



1 Underbody charging in public areas.

UNDERBODY CHARGING TECHNOLOGY AUTOMATED FAST CHARGING

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Background

In order to achieve a high range, large amounts of energy have to be transferred in short periods of time – similar to the standard refueling process. As the numbers of automated vehicles increase in the future, it will be possible to execute a fully automated charging process from positioning to billing.

Outset

At present, the market offers different charging systems for electric vehicles. If large energy amounts are to be transmitted, only conductive, i. e. contact-based systems (charging cable and plug), can be applied. These flexible solutions limit the system's charging capacity to approx. 150 to 200 kW and are therefore not suitable for fast-charging systems with higher performance.

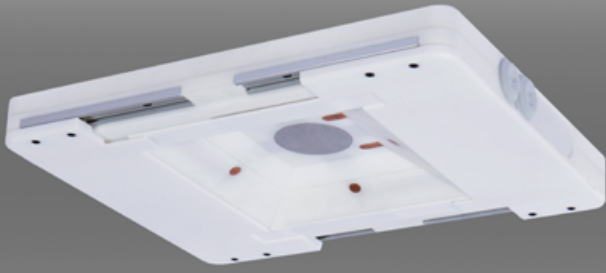
Fraunhofer IVI has developed a fully automated, reliable and safe charging system for this application scenario that overcomes the performance restrictions of conventional plug-and-cable combinations.

With the help of this new technology, it is possible to transmit one megawatt to electric passenger cars and two megawatts to electric trucks. All this is done fully automatically, safely and reliably without the involvement of a human operator.

The system has

- a single interface for both fast and slow charging,
- no charging capacity limitations and
- optimal operating comfort thanks to full automation.

The use of charging cables will no longer be necessary.



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Vehicle Interface

During the development process, special attention was paid to keeping the technology simple and easy to maintain. According to the directives of the automotive industry, the system's vehicle component needs to be very small, light and also cost-effective, given its prospective high production numbers. Additionally, the following requirements must be met:

- compatibility with DIN EN 61851-23-1
- 2.8 liters installation space
- 2.5 kg total weight
- dirt protection cover
- easy integration or retrofitting
- compatibility with the infrastructure of both public and private areas

Public Area (Charging Station)

Because of the system's high transmittable charging capacity, the recharging process is comparable to conventional refueling in terms of duration.

Therefore, suitable installation sites for the roadside charging interface are conventional gas stations. The charging actuator is embedded in a compact shaft system and placed 70 cm deep in the ground. Vehicles can easily drive over it for recharging. 10 to 20 charging processes per hour and contact system can be performed at this electric charging station.

Key design aspects such as simplicity, robustness, durability and low maintenance requirements guarantee that the system will work smoothly over several years:

- 1 MW charging capacity for cars (up to 3,5 t)
 - 600 km range within 5 minutes
- 2 MW charging capacity for trucks
 - 100 km range within 3 minutes
- fully automated charging process
- integrated compensation of positioning tolerances
- safe to be driven on, D400 cover
- dimensions of road duct
 - 763 mm x 550 mm
 - depth 665 mm

Private Area (Garage)

Fraunhofer IVI also offers a cost-effective and simple solution for charging at home, for instance, in a garage. This system is simply placed on the garage floor. Its maximum charging capacity is currently restricted by the typical limitations of home power connections:

- recharging in non-public areas
 - 600 km range within 5 hours
- simple installation
- Mecanum-wheeled
- safe to be driven on

The option of recharging in private areas allows the use of this newly developed charging technology even prior to a comprehensive, widespread introduction of the automated fast-charging system.

Safety

Short charging periods require a high system voltage of 400 or 800 VDC and charging currents of 2000 A and more. Therefore, the requirements towards the safety and reliability of the contact system are especially high.

This affects contact protection, the prevention of electric arcs and unintended heating as well as a secure charging sequence control. In addition, basic safety regulations, for instance regarding slipping and getting caught, have to be followed.

The system developers applied European and international safety and execution standards and norms regarding a clean and safe development process.

2 *Vehicle interface.*

3 *System ready for installation.*