Fraunhofer IVI

Underbody Charging Technology

Automated Fast Charging

1 Underbody charging in public areas.
2 Vehicle interface.
3 System ready for installation.

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 the car 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 kW (uncooled) to 350 kW (liquid-cooled) and are therefore not suitable for fast charging systems with higher performance.

For this application scenario, Fraunhofer IVI has developed a fully automatic charging system 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

- an identical vehicle 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 and IEC 61851-26 (under examination)
- 3.2 l installation space, 3.0 kg total weight
- Parking is supported in the direction of travel and reverse
- 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. Vehicles can easily drive over it for recharging or leaving the electric charging point.

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

- 900 A continuous charging current and up to 1000 V charging voltage for cars (up to 3,5 t)
- 1700 A continuous charging current and up to 1250 V charging voltage for trucks
- Fully automated charging process
- 140 mm by 140 mm integrated compensation of positioning tolerances included
- Safe to be driven on, D400 (DIN EN 124) cover
- Dimensions of road duct
  - 920 mm x 553 mm
  - depth 880 - 1100 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
- Up to 22 kVA AC and up to 150 kW DC charging power (combined charging interface with separated contact pins)
- Simple installation
- Mecanum-wheeled self positioning
- 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, 800 or even 1250 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.

References

MEGA-LADEN

GUW+