CharIN subgroup „Automatic Connection Device Interface“

Public request for an automatic underbody connection interface

Scope

CharIN plans to give a recommendation to standardization bodies regarding an Automatic Connection Device Underbody (ACDU). This recommendation will focus on an interoperable connection interface and any related requirements for the EVSE, EV, communication and related hardware. To this end, CharIN has formed an ACD focused subgroup to draft these recommendations.
To aid in this effort, the CharIN subgroup is issuing this public requests for concepts for ACDU systems and interfaces. After submission, the concepts will be presented and reviewed as described below. The subgroup will then vote for one system and, together with the applicant, work on an optimization of that concept to create a proposal for the official standardizations bodies.
A list of relevant criteria is part of this document. The aim is that a single ACD-Interface (Plug, Inlet, communication, positioning technology, etc.) between EVSE and EV shall be able to fulfill all requirements.

Area of application

This request focuses on ACD systems for cars and light trucks.
For further details please refer to the position paper[1] of the subgroup „Automatic Connection Device Interface“.

Concept proposals

A proposed concept does not need to fulfill all of the listed requirements to be considered, and applicants are encouraged to present any concept so long as a delta list stating the deviations from the listed requirements is provided.
Before a concept proposal can be submitted the applicant needs to sign the provided legal term sheet or the “Patent Statement and Licensing Declaration Form” of ITU / ISO / IEC.
Handed in concepts will be available for CharIN members for consideration. The winning concept will be published by CharIN.

Concept proposals are divided into technical readiness levels:
a)***Functional Prototype:*** A fully functional prototype with all necessary components included. A tabletop presentation of the prototype is preferred.

b) ***Partial Prototype***:

- If a robot is presented without a connection interface, then a concept of an interface shall be provided as an interface description. Alternatively, a partner to provide an appropriate interface shall be proposed.
- Presenting a functional connection interface without the robotic part is also possible. In this case a concept of this robotic unit shall be provided as well as an interface description with all relevant requirements to the robotic part.

c) A nonfunctional prototype or a concept without technical proof is not accepted for application.

[1] https://www.charinev.org/fileadmin/Downloads/Papers_and_Regulations/20190510_ACD_Position_Paper_V1.13.pdf

Concept presentation

The concept presentation will be performed in three stages.
In the first stage, concept proposals need to be handed in at the CharIN coordination office until November 1st 2019 in form of a presentation and a filled in deviation list.
In the second stage, video conferences for each applicant will be held in November 2019 to present their concept.
In the final stage it is planned to invite a selection of the concepts for a presentation of their physical prototypes.

Criteria list

The following list of criteria is compiled from requirements submitted by the members of the subgroup "Automatic Connection Device Interface". They describe the proposed technical limits of ACDU concepts considered by the subgroup for recommendation. These requirements are still in consideration and deviations are accepted to a certain extend.

ID	cluster	Item	Requirement
1	Communication	Wireless communication	WLAN shall be used for ACD related communication. Physical communication shall be maintained for charging safety (CP and PP).
2	Communication	WLAN access point (AP)	A single WLAN AP (offboard) shall be capable to coordinate/ control pairing and positioning of multiple ACD ground units (parking spots) with multiple EVs. Details of this procedure will be detailed in ISO standards.
3	constructional - infrastructure	Maximum height of ground unit components vehicle must drive over. (to ensure ground clearance)	85 mm above floor level is maximum, though reducing ground unit height is desired.
4	constructional - vehicle	Integration in vehicle	The Vehicle inlet will not reduce the underbody ground clearance of the vehicle. Minimal vehicle unit height is desired.
5	constructional - vehicle	Connector interface size	The connector interface size is to be minimized.
6	EMC	Electromagnetic compatibility (EMC)	The ACD system shall not interfere with other electronic devices (whether in or around EV). (see EMC guidelines)
7	Environmental robustness	IP classification	connector: - not connected: IPxxB - connected: IPxxD overall system: product specific according to use case ,e.g.: @home (indoor, connected state): IP33D @public (outdoor, connected state): IP54D

8	Environmental robustness	corrosion of contacts	- corrosion shall not influence power transfer performance - contact surface is open to the developer of the ACDU prototype, but will be part of a future standardization
9	Environmental robustness	Environmental temperature conditions	Ambient temperature range for full functionality of infrastructure and vehicle unit: -40 ... +50°C Current regulations for surface touch temperatures must be met.
10	Environmental robustness	Indoor/Outdoor use	The ACD system shall support indoor and outdoor solutions.
11	Intellectual property	licensing model	standardization relevant parts of the concept shall be under royalty free license or FRAND (Fair, Reasonable and Non-Discriminatory)
12	Mechanical robustness	Drive over protection of all ground bound components in non connected state	Units that can be driven over must be rated for vehicle drive over loads appropriate to their intended application (public vs. private infrastructure). For the development it should be considered that a passenger car may apply as much as 1000 kg / 200 cm^2 and steering of a tire of this load. For public use cases with heavier vehicles (trucks, busses, etc.) a higher load capability might be considered (e.g. 2500 kg / 200 cm^2).
13	Mechanical robustness	Protection against vandalism or unintended damage by user	No hazard shall occur for forseeable use/misuse
14	Positioning	Positioning information	The ACDU system shall provide information about the relative position of the VU with respect to the GU to the EV. These information shall be usable for autonomous parking. The positioning process shall start latest after visual contact between EV and ACD at a specific distance. The working distance for the positioning system should be maximized.
15	Positioning	Parking direction (forward vs. reversed)	- The technical concept shall allow forward or reverse parking in principle. - Any vehicle shall be able to use a given parking spot regardless of whether the vehicle unit is installed in the front or the back of the vehicle. Vehicle parking direction (forward or reverse) can be dictated.
16	Positioning	Contact window of infrastructure unit	@public, @semi-public, @work and @fleet charging: Concept shall communicate the position of contact window and dimensions of parking spot to the EV.
17	Power transfer	AC and DC charging	While a system supporting both AC and DC is preferred, AC only and DC only options will be considered.

18	Power transfer	Charging Power	AC: - up to 22kW charging power - supports: 1-phase, split-phase, 3 phase for world wide use (useable in every grid) DC: - the concept shall be classified according to the CharIN Power Classes: DC5, DC10, DC20, FC50 - up to class FC50 (optional, not mandatory) The applicant is requested to show how the aimed power class could be reached, even if the currently proposed concept is not capable of it.
19	Power transfer	Low cost connector option	An optional low cost and low power solution for the EV or EVSE connection interface is acceptable as an alternative to the high power charging connector as long as it is fully interoperable with a high power connector.
20	Power transfer	Bidirectional charging	Bidirectional charging with DC shall be supported
21	Safety	Safety rules for moving parts	Injuries by moving parts or electrical contacts shall be prevented. The maximum applied force and moving speed during movement shall be limitable to a value defined in future standards. As soon at the connector movement is limited to a range safe to touch, a higher force may be applied. This safe range will be defined in future standards.
22	Safety	Thermal behaviour	ACD system heating and surface temperatures shall be limited in order to prevent: - hot parts which could be touched by persons (injuries must be prevented) - fire in case of contact to other materials
23	Safety	Isolation monitoring	It shall be proved that the ACD does not interfere with the isolation monitoring system of EVSE and EV.
24	Safety	Temperature monitoring	Permanent connector contact temperature monitoring is mandatory.
25	Safety	Connector locking (background: low force following mechanic for vehicle movement and crash)	Unwanted disconnection during power transfer shall be prevented by applying a locking function to the connector.
26	Safety	Electrical safety loops	Safety loops similar to CCS shall be considered, such as Control Pilot and Proximity Pilot.

27	Usability	The workspace for ACD connection describes the spatial volume, where the center of the VU can be placed in order to still allow a connection.	Minimum workspace for an ACD connection: X / Y / Z: 300 x 300 x 85-250 mm (including all tolerances) Rotational offset of the vehicle: yaw: ±15° roll: ±4° pitch: ±2° These values include the temporary movement that a vehicle might do after connection.
28	Usability	Cross market usage	AC charging: Cross market usage of VU would be beneficial. DC charging: Shall be interoperable worldwide.
29	Usability	Vehicle movement in connected state reasons for vehicle movement: steering in parking position, loading/unloading of the vehicle, crash while parked, dis/-embarking passengers, heavy movements inside the vehicle	The ACD system shall be able to follow vehicle movements with a low force in a limited window in order to prevent damage. The dynamic movement is to be regarded additionally to the static movement in ID27. These dynamic movements can be expected to be relatively fast as for example in a parking collision. translation: ΔX: ±20 mm ΔY: ±7 mm ΔZ: ±15 mm Further movement in Z-direction may be caused by slow events such as gradually loading of the trunk or descending air suspension: ±50 mm (slow movement) Any dynamic z-movement does not exceed the static limits mentioned in ID27. rotational movement additional to the static movement: Δyaw: ±1° Δroll: ±2° Δpitch: ±2°
30	Usability	Additional charging Features	All charging features of conductive charging from ISO 15118-20 shall be supported, such as Plug and Charge, etc.
31	Usability	Start of charging process	After successfull connection the ACD system shall allow the EV and EVSE to start the charging process.
32	Usability	Error handling	The EV shall not be immobilized due to foreseeable ACD faults or external events (e.g. blackout).

33	Usability	Charging Use Cases	The EV connection interface shall support all use cases and described charging options and power classes. EVSE connection interface may be designed according to EVSE properties (e.g. lower power) but shall be fully compatible with the common EV connection interface (e.g. higher power). Use cases according to "CharIN ACD interface subgroup" position paper ed. 1: @home: "Full charging over night" in garage or car-port with solid ground @work: "Full charging during working hours" @public: "Recharging on long distance trips" @(semi-) public: "Maximum recharging on the way" @fleet charging: "Full charging in a private depot during regular pause"
34	Usability	Retrofitting option	It is advantageous if the ACD system could be used as a retrofitting solution for existing EVSE.
35	Usability	Noise	Concept shall avoid loud noise (see country specific regulations) during charging, moving etc.
36	Usability	Connection confirmation	A concept for indicating a successfull connection to the user shall be presented.
37	Usability	Disconnection time	The disconnection process up to the "all clear" signal to the EV shall not exceed a duration of 8 s.
38	Usability	Special parking requirements	The concept shall not entail any restrictions for handicapped parking.

Acronyms

acronym	meaning
AC	Alternating Current
ACD	Automatic Connection Device
ACDR	Automatic Connection Device for vehicle Roof-mounted connections
ACDS	Automatic Connection Device for conventional Side connection interface
ACDU	Automatic Connection Device for vehicle Underbody connector
AP	Access Point
BEV	Battery Electric Vehicle
CCS	Combined Charging System
CP	Control Pilot
DC	Direct Current
EMC	Electromagnetic Compatibility
EV	Electric Vehicle

EVSE	Electric Vehicle Supply Equipment
GU	Ground Unit
PE	Protective Earth
PHEV	Plug-In Hybrid Electric Vehicle
PLC	Power Line Communication
PnC	Plug and Charge / Park and Charge
PP	Proximity Pilot
VU	Vehicle Unit
WLAN	Wireless Local Area Network