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Conductive charging for electric vehicles - Part 2-4: Communication protocol between off-board charger and electric vehicle

Conductive charging for electric vehicles -- Part 2-4: Communication protocol between off-board charger and electric vehicle

Konduktive Ladung von Elektrofahrzeugen -- Teil 2-4: Kommunikationsprotokoll zwischen externem Ladegerät und Elektrofahrzeuge

Charge conductive pour véhicules électriques -- Partie 2-4: Protocole de transmission entre le chargeur extérieur et le véhicule électrique

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Conductive charging for electric vehicles
Part 2-4: Communication protocol between off-board charger and electric vehicle

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European prestandard was prepared by the Technical Committee CENELEC TC 69X, Electrical systems for electric road vehicles in accordance with the decision taken by CLC/TC 69X at its sixth meeting held on 17 September 1997.

The following date was fixed:

- latest date by which the existence of the ENV has to be announced at national level (doa) 1998-09-16

This European prestandard is to be used in conjunction with several specific European prestandards listed in the scope.

Annexes designated « normative » are part of the body of the standard.
Annexes designated « informative » are given for information only.

CONTENTS

Introduction

This European Prestandard - Conductive charging for electric vehicles - is published in separate parts according to the following structure:

Part 1 of this prestandard - General considerations - is a general description and contains general requirements for charging electric vehicles.

Part 2 of this prestandard covers the physical, electrical and performance requirements concerning devices for the charging system, when they are not already standardized.

Part 2 is further subdivided into parts:

Part 2-1: Connection of an electric vehicle to an AC/DC supply.
Part 2-2: AC charging station.
Part 2-3: DC electric vehicle charging station.
Part 2-4: Communication protocol between off-board charger and electric vehicle.

1 Scope

This prestandard applies to communication Data Link between external charger and electric road vehicle for the charging procedure, using the most common communication link.

This part applies to communication data link between Off Board Charging system with Direct Current and electric road vehicles.
The aspects covered are the physical layer, the data link layer and the communication applicative layer.

This prestandard does not cover communication between dedicated off-board charger and their electric vehicle.

The annex gives an example of normal operation.

2 Normative references

This European Prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this draft of a standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO/DIS 14229 - Road vehicles - Diagnostic Systems- Diagnostic Services Specifications

ISO/DIS 14230 - Keyword Protocol 2000 - Part 1: Physical layer
Part 2: Data link layer
Part 3: Implementation.

3 Definitions

For the purpose of this prestandard, the following definitions shall apply.

3.1 Vehicle Charging Control Unit (VCCU)

System embedded in the Electric Vehicle able to command and control the charging parameters of the Off Board Charger.

3.2 Charging Parameters

Parameters including set points needed by the Off Board Charger to generate a current adapted to the Vehicle Battery.

3.3 Charging Values

Values measured during charging process.

4 Off board charging system

4.1 General overview

Electric Vehicles will be equipped with different technologies, voltage and charging current batteries.
In order to avoid any error during charging and to guarantee that the Off Board Charger will be able to charge all existing and future batteries, the charge shall be managed by the vehicle.
Any vehicle to be connected to a general purpose Off Board Charging system must include a Charging Control Unit able to manage the charging process.

4.2 Charging process

The Off Board Charger shall be able to supply controlled DC voltage and/or current to the Vehicle Battery. The charging values current and voltage shall be measured at least by the Off Board Charger.
If the Vehicle Charging Control Unit also makes this measurement, a full redundancy system could be established to achieve a high safety charging system.
- The Charging Parameters shall be established by the Vehicle Charging Control Unit and sent to Off Board Charger in order to be used as set points.
- The Charging measured Values will be sent by the Off Board Charger to the Vehicle Charging Control Unit.

4.3 Safety Process

The start of the charging process shall be allowed by both Off Board Charger and Vehicle Charging Control Unit.
The charging process can be stopped at any time by Off Board Charger or Vehicle Charging Control Unit and shall be stopped in case of communication loss.

5 Communication interchange

5.1 Protocols Basis

The standard data interchange is based on ISO/DIS 14230.

5.2 Adaptation for Off Board Charging application

The scope of ISO/DIS 14230 concerns requirements for diagnostic systems implemented on a serial data link layer, which allows a tester to control diagnostic functions in and on Vehicle Electronic Control Unit. The same protocol is used for the communication between an electric vehicle and an off-board charger for the charging procedure. After the initialization phase by the OBC, the VCCU shall control the charging process of the OBC. Contrarily to communication according to ISO/DIS 14230 where the server and the client are fixed during all the session, the roles are definitively reversed after the initialization phase.

5.3 Initialization header values

Initialization header values are those defined in ISO/DIS 14230-2 except for those specified hereafter.

5.3.1 Initialization mode

The initialization mode is 5 bauds only

5.3.2 Address

The address sent to open the communication to the Vehicle Charging Control Unit shall be 66 h (Functional address).

NOTE: 66 h is the value 66 in hexadecimal code

5.3.3 Key bytes

The key bytes are defined in accordance with ISO/DIS 14230-2 with for KB1 :

AL0 = 1
AL1 = 0
HB0 = 1
HB1 = 0

TP0 = 1
TP1 = 0

That is to say the following two key bytes :

KB2	KB1	Hexadecimal code	Decimal code
10001111	11010101	8FD5	2005

KB2 is the most significative key byte.

The key bytes will define the state of the protocol; any change in the protocols for future use will change the key bytes.

5.4 Message structure

5.4.1 Message length

The maximum length for charging application shall be 16 bytes (included header and check-sums).

5.4.2 Message header values

The message header values shall be changed and defined as follows :
- number of header bytes: 1 as defined in § 8.1.2.

6 Service definition

6.1 Basis

The services definition is based upon the draft of ISO/DIS 14229 with the following main differences:
- diagnostic is hereby replaced by data interchange
- Client (Tester) is replaced by the Vehicle Charging Control Unit (VCCU)
- Server (ECU) is replaced by the Off Board Charger (OBC)
- As there is only one server, no server identifier parameter shall be provided

6.2 List of services used

Services of ISO/DIS 14229 used for this application		Generic services (client)	Generic services (server)
Diagnostic management	TesterPresent	TestDevicePresent	
	StopDiagnosticSession	StopSession	
	Specific code		StopSessionRequest
Data transmission	ReadDataByLocalIdentifier	ChargerCharacteristics	
		ChargerIdentification	
	ReadDataByLocalIdentifier	VehicleIdentification	
Stored data transmission	ReadDiagnosticTroubleCodes	ReadDiagnosticTrouble Codes	
Input/Output Control	InputOutputControlByLocalIdentifier	SetSafetyLimits	
		SetpointAdjust	
		DisplayMessage	
		StartCharging	
		StopCharging	

6.3. Message interchange rules

After initialization, at any time the server is waiting for a request.

Any request sent by the client must be acknowledged by the server.

The server has the possibility to stop the session by using the generic *StopSessionRequest* answer.

7 Communication session

In this clause the generic messages to be sent are written in italics.

7.1. Phases

The communication sequence uses 7 main steps
- -a) communication opening
- -b) charger identification
- -c) vehicle identification
- -d) starting charging process
- -e) charging process
- -f) ending charging process
- -g) closing communication

The use of services, for each step, is detailed hereafter

Table 2: Use of services

	Communi-cation Opening (a)	Charger identifi-cation (b)	Vehicle identifi-cation (c)	Safety limits (d1)	Starting charging process (d2)	Charging process (e)	Stopping charging process (f)	End of commu-nication (g)
ChargerCharacteristics	M (b)	A	F	F	F	F	F	F
ChargerIdentification	F	A	F	F	F	F	F	F
VehicleIdentification	F	M (c)	A	F	F	F	F	F
ReadDiagnosticTroubleCodes	F	A	A	A	A	A	A	F
DisplayMessage	F	A	A	A	A	A	A	F
SetSafetyLimits	F	F	M (d1)	A	F	F	F	F
StartCharging	F	F	F	M (d2)	A	A	A (d2)	F
SetpointAdjust	F	F	F	F	M (e)	A	F	F
StopCharging	F	F	F	F	F	A (f)	A	F
StopSession	A (g)	A (g)	A (g)	A (g)	A (g)	A (g)	A (g)	F
StopSessionRequest	A	A	A	A	A	A	A	F
TestDevicePresent	A	A	A	A	A	A	A	F

A = Allowed,
A(x) = Allowed, go to step (x),
F = Forbidden,
M(x) = Mandatory, go to step (x).

7.2 Basic Session Sequence

7.2.1. Communication opening

The OffBoardCharger starts the initialization sequence as defined in ISO/DIS 14230-2.

Direction	OBC->VCCU	VCCU->OBC	OBC->VCCU	VCCU->OBC
Content	*66h*	*55h KB1 KB2*	*70h*	*99h*
Speed	5 Bd	10,4 kBd		

At the end of the initialization sequence, the VCCU becomes the master and shall manage all the other sequences by sending appropriate requests to the OBC.

7.2.2. Charger identification

ChargerCharacteristics
This request is used to inform the VCCU of the major characteristics of the OBC *ChargerIdentification.* This request is used to identify the OBC (for instance: OBC manufacturer, OBC owner, OBC version...)

7.2.3. Vehicle identification

VehicleIdentification
This service intends to identify the vehicle. It can be used for instance to provide the charger with an access control facility, it can identify the version of the communication protocol. In case of an unauthorised vehicle, the OBC shall answer to the request with a StopSessionRequest message. Any further request request in this session shall get the same answer.

7.2.4. Starting charging process

SetSafetyLimits
The OBC shall not be allowed to supply any power before receiving this request.

StartCharging
From receiving this request, the OBC current setpoint is reset to zero and the OBC shall be ready to supply power to the battery.

7.2.5. Charging process

SetpointAdjust request sent by the VCCU.
At any time the VCCU can temporarily disconnect the power by using a *StopCharging* request. The charging process will then be resumed using a *StartCharging* request.

7.2.6. Ending charging process

This can occur in two different ways:
- from VCCU (normal end of process)
the VCCU shall send a *StopSession* request.
- from OBC (for safety reasons or elapsed credit time for instance)
any request other than *StopSession* shall get the *StopSessionRequest* answer.

7.2.7. End of communication

After echoing a *StopSession* request, the OBC will remain idle till a next initialization.

7.3 Other functions

TestDevicePresent can be used at any time to avoid time-out.

ReadDiagnosticTroubleCodes
This service allows the VCCU to inform the OBC about defective states. It is provided to allow the display of warning messages on OBC readout.

DisplayMessage
This service is provided for direct display of messages on OBC readout, these messages may be sent by the VCCU as ASCII strings.