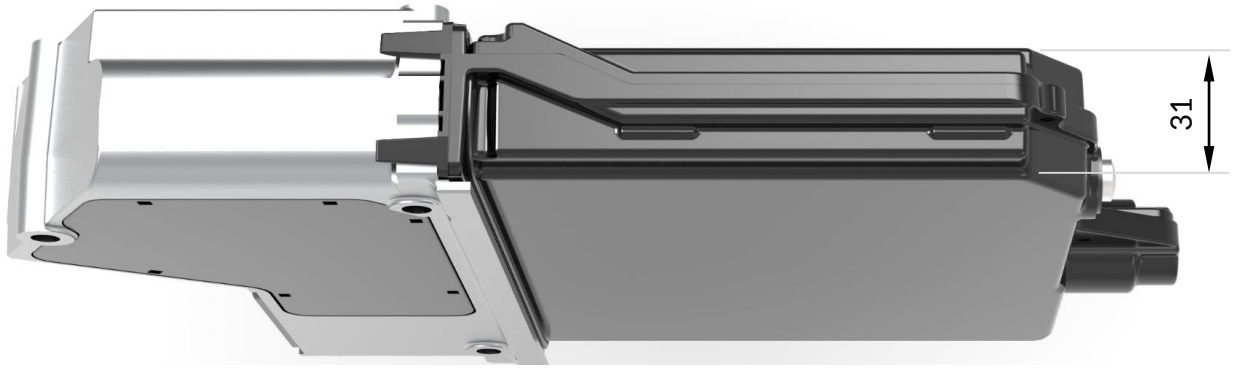


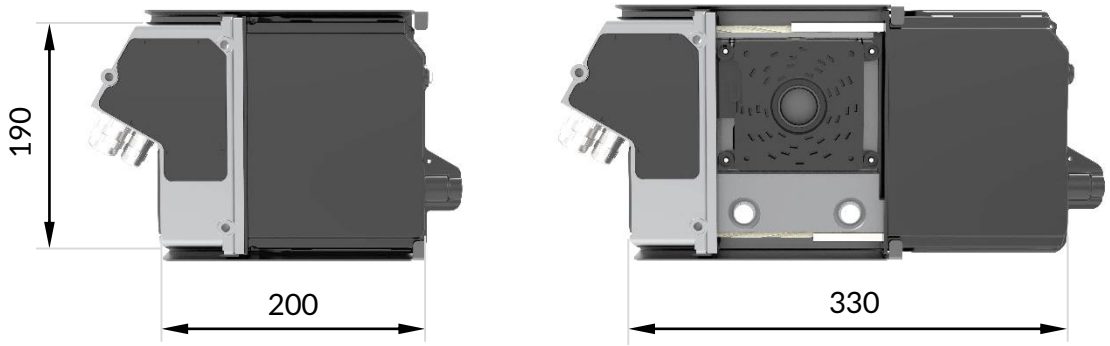
CONNECTOR INTERFACE - UNDERBODY VIEW



VEHICLE UNIT - PACKAGING

Dimensions in mm





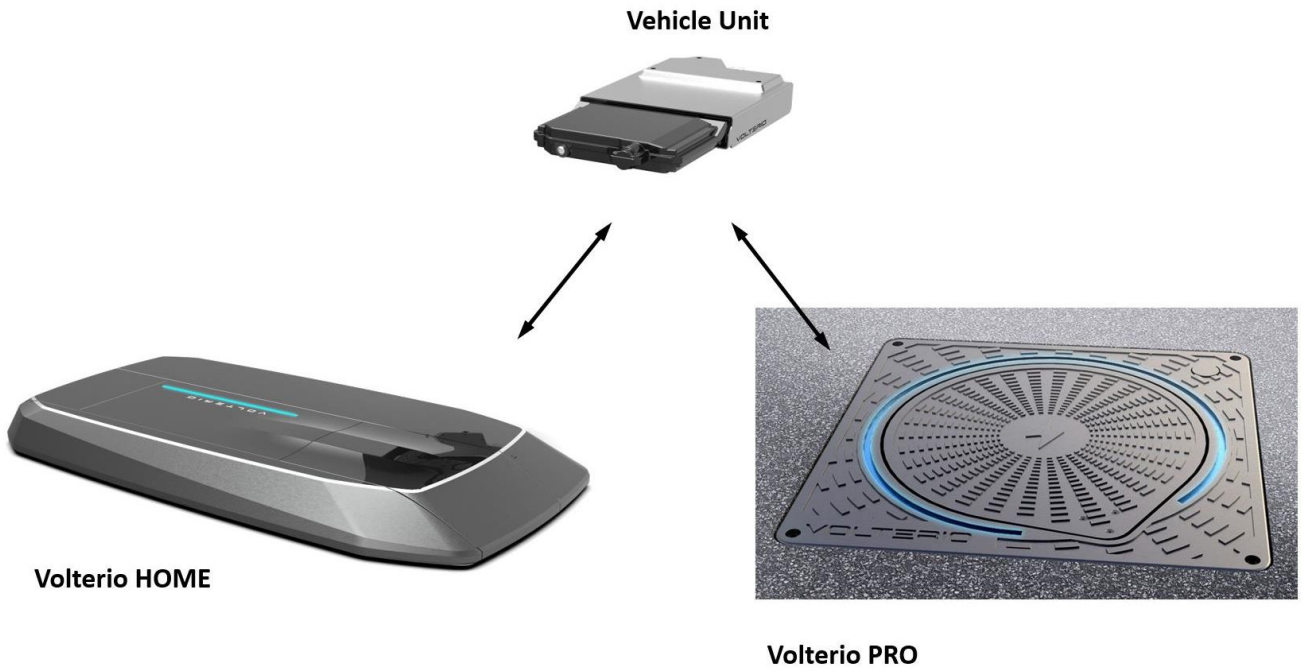
INTEROPERABILITY

Use Case Primarily for Charging at Home (Garages/Carparks)

- No complicated Installation
- → Just Plug and Play and On-The-Ground Solution

Public Charging (Street Charging, Primarily for Outdoor)

- Robot will be fully flush embedded in the ground
- Fully interoperable system, different use case



INTELLECTUAL PROPERTY & STANDARDIZATION ACTIVITIES

- 8 patent families in most important markets worldwide
  - Charging process
  - 360° hpc connector
  - Different robot variants
  - Positioning system

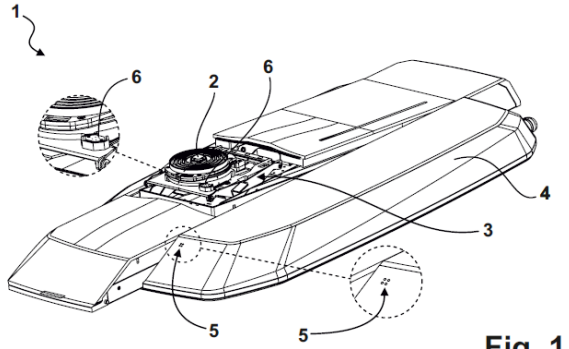


Fig. 1

- Standardization Bodies VDE/DKE, VDA, ISO, IEC
- Core Member in CharIN (Charging Interface Initiative e.V.)
- Support from industry leaders

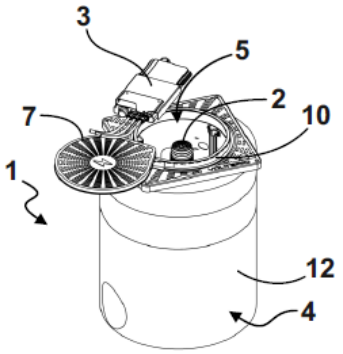


Fig. 7

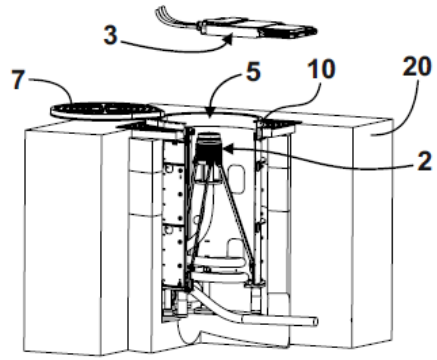


Fig. 8

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