Faster and faster, further and further

When it comes to presenting new electric vehicles, automobile manufacturers are constantly beating each other with increasingly shorter charging times and longer ranges. It is easy to determine that this calculation only works to a limited extent. In addition, this procedure is anything but beneficial for the service life of a vehicle.

More and more cities want to impose a driving ban on diesel vehicles due to stricter air pollution regulations. The pressure on the automotive industry to offer vehicles with the lowest possible emissions is growing. After all, who buys a vehicle that will no longer be allowed to drive into town tomorrow?
So the potential buyers have to be convinced with pithy slogans that the latest electric model can be charged from zero to 100 % in just a few minutes and can cover hundreds of kilometres. Unfortunately, it is not that simple. Physics cannot be outwitted with such sayings. Here are a few simple facts.

The weakest link determines the maximum charging power.

How long does it take to charge?

The calculation is done quickly. Take the battery capacity of a vehicle in kWh and divide it by the power (kW) of the charging station. This way you get the number of hours for a full charge (0 100 %).

The weakest link

When charging, always note that the charging process consists of the mains, the charging station, the charging cable and the charger itself like a chain. The weakest link of such a chain always determines the maximum charging power. If the charger can only cope with 6.6 kW, it won't help if you "pump" electricity into the batteries with a 22 kW charging station.
At this point, you should say goodbye to the information provided by some manufacturers, who attribute particularly short loading times to their vehicles. Please read the small print! Under which conditions are these loading times realistic? At an external three-phase high performance charging station or at home?

Charging at home

In practical terms, this results in the following charging times at home for the Nissan LEAF with the 40 kWh battery, which has been the best-selling electric vehicle for a long time: We need 22 hours at a standard 230 V socket (10 A / 1.8 kW) via a charger belonging to the vehicle, which should only be a practicable value for real emergencies. Moreover, it should be remembered that these socket outlets are not designed to withstand such continuous loads.
It makes more sense and is also recommended by the manufacturer to use their own wall box, a separate charging station. However, the installation of such a terminal belongs in the hands of an electrician. In a 1-phase network, the lithium-ion battery can be charged with 3.7 kW of power, which still leads to charging time of 11 hours. So we have to switch to the 3-phase grid to get more power. The next call to the electrician is scheduled.

Required charging capacity

If you are in the privileged position of owning a detached house, you can easily get a powerful home charging station. The story is different, however, for appartment owners and tenants who park their vehicles in an underground car park used by several parties. The appartment owner must obtain the consent of the owners' meeting. And the tenant needs the permission of the landlord. Let's take another small example: there is room for 30 cars in a normal underground car park. If a conventional vehicle is replaced by an electrically operated one with a three-phase charging station, this should not cause any problems. The situation is different for three, five or even ten electric vehicles. The power system for the underground car park was simply not designed for such loads.
It is therefore not only advisable, but also absolutely imperative, to clarify from the outset how many charging stations the reserves of the house connected load are sufficient for and whether it will be possible at all to boost them later. If several electric cars are attached at the same time, it is best to choose intelligent charging stations which measure the load on the power grid and include it in the respective charging capacity.

Fast charging is "no good"

No matter what the marketing strategists of the automobile manufacturers say: Fast charging harms a lithium-ion battery. The IU charging process, which is used for lithium-ion cells, works with constant current and constant voltage (Constant Current = CC, Constant Voltage = CV). Like the service life, the charging time also depends on various factors, with higher charging capacities above all on the

temperature. Short charging times or high charging currents have a negative effect on the electrode material, shortening the service life and the number of cycles. Gentle charge/discharge massively increases the service life!

Lithium Plating

Charging and discharging Li-ion cells at high currents or low temperatures can lead to lithium plating. Lithium ions are preferably deposited on the anode surface instead of between the layers of graphite. This effect leads to significant losses in performance, lifetime and safety. In extreme cases, lithium plating can even lead to a short circuit or, since metallic lithium is highly flammable, to a fire.

Communication / BMS

BMS (Battery Management Systems) are responsible for controlling and monitoring the charging and discharging process of high-performance battery packs. Their main task is to ensure that each individual cell does not exceed or fall short of a defined state of charge (SoC) during both charging and discharging. The SoC value denotes the remaining capacity of a battery in relation to the nominal value. The value is given as a percentage of the fully charged state. Example: 30 % means that the battery still has a residual charge of 30 % relative to full charge. Depending on the application, the upper and lower limit values for the SoC are 20% to 100% for max. power and 30% to 70% for max. service life.

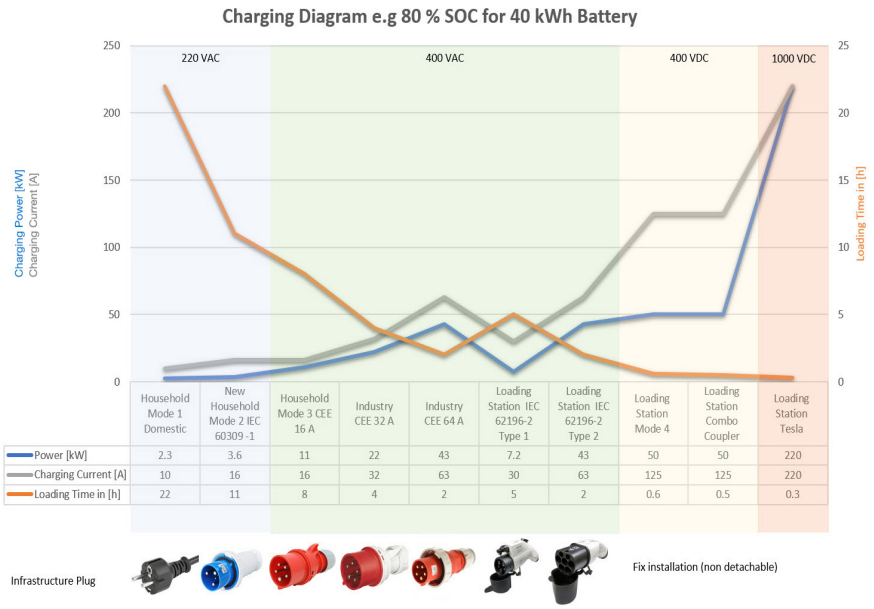
Charging systems overview

Unfortunately, there is no standardized method for charging electric vehicles. There are both country- and manufacturer-specific techniques and plug/socket combinations. Below is an overview of the most common systems currently in use with their key specifications.

The large number of different connections and charging standards may seem confusing from a potential consumer's point of view. In everyday life, however, it is less problematic than one might think at first glance. However, what still needs to be simplified, particularly in the case of public charging points, is access authorization and payment options. For the sake of simplicity, it should be possible to pay by Maestro or credit card, as at a petrol station. This will take some time, but there is no way around it.

IATF 16949: experienced partner

SCHURTER is certified according to IATF16949 and serves a large number of customers with fuses that have been tested according to AEC-Q200 (White paper AEC-Q200 [1]) for various applications (battery management, climate control, engine related electronics for diesel/petrol engines and many more). Millions and millions of fuses to protect against overcurrent and overtemperature (Thermal Protection [2]) are in use worldwide. The close networking with international automotive organizations and the industry itself make SCHURTER a competent partner for all questions concerning the protection of electronics in automotive engineering (Automotive [3]). In addition, SCHURTER has a competence center for EMC solutions, which has been developing customized solutions for industrial and medical applications for decades.



Charging systems overview

Conclusion

The subject of "charging electric vehicles" is characterized by an uncanny dynamic. To illustrate all facets of this topic in a compact white paper is impossible. We will therefore continue to do so.

It's about a future market worth billions. Mobility for all of us. In Germany alone, more than 800,000 jobs depend on the classic automotive sector. The introduction of electro mobility will change a lot. Accordingly, the manufacturers of electric vehicles are struggling with tough bandages and pithy slogans. One should not always believe everything one is presented with. Much is simple physics.

About SCHURTER

SCHURTER continues to be a progressive innovator and manufacturer of electronic and electrical components worldwide. Our products ensure safe and clean supply of power, while making equipment easy to use.

SCHURTER AG
Werkhofstrasse 8-12
6002 Lucerne
CH-Switzerland
+41 41 369 31 11
contact.ch@schurter.com
schurter.com

References / Document Downloads

[1]: https://www.schurter.com/data/download/2356161
[2]: https://www.schurter.com/thermal-protection
[3]: https://www.schurter.com/automotive

3-120-978/07.19/KD