



Transit

Battery Driven Vehicles

Pioneering charging solutions for the mobile future





E-mobility is on its way. Get on board!

All around the world, mobility is becoming more environmentally friendly, more networked, more efficient and easier. Schunk has been a part of this development from the beginning. As an innovative development partner for e-mobility, we are paving the way into a new mobile future for our customers.

The way we move has been continuously changing for centuries. Over the course of this development, we have regularly seen key innovations that took mobility to a new level, such as the invention of the steam engine and the combustion engine. Today, we are on the cusp of another such shift: Mobility is going electric!

Battery-driven vehicles are a key component of this new area of mobility and are increasingly expanding their role in private, industrial and public transportation. Alongside batteries and vehicles, charging systems and infrastructures must undergo continued advancements in order to realise the electrification of our mobility systems.

Schunk supports you in taking the critical step toward e-mobility. With Schunk Smart Charging, we offer you a technologically-leading, mature and practice-proven charging system for buses and cars that harnesses the advantages of hybrid and fully-electric vehicles: greater sustainability, lower environmental and noise impact and greater efficiency and economy.

In collaboration with our customers, we are advancing the development of e-mobility and opening up new, zero-emission drive alternatives that can be flexibly adapted to the respective operating parameters. For instance, our charging system for electric buses and industrial electric vehicles enables automated and reliable charging of batteries in seconds via a fast charging pantograph or an inverted pantograph.

With the underbody charger, Schunk presents a prototype of the electric fuelling station of the future, which will safely, efficiently and conveniently allow for autonomous charging of various vehicle types in just seconds. This is made possible by a charging station embedded in the pavement and the docking module installed in the vehicle underbody.

Schunk is a global leader and your competent development partner for all aspects of e-mobility. Take advantage of our extensive material know-how, our capacity for innovation and our flexibility to address your specific requirements. Get on board with the mobility of the future and embark on the journey with us at your side.

Schunk is a global leader in the development, manufacturing and application of carbon and ceramic solutions. No other company can match Schunk when it comes to combining innovation and technological expertise with an exceptional service orientation to produce a spectrum of services that is unique on the market.

In Schunk, you will find a partner that offers you all the technological capabilities of a globally active company who can realize your ideas pragmatically, and specifically tailor them to your needs - for high-volume industrial markets and highly-specialised niche markets.

The Schunk Group

Empowering, idea-driven, collaborative - this is how the Schunk Group has made a name for itself as a globally active technology group since 1913.

Empowering, because we build bridges for our customers to help them develop better products and conquer new markets with innovative technologies. Idea-driven, because innovations are a significant aspect of our company culture.

Collaborative, because every employee of the Schunk Group is focused on the customer.

The Schunk Group is a globally operating technology company with a global business unit structure. The company is a leading supplier of products made of high-tech materials - such as carbon, technical ceramics and sintered metal - as well as machines and systems - from environmental simulation and air conditioning to ultrasonic welding and optical machines. The Schunk Group has more than 9,500 employees in 29 countries and achieved sales of €1.28 billion in 2018.



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Schunk Smart Charging prepares electric buses for daily service

With the innovative Schunk Smart Charging system, electric buses will always run on time. Our system enables reliable charging of batteries along the route or at the depot in just seconds.



More and more cities and companies are banning diesel-powered buses in favour of zero-emission, battery driven vehicles. The largest problem here are the batteries. To ensure that electric buses have sufficient range for daily use, batteries must either be large enough or be charged more frequently.

We have developed a fitting solution in the form of Schunk Smart Charging. With short charging times and the associated large operating ranges of the buses, this innovative charging system opens up entirely new possibilities in matters of efficiency, performance and flexibility. The electric buses are charged automatically, reliably and in just seconds at the depot or during continued operation.

This allows batteries to be sufficiently charged even while passengers are getting on and off at a stop. Even a full charge of empty batteries can be accomplished in less than

20 minutes. This allows the battery size to be significantly reduced to achieve a highly-effective relationship between battery size, passenger capacity and range.

The extremely flexible system can be custom-designed and optimally integrated into a completely new charging infrastructure installation or in connection with pre-existing solutions. The system can be implemented with a fast charging pantograph or an inverted pantograph - You can read about both variants and their respective advantages on the following pages.

Next stop: Charging.

Our fast charging pantographs are a technological milestone. Thanks to many years of development competence, they set entirely new standards in the market segment for conductive, fully-automatic charging of electric buses.

The compact, fast charging pantographs SLS 102 and SLS 103 are mounted on the roof of the electric bus and function according to the "bus up" principle: The bus stops under the charging station, and the roof-mounted current collector extends to connect with the charging station and charge the batteries.

The charging can take place either in the depot or at a charging station along the route - without causing a delay in regular operations. This is achieved through extremely fast contact and very high current transmission. For example, the SLS 102 enables contact in just four seconds and 30-second 1 MW pulse charging. It is capable of reliably charging buses of varying heights, all the way to a double-

decker. The drive mechanisms of the system compensate for vehicle movements during the charging as well as parking tolerances.

Our fast charging pantograph SLS 102 is already reliably in use on many buses. With Schunk at your side, the economical use of electric buses is no more theory, it is an established fact.



Fast charging pantograph SLS 103

Enjoy the following advantages:

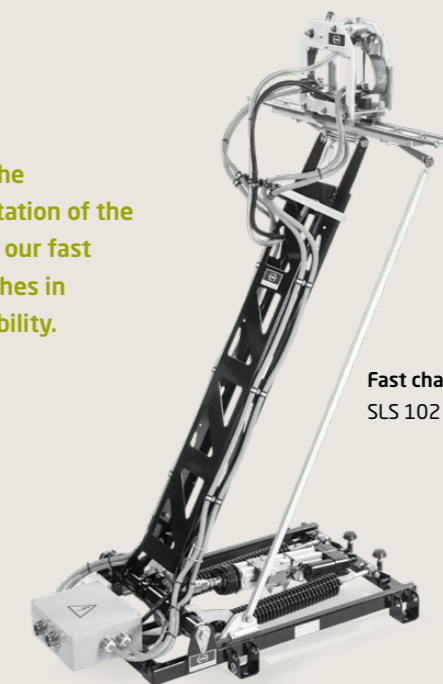
- "Bus up" contacting principle
- High-power transmission up to 1 MW
- Recharging in just a few seconds
- Minimum of four poles and contact sequence for reliable charging
- Precise compensation of parking deviations and kneeling effects
- Suitable for opportunity charging, flash charging and depot charging

Your contact for our Schunk Smart Charging:

✉ bus-transit@schunk-group.com

We do it your way.

Your requirements and conditions form the framework for the design and implementation of the charging system. We can precisely adapt our fast charging pantograph to your specific wishes in terms of current transmission and availability.



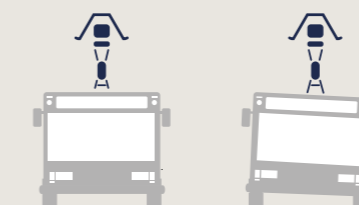
Fast charging pantograph SLS 102

Contact units



Various contact units can be employed, depending on the conditions. For instance, a pre-existing infrastructure can be utilised, and even varying electric grids pose no problem for the system.

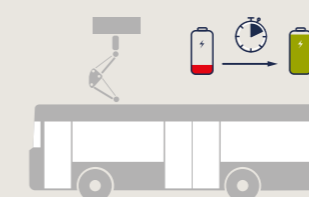
Compensation of tolerances



With our drive mechanisms, we offer fast and efficient charging - regardless of the road conditions. Vehicle movements during charging as well as parking tolerances are compensated for.

- ± 500 mm in the direction of travel
- ± 250 mm transverse to the direction of travel
- 4° kneeling

Current transmission



Whether flash, opportunity or depot charging - our system allows flexible, situation-optimised charging of the batteries.

- 1 MW up to 30 s
- 750 kW up to 60 s
- 500 kW up to 15 min.
- 150 kW continuous

Charging turned on its head

Sometimes there are systems that completely redefine a category. Our inverted pantograph SLS 201 is just such a solution - it establishes the globally-proven standard for the flexible, fast and reliable charging of electric buses.

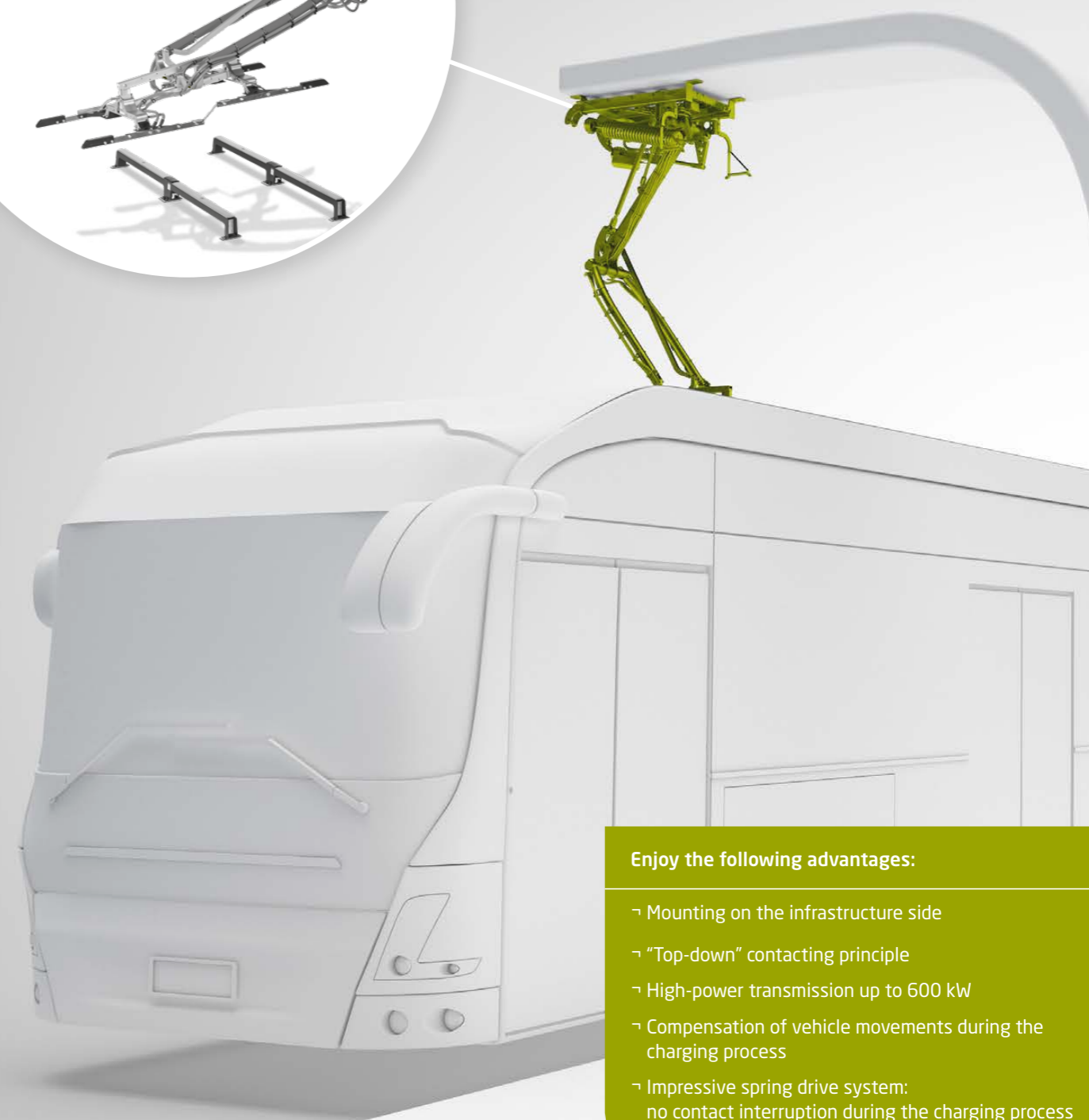
On the infrastructure side, the inverted pantograph SLS 201 from Schunk is integrated at a central location, such as the bus depot or a location within the route network. The contacting functions according to the top-down principle: The bus parks beneath the inverted pantograph, the collector lowers itself, connects to the opposite element on the bus roof and charges the batteries.

With its half-scissors design, it is possible to charge vehicles of various heights at the same central station - from typical buses to double-deckers and special vehicles. The unique spring drive system exerts a constant contact pressure to ensure uninterrupted contacting and requires no additional sensors for the charging of different bus types. A built-in, fail-safe function protects the pantograph in the event of a power failure or a fault.

The SLS 201 is designed for over one million charging cycles and has a multi-pole concept with at least four poles. The secure contacting takes place within just five seconds and enables a power transmission of up to 600 kW. Thanks to the open interface of the contact system, the inverted pantograph can be easily adapted to existing systems. Three solutions are available with the INVESA Current Rail Interface, the INVESA Cover Interface and the INVESA Funnel Interface.



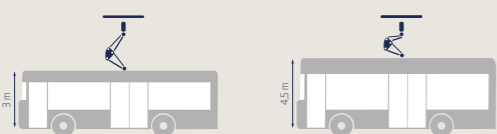
Inverted pantograph
SLS 201



Flexible from empty to full

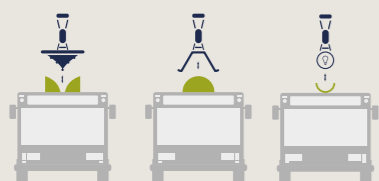
In developing the inverted pantograph SLS 201, we put the focus on adapting precisely to the requirements of our customers. It can be implemented in entirely new charging infrastructures or embedded into pre-existing systems.

Operating range



The flexible half-scissors design of the inverted pantograph enables the charging of various vehicle types (typical buses as well as double-deckers) at a bus stop or charging point.

Kontakteinheiten



The 4-pole system ensures a constant distribution of contact pressure at all four conductors and reliably compensates for vehicle movements during the charging.

Enjoy the following advantages:

- ↳ Mounting on the infrastructure side
- ↳ "Top-down" contacting principle
- ↳ High-power transmission up to 600 kW
- ↳ Compensation of vehicle movements during the charging process
- ↳ Impressive spring drive system: no contact interruption during the charging process

Your contact for our Schunk Smart Charging:

✉ bus-transit@schunk-group.com

 Start 2012

 over 20 countries

 SLS 102

 SLS 201

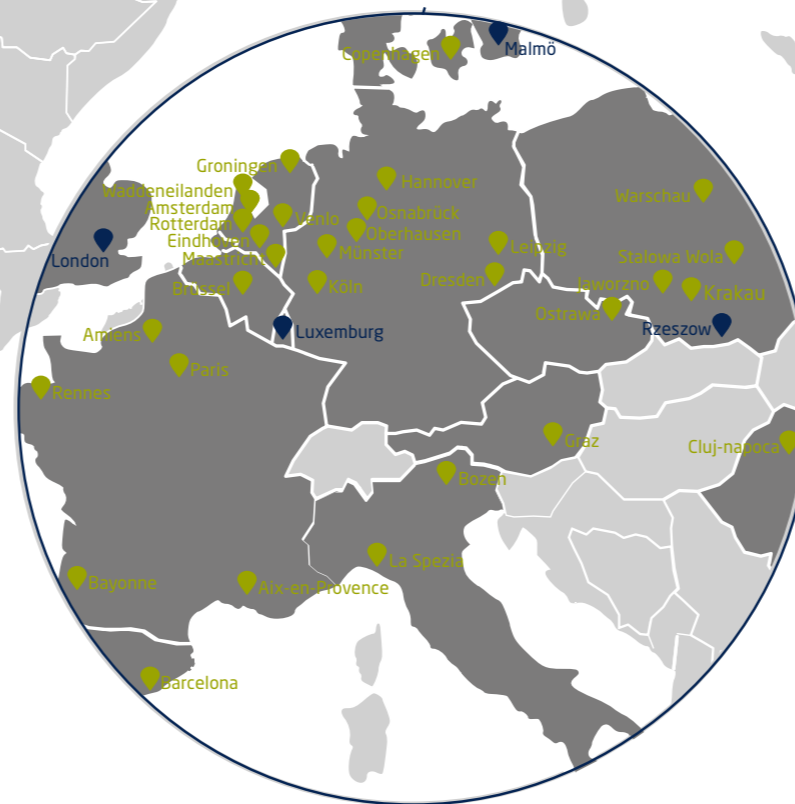
In successful use around the world

E-mobility is gaining speed everywhere. Now's your chance to hop on board! With Schunk, you can transition from a pure paper concept to a successful practical application. Rely on our years of experience gained as a world market leader in over 600 international projects.*

The efficient and flexible opportunities presented by Schunk Smart Charging make our charging system one of the most attractive solutions the world over. Numerous vehicle and charging station manufacturers are working closely with us to develop the best customer-specific and country-distinct applications possible.

The number of projects is constantly growing: While only individual buses were outfitted at the start, today we supply this key technology to fleets of up to 200 vehicles. This, too, demonstrates that e-mobility is constantly gaining speed. We would be happy to provide you with more detailed information about individual projects. Just contact us!

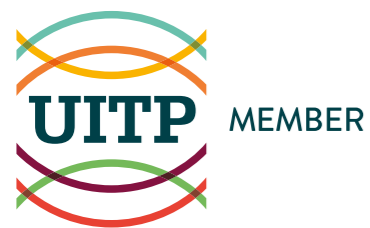
*As of the start of 2019





Charging will be as easy as filling up the tank

In the automotive industry, e-mobility is held back primarily by insufficient charging infrastructure. Either it is entirely absent or the current charging stations require too much time and laborious manual operation. Schunk is developing the leading alternative technology here: The electric charging station of the future for the public and private sectors.



Simple battery charging will mark a critical advancement in the daily usage of e-mobility applications. This is precisely the challenge being addressed by Schunk with the development of the underbody charger. This underbody charging system will eventually permit efficient charging in just a few seconds, safely and conveniently - both as a public charging station and in the home garage.

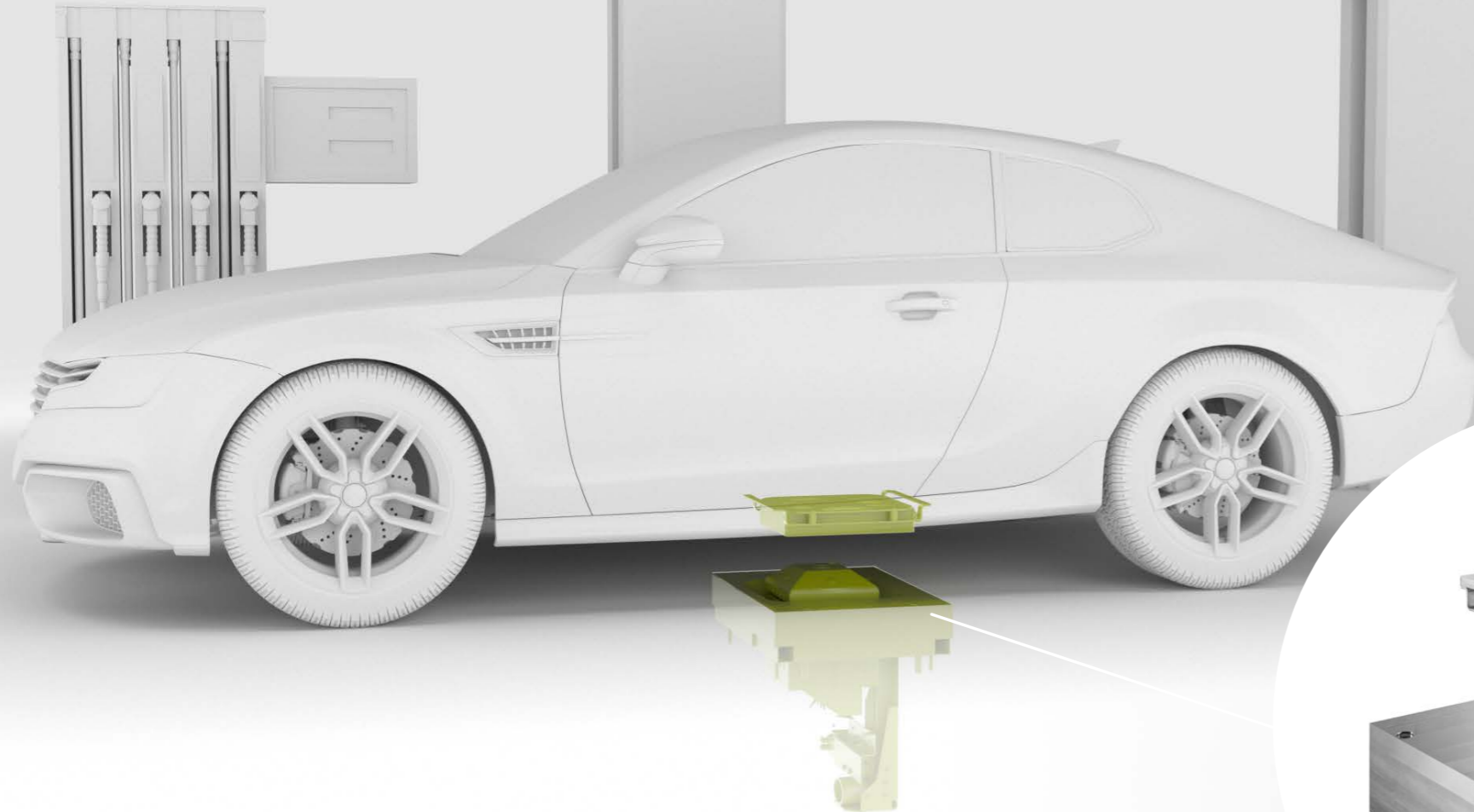
This is made possible by a charging station that can be embedded into the ground, the interface installed in the vehicle underbody and the extremely high power transmission of up to 1 MW - typical charging technologies only achieve a power level of about 500 kW. The charging system is set approximately 70 cm into the ground and is driven over by the vehicles to be charged. This allows approximately ten charging processes per hour with one contact system.

For private use, the charging station can be easily placed on the garage floor without the need for any excavation. Alongside the enormous reduction in charging time, the other outstanding innovation of this charging solution is the complete automation of the charging process. No more charging cable or plug - the car is positioned precisely overtop the charging station and charged automatically.

Since the project began at the end of 2017, Schunk has already achieved impressive results with the underbody charger. After building of the prototype, it has already been possible to realise the first successful pilot projects. If you are also looking to get e-mobility into the passing lane, we would be pleased to share our development know-how with you!

The power station of the future is in the ground

The best things come from below - at least when it comes to the future charging of electric vehicles.
With its underbody charger, Schunk has developed a fully-automatic charging system that sets new standards.



Simple and safe

The vehicle interface - simple and maintenance-friendly

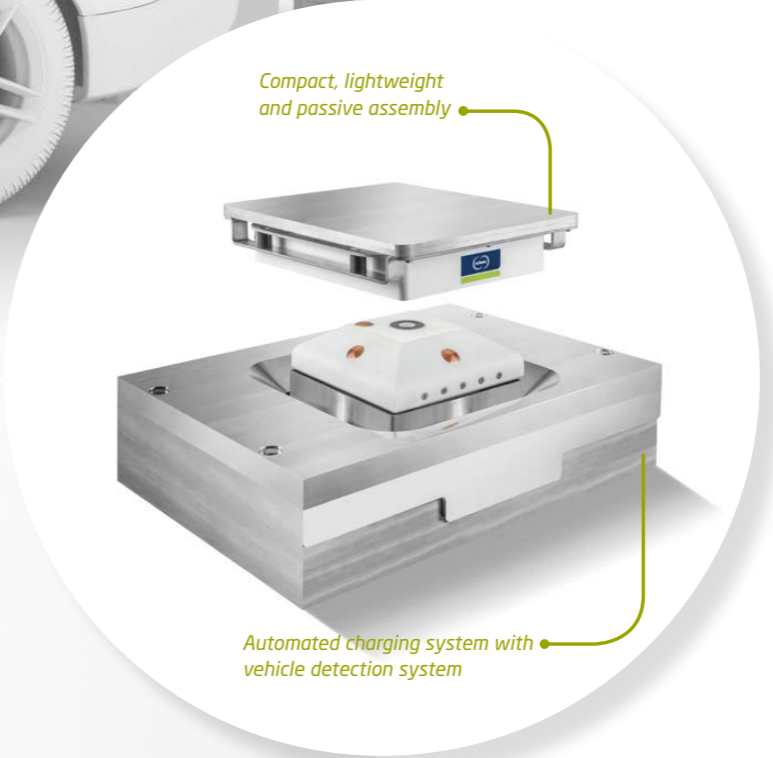
In line with the requirements of the automotive industry, the vehicle interface will be small, lightweight and inexpensive. As a passive component, it is easy to integrate or retrofit and has an installation volume of just 5 litres and a weight of only 5 kg.

Safety first - we've thought of everything

All relevant safety and design standards as well as fundamental safety regulations - such as problems related to getting caught or sliding out - were taken into account in the development of the underbody charger. In consideration of the high-system voltage, the contact systems were designed for particular safety and reliability with regard to contact protection, avoidance of arcing and undesired heating as well as secure charging process control.

The payment system - simple and convenient

The underbody charger is also ideal for autonomous vehicles in connection with a networked payment system. In this combination, you need not concern yourself with the driving, charging or paying.



Benefit from the advantages of the underbody charger:

For public charging stations:

- ↳ Up to 1 MW charging power for cars - 600 km range in 5 minutes
- ↳ Fully-automated charging process
- ↳ Integrated parking tolerance compensation
- ↳ Integrated vehicle detection system
- ↳ Robust, long-lasting, low-maintenance
- ↳ Reliable and safe
- ↳ Conforms to DIN EN 61851-23-1

For the private sector:

- ↳ Inexpensive solution placed on the garage floor (no excavation required)
- ↳ Connection of the cable to the home wall box or power supply
- ↳ Compatible with the underbody high-power charger (same vehicle interface)
- ↳ Integrated vehicle recognition system

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