

Diamond Electric Holdings Provides V2X OBC to Stellantis for V2G AC Demonstration Experiment in California

Diamond Electric Holdings (hereinafter “DE”) is installing a Stellantis' electric vehicle equipped with DE's V2X AC capable On-Board Charger (V2X OBC) in California to demonstrate its V2X capabilities, including charging, discharging, and supporting grid through the V2X OBC. In July 2021, DE reached an agreement with Stellantis to participate in a demonstration of Vehicle-to-everything using Alternative Current (V2X AC), then in August 2022, DE developed a V2X AC capable On-Board Charger (V2X OBC).

As electric vehicles (xEVs) and distributed energy resources (DERs) become more prevalent, there are concerns about grid instability due to excessive electricity demand from recharging xEV and over/under generation of renewable energy. Therefore, V2G (Vehicle-to-Grid) is expected as a next-generation technology to stabilize the power grid by discharging electricity from the storage batteries of xEVs into the grid. In addition, V2H (Vehicle-to-Home, electricity backup for a house), which utilizes the batteries of xEVs as a backup power source in the event of a power outage, and V2X, which collectively refers to V2G, V2H, etc., is drawing increasing attention.

In V2X AC, one of the V2X systems, the OBC installed in the xEV charges and discharges, stabilizes the grid through its grid support functions, and provides backup electricity in case of power outages. Therefore, the OBC is required to operate as an inverter and have functions required by grid interconnection rules.

Our new vision “Contribute to the Improvement of Global Environment by Connecting Cars and Homes with Manufacturing” stated in our medium to long-term management plan “Scrum of Fire”, our intent as a public company will be to continue to strongly support our customers while contributing to the enrichment of society through our Monozukuri.

[About the demonstration](#)

V2X system is classified into two systems; V2X DC and V2X AC. In V2X AC, the vehicle directly discharges in AC and performs grid supporting functions via its V2X OBC. In V2X DC, in contrast, an off-board equipment, i.e., electric vehicle supply equipment (EVSE), takes out the energy from the vehicle in DC, converts it into AC, and performs the grid supporting functions.

The state of California is one of the first states in the US to establish a roadmap¹ related to V2X in order to promote the spread of xEV. A bill² that requires V2X is also under deliberation. In addition to V2X DC, the state of California is also investing in V2X AC, which is estimated

to have a lower total cost³. V2X AC requires the development of regulations and standards specific to the xEV as it roams. The US has taken the lead in developing regulations and standards related to V2X AC, and one of the purposes of this demonstration is to promote and verify the development of these regulations and standards.

On the other hand, there are currently no vehicles on the market equipped with an OBC conforming to the US Interconnection Standard IEEE 1547-2018.⁴ DE has developed the world's first V2X OBC complied with IEEE 1547-2018. Evaluation and verification are also the purpose of this demonstration.

In the US, where power outages due to disasters occur frequently, V2H, which backs up homes from xEVs during power outages, is also attracting attention. This demonstration includes the evaluation of V2H as well.

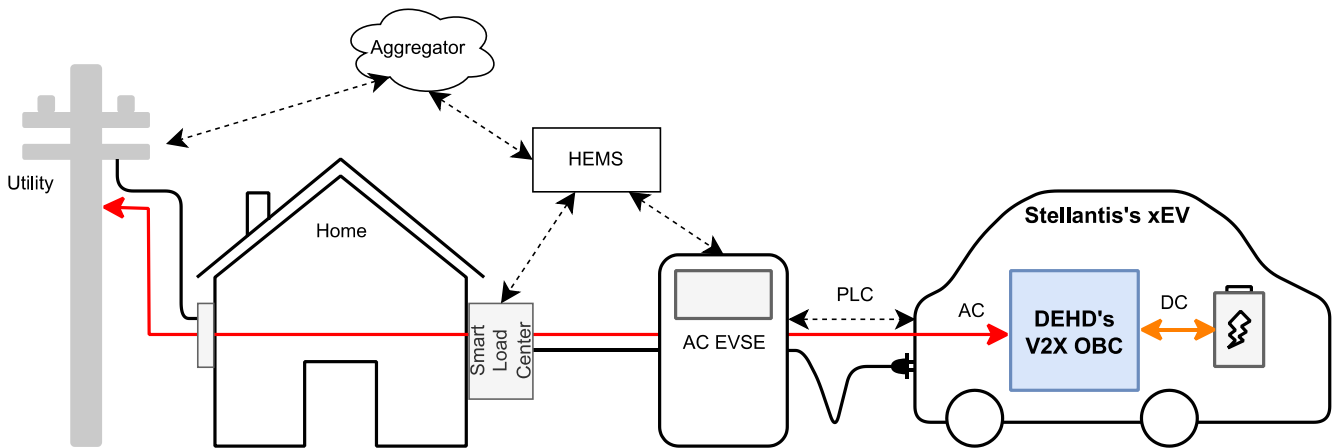


Figure: Demonstration System Architecture

- 1 California Vehicle-Grid Integration (VGI) Roadmap: Enabling Vehicle-based Grid Services.
- 2 SB-233 Electric vehicles and electric vehicle supply equipment: bidirectional capability.
- 3 FINAL REPORT OF THE VEHICLE TO GRID ALTERNATING CURRENT INTERCONNECTION SUBGROUP

4 As of April, 2023. The source is from California Energy Commission database;

<https://database.epicpartnership.org/project/132493>

About the development

V2X OBC, provided in this demonstration complies with IEEE 1547-2018. It has smart inverter functions such as Volt-var, Volt-watt, and Frequency droop. It also rides through under the grid abnormal events and to help stabilize the system and has safety-related functions such as anti-islanding.

It also complies with the V2X AC standard SAE J3072 developed by the Society of Automotive Engineers (SAE) and the V2G AC Profile, and performs information exchange to realize the smart inverter function. In addition, it has a grid forming function to back up the house in case of a power outage.

■ Specification Overview

Basic Performance	Maximum power	Charge/discharge active power: +/- 6.6 kW Reactive power: +/- 6.6 kvar
	Maximum AC current	32 Arms
	Applicable DC voltage	310 to 450 V
	Power factor	Variable from 0 to +/-1
Inverter Performance	Compliance	IEEE 1547-2018 IEEE 1547.1-2020 + UL 1741SB
	IEEE 1547 Category	Normal: B Abnormal: III
	Applicable voltage	240 V nominal
	Applicable frequency	60 Hz nominal
	Advanced functions	Yes: Constant var, Constant PF, Volt-var, Volt-watt, Watt-var, and Frequency droop
	Protective functions	Yes: Voltage ride-through and trip Frequency ride-through and trip
	Anti-islanding function	Yes: Passive and active islanding detection
Grid Forming Performance	Maximum power	6.6 kVA
	Output voltage	Single phase two wire 240 V The voltage can be altered via communication.
	Output voltage quality	Waveform X, Class 1 (IEC 62040-3:2021)

What's next?

By participating in this demonstration, DE has been quickly capturing standards, regulations, and market trends for the V2X ecosystem's market trend, standardization work, and regulation changes which includes not only V2X AC but also V2X DC. Not limited to V2X compatible OBC, we are using this knowledge in the product development to realize the corporate vision; "Connecting Cars and Homes through Manufacturing".

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