

Basics about EV's charging

Due to rise of EVs sold in last few years, EV charging infrastructure has become a big talking point in e-mobility. As EV do not have same benefits as ICE vehicle owners in “refueling” (no unique standard), need for spreading charger network is even bigger. Because EVs do not have same range as ICE vehicles do, this expansion is even more important.

Number of EV charging stations in the world is changing daily, so it is difficult to get correct information about correct number. Some studies say that in year 2015 there were around 55.000 charging stations across Europe. This number is much larger than approx. 11.000 stations in 2012 (Source: AVERE France), and is growing rapidly. Rise of EVs sales during this last few years has a big influence upon this growth.

Also, lots of countries now offer some kind of government incentives for EV purchase and EV charger installations.

To fully understand EV charging technology, we must mention some terms used in EV charging infrastructure.

Energy supply unit – Device that provides electric power for charging. As you will read later, there are two types of these devices – Home and Public. These units are called Electric Vehicle Supply Equipment (EVSE).

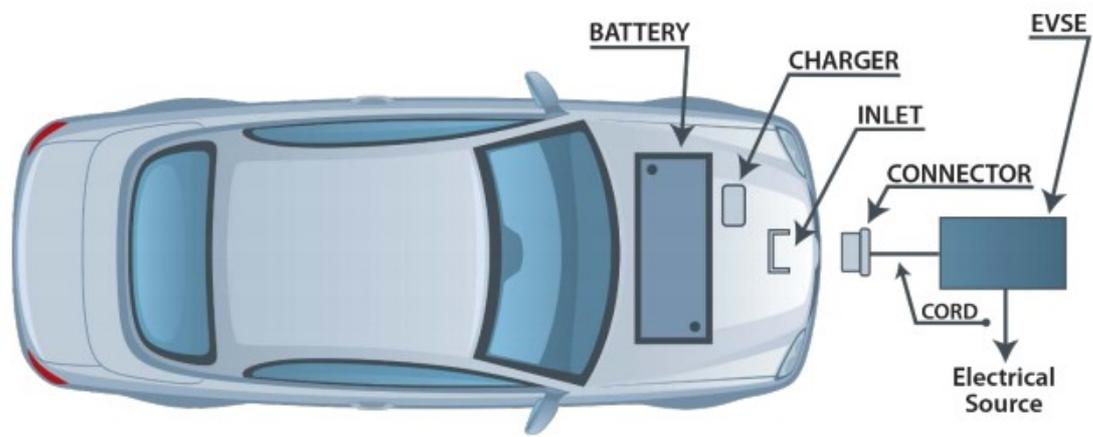
Vehicle connector – Device , which provides physical connection between vehicle and EVSE. Currently there is no standard connector type, and EV producers use few standard connector types.

EV inlet – Mounted on EV, it provides connection between connector and EV. Same as connector, there is no standard inlet type. As there is no standard type, there is no standard mounting location of inlet on vehicle. Most EVs use the location of gas tank plug on ICE vehicles, but inlets can be found on front part of EV, or in the back.

Battery charger – On board device which converts alternating current (AC) to direct current (DC) needed to charge the EV batteries. Battery charger is not needed when DC is applied directly to batteries, but its use is to monitor the charging process.

EV batteries – Known also as “traction” batteries as they provide propulsion to EV. Same

as connectors and inlets, lots of different battery types currently exist, and they differ in their power capacity. Larger power capacity means more driving range. Most of EV today use rechargeable lithium-ion batteries.



Picture 1 - EV charging system ([www.http://www.fsec.ucf.edu/](http://www.fsec.ucf.edu/))

EV charging modes

In year 2001, International Electrotechnical Commission (IEC), published an international standard charging modes in publication IEC 61851 (Electric vehicle conductive charging system) where they defined modes of charging EVs according to power and speed. Today, new publication IEC 62196-2 divides charging modes:

MODE 1 – Slow charging from regular socket. Direct, passive connection, maximum 16A – 3,7 kW single phase / 16A – 11 kW 3 phase, without earthing, prohibited in some countries. It uses standard home inlets, it is very slow, but does not use a lot of electricity.

MODE 2 – Slow / fast charging from regular socket, but equipped with some specific protection (in cable). Direct, semi-active connection, maximum 32A – 7,4 kW single phase / 32A – 22 kW 3 phase. Provides earthing, over-current and over-temperature protection. It is typically used in households which buy EVSE to use faster charging, or in commercial areas for adding range to EV.

MODE 3 – Fast charging using specific multi-pin socket with control and protective function. Active connection, maximum 63A - 14,5 kW single phase / 63A – 43,5 kW 3 phase. Communication between EV and grid allows integration of system in smart grid. Mostly used in commercial, public, chargers, where recharging of vehicle is needed in a short time.

MODE 4 – Fast charging using DC connection and specific chargers with built-in control and protective functions. Maximum 400A – 240 kW. IEC 62196-3 has approved additional specifications for mode 4, which include maximum of 400A – 400 kW. This mode is used only for commercial purposes, as installation of the needed technology is very expensive. Communication method used is Pulse-width modulation (PWM).