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Combined Charging System (CCS) and ISO15118

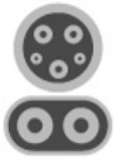
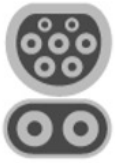
In this short article, we will learn about CCS (Combined Charging System) and ISO15118; in relation to other charging standards and Lumissil HomePlug Green PHY (HPGP) IS32CG5317.

CCS

It would be nice if the entire world used same charging standard but just like mobile phones, there are multiple standards. Globally, the dominant EV charging standards are CCS, Tesla, CHAdeMO, and GB/T.

CCS standard adopts ISO/IEC 15118 which specifies HPGP for wired charging. Lumissil IS32CG5317 is the world's first HPGP device that is automotive grade enabling it to be both on-board the EV and off-board in the charger. CCS is called "combined" because it added 2 conductors for DC charging to AC charging plugs IEC62196 type 1 (aka J1772) and type 2 (aka Mennekes) which were already in use in NA and EU respectively. CCS type 1 is found in NA while CCS type 2 is found in EU; the DC charging connector is the same for both CCS types but the AC charging plugs are different. At the moment, CCS is gaining ground globally based on its technical merits. Further, the CharIN organization promotes CCS for adoption in all charging applications around the world.

CCS is predominant in N. America (NA) and Europe (EU). Tesla uses proprietary method; but the Model 3 sold in EU comes with CCS plug and a CCS adapter is offered to Model S/Y owners. Tesla EVs charging communications protocol is rumored to be CCS based with some specializations and CAN bus is the physical layer transceiver. Recently, Tesla announced their support of CCS and their chargers will incorporate the CCS plug and be opened to all CCS-capable EVs.

	N. America	Japan	EU *and the rest of markets*	China	All Markets *except EU*
AC	 **J1772** (Type 1)	 **J1772** (Type 1)	 **Mennekes** (Type 2)	 **GB/T**	 **Tesla**
DC	 **CCS1**	 **CHAdeMO**	 **CCS2**	 **GB/T**	

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NON-CCS STANDARDS

The CHAdeMO and GB/T standards are predominantly used in Japan and China respectively. Given that CHAdeMO is used in Japanese EVs, its charger can be found in NA or EU as well. Both standard uses CAN Bus as the communication transceiver. China is forecasted to be the world's largest EV consumer. The Japanese CHAdeMO association lobbied China Electricity Council (CEC) to co-operate and develop a new standard called ChaoJi. i.e. leveraging the power of government regulation to secure market share. The goals for the new standard, ChaoJi, are security and rapid charging up to 900kW; surprisingly it doesn't mention load balancing to manage Electric Grid power demands or leveraging EV batteries as energy backup sources in their initial proposal.

ISO15118

In 2010, The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) jointly created ISO/IEC 15118 (or ISO15118 for short), bringing automotive and utility industries together to set an international communication standard for charging EVs.

The ISO15118 international standard specifies

- Integration of EVs into SmartGrid (aka V2G or Vehicle-to-Grid)
- Secure communications method called "Plug & Charge"
- HPGP for wired charging; including Pantograph charging of large vehicles. HPGP provides wired physical layer communication up to 10Mbps.

The diagram below summarizes the different parts of ISO 15118 (the number after hyphen is the part number):

V2G, HPGP and "Plug & Charge" enables

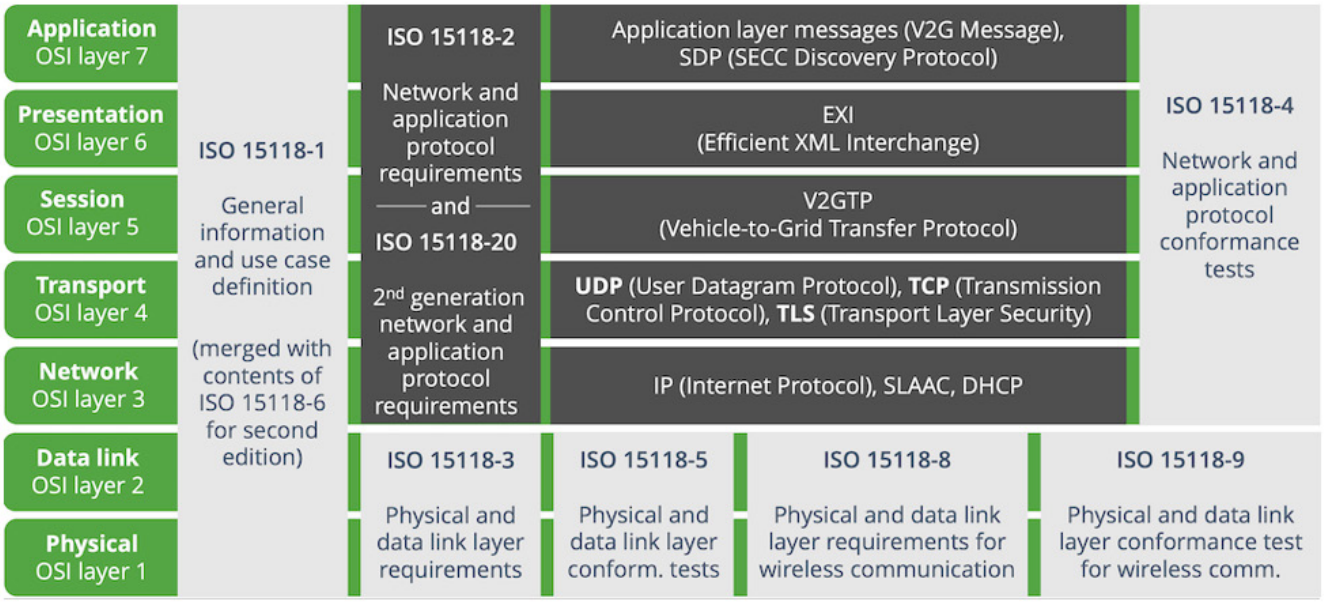
- Secure billing and payment
- Smart charging - regulating the energy load for charging multiple EVs without overloading the Grid. Information from the Grid, the energy demand of each EV and the mobility needs of its driver (departure time, driving range) can be used to set optimal individual EV charging schedule.
- Bi-directional energy transfer - EV batteries can be leveraged as backup energy storage by the Grid.

ISO15118-20 (aka Part 20 of ISO15118) is in progress to define next-gen networking requirements such as Pantograph and WPT (Wireless Power Transfer; aka inductive charging). Pantograph charging is for buses where charging contacts are on the vehicle's roof to enable charging large fleet of buses at 50 to 150kW overnight or during the day with 150 to 600kW for opportunity charging.

Outside of charging requirements, note that HPGP are installed in both the EV and Charger, making it a portal for other tasks such as diagnostics (both charging and other ECUs), firmware updates, entertainment and advertisement data uploads etc.

LOOKING INTO THE FUTURE

CCS and ISO15118 are established international standards with comprehensive coverage of all EV charging aspects; inclusive of the Electric Grid management, Security, cost-effective and rapid charging. Due to pervasive adoption in NA and EU, it is already possible for CCS-enabled EVs to drive coast to coast in US/Canada or country to country in EU.



The CCS plugs are compact in size and can fit behind traditional ICE (Internal Combustion Engine) vehicle's fuel trap door. CHAdeMO and GB/T require about twice the space of CCS as its AC and DC plugs are circular and placed side-by-side. Note that the future ChaoJi plug will be much more compact. CCS vehicles, especially larger heavy-duty vehicles will likely require multiple charging ports for the convenience of vehicle positioning and charging its high-capacity batteries. CharIN organization is currently defining MCS (Megawatt Charging System) for heavy-duty EVs.

AC charging power levels are similar for all standards and is mostly used in home charging while DC charging power varies dramatically and is deployed in commercial chargers which EV owners are dependent outside their homes. In NA or EU, most CCS DC charging today is about 150kW; and Tesla SuperCharger is about 120kW. In comparison, DC charging with CHAdeMO and GB/T today are 50kW and 187kW respectively. Today's DC charging still takes too long compared to ICE vehicle gas refill. This results in range anxiety and slows the adoption of EVs today. Future CCS plans supports for 350kW; and ChaoJi (future CHAdeMO and GB/T) intends to support 900kW. Both CCS and ChaoJi will drastically reduce charging duration but CCS is already designed to prevent the electric Grid from overloading.

CHAdeMO and GB/T or the future ChaoJi uses CAN bus for communications which supports up to 1Mbps max. In comparison, HPGP supports 10Mbps max.; enabling CCS requirements.

There are 2 market trends - CCS is already deploying and gaining more acceptance based on its technical capabilities along with CharIN's promotion and standardization while CHAdeMO and GB/T or the future ChaoJi has the power of large numbers and government enforced regulation. ChaoJi working group recently started working with CCS workgroup and IEC to make ChaoJi also compatible with CCS and IEC standards. This would address Electrical Grid management (V2G) concerns and may result in a standard compatible with all charging standards (CCS, Tesla, CHAdeMO and GB/T) but do note that this is still vaporware at this time.

Many countries (including China, Japan, the UK, South Korea, Iceland, Denmark, Sweden, Norway, Slovenia, Germany, France, Belgium, Netherlands, Portugal, Canada) have proposed ban of ICE vehicle sales or implementing sales of zero-emissions vehicles only with varying target dates from as early as 2026 to latest 2050. At the same time, Covid pandemic has shifted preference for travel by roads. These forces translate to an increase in both EV and EV Chargers infrastructure build out. Since CCS is the best EV charging standard, it is expected that both NA and EU will be building more HPGP based CCS EVs and Charging stations; but perhaps at a rapid pace.

PRODUCT ORDERING AND AVAILABILITY

Lumissil HPGP ordering part numbers:

Part Number	Packaging
IS32CG5317-LQLA2	Tray
IS32CG5317-LQLA2-TR	Tape and Reel
IS32CG5317EVK_KIT	2 IS32CG5317 reference boards, power supplies, 2 micro SD cards, cables, HDK and SDK
IS32CG5317HDK	IS32CG5317 reference board schematics, layout and BOM
IS32CG5317SDK	IS32CG5317 firmware binary, host library (source code), production library (source code) and SW utilities

IS32CG5317 is sampling; with development kits to follow later. Enquire with your Lumissil Sales Representative to place orders now.

Lumissil connectivity team is committed to provide IS32CG5317 customers strong technical support and abide to ISSI company's mission to maintain long-term support.

CONTACT:

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