Product overview

CANoe option.SmartCharging / CANoe Test Package EV
Agenda

- CANoe option.Smartcharging
  - HIL Test for Smart Charge Communication
  - CANoe Test Package EV
Combined Charging System (CCS)

**AC**
- **North America**: Type-1 SAE J1772 / IEC 62196-2
- **Japan**: Type-1 SAE J1772
- **EU (and the rest of markets)**: Type-2 IEC 62196-2
- **China**: GB/T 20234.2

**DC**
- **North America**: CCS Type-1 SAE J1772 / IEC 62196-3
- **Japan**: CHAdeMO
- **EU (and the rest of markets)**: CCS Type-2 IEC 62196-3
- **China**: GB/T 20234.3

**Tesla**

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**ChaoJi**
Combined Charging System (CCS)

Source: https://www.vwfs.de/content/dam/bluelabel/valid/www-vwfs-de/2017-initial-pool-images/products/2_plug-types_ImageText.jpg.l.jpg
# ISO 15118 – OSI-Model

## Use-Case

<table>
<thead>
<tr>
<th>Layer</th>
<th>Edition 1</th>
<th>Edition 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Layer</td>
<td>ISO 15118-1: General information and use-case definition</td>
<td></td>
</tr>
<tr>
<td>Presentation Layer</td>
<td></td>
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<tr>
<td>Session Layer</td>
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<tr>
<td>Transport Layer</td>
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<tr>
<td>Network Layer</td>
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<tr>
<td>Data Link Layer</td>
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<tr>
<td>Physical Layer</td>
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</tbody>
</table>

## Communication Protocol(s)

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ISO 15118-20</td>
<td>Application layer messages, SDP</td>
</tr>
<tr>
<td>ISO 15118-2</td>
<td>EXI (Efficient XML Interchange)</td>
</tr>
<tr>
<td>ISO 15118-3</td>
<td>Physical and data link layer requirements</td>
</tr>
<tr>
<td>ISO 15118-4</td>
<td>Network and application protocol conformance test</td>
</tr>
<tr>
<td>ISO 15118-5/-9</td>
<td>Physical and data link layer conformance test</td>
</tr>
<tr>
<td>Value Added Services (VAS)</td>
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<tr>
<td>V2GTP (V2G Transfer Protocol)</td>
<td></td>
</tr>
<tr>
<td>UDP, TCP, TLS</td>
<td></td>
</tr>
<tr>
<td>IP, ICMP, SLAAC, DHCP</td>
<td></td>
</tr>
<tr>
<td>Physical and data link layer requirements for wireless communication</td>
<td></td>
</tr>
</tbody>
</table>
Option CANoe option.SmartCharging

- supports **analysis** of smart charge communication.
- supports **test** of smart charge communication.
- supports **simulation** of smart charge communication.

Supported Smart Charging Communication

<table>
<thead>
<tr>
<th>Standard</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO - 15118</td>
<td>Option. Ethernet</td>
</tr>
<tr>
<td>GB/T - 27930</td>
<td>Option. J1939</td>
</tr>
</tbody>
</table>
Agenda

CANoe option. Smart charging

- **HIL Test for Smart Charge Communication**
  CANoe Test Package EV
HIL Test for Smart Charge Communication

Main Requirements for a SCC Test System

- Support for Test Cases defined in ISO/IEC 15118
- Test of EV and EVSE is possible
- All ISO/OSI protocol layers are covered
- Fault injection is possible
- Useful in development (EV + EVSE) and for compatibility tests
- Open (programmable)
- High degree of automation
- Physical layer of smart charge communication is realized (PWM + PLC)
- Generation and receiving of control pilot signal (CP)
- Power line communication for ISO15118 and DIN 70121 is possible
- Support of GREEN PHY PLC according to ISO standard
Test of On-Board Charger – Objectives

- Main aims for testing:
  - Behavior of on-board charger ECU
  - Interface to station
    - Communication
    - Protocol and signal handling
  - Interface to car
    (if separate on-board charger ECU should be tested)
    - Sensor/actuator simulation
    - Remaining bus simulation

- Different test strategies possible
  - Testing functionality without high currents/high voltages
    (typically sufficient for AC)
  - Comprehensive testing of whole system including real charging currents
    (typically necessary for DC)
Test of On-Board Charger – Setup

**Test hardware VT System**
- Access to control pilot signal (input and output)
- Control of external equipment (power supply, electronic load)
- Simulation of additional sensors and actuators of ECU

**PC-based software tool CANoe.Eth**
- Test scripting and execution
- State machine and environment simulated using SCC DLL (smart charge communication according ISO 15118)
- Analysis, measurement and logging
- Remaining bus simulation if required

**Test Design and Authoring Tool vTESTstudio**
- Test programming (CAPL, C#)
- Table-based test design: "Test Table Editor" "style of Test Automation Editor"
- "Test Diagram Editor"
- Definition of parameters and curves
HIL Test for Smart Charge Communication

Test of Charging Station – Objectives

- Main aims for testing:
  - Behavior of station
  - Conformance check of station
  - Communication between station and car
  - Protocol checking
  - Signaling between car and station (Control Pilot)

- Simulation of “remote station” = charger ECU in car
  - Check and develop station without a real car

- Checking the high-power electronics and testing with real currents may be realized using external load
HIL Test for Smart Charge Communication

Test of Charging Station – Setup

Simulation of car/on-board charger
Test automation

SUT
charge station

Control
Pilot
Powerline
Communication

VT System incl.
Develol
 dlaN®
GreenPHY
module on
VT7870

CANoe.IP

SCC over Ethernet

Optional:
sinking
real power

Electronic Load
Agenda

- CANoe option. Smartcharging
- HIL Test for Smart Charge Communication
  - CANoe Test Package EV
Overview

- **CANoe Test Package EV** provides **conformance/interoperability** tests for **electric vehicles** (EV)
  - Tests implemented with vTESTstudio in CAPL (source code included)
  - Separate licenses for each standard CCS, GB/T and CHAdeMO
  - Available only as subscription license (period 12 months)

- **Current release** (2.0)
  - First support of test cases from **ISO15118-4**
  - More test cases with later releases

- **Requirements** (CCS standard):
  - CANoe 13 with the Options .Ethernet and .Smart Charging
  - vTESTstudio 4.0 SP2 or later
  - VT System with VT7870 (interface hardware for communication)
  - Integration of third-party hardware (power sink/source)
Release planning

- **Already released (1.0)**
  - Test cases from DIN 70122

- **Current release (2.0)**
  - First support of test cases from ISO15118-4
    - Good case test cases for DC charging with EIM and PNC

- **Planned release (3.0)**
  - All test cases from GB/T 34658
    - Test specification of GB/T 27930 (DC charging)
  - More test cases from ISO15118-4
    - Error case test cases for DC charging with EIM and PNC

- **Planned release (3.1)**
  - More test cases from ISO15118-4
Workflow

CANoe Test Package EV

+ "Generator Tool"

vTESTstudio
automated ECU test creation

create
Test unit

integrate

CANoe
test execution & hardware control

generate CANoe configuration

generate project

Test report
Setup generator

- Selection of protocol
- Extraction of test cases as vTESTstudio project
- Generation of ready-to-run CANoe configuration with test cases and simulated EV
- Setting of output folder for vTESTstudio project and CANoe installation folder
CANoe Test Package EV

**vTESTstudio**

- Implementation with test tables and CAPL
- Preparation and completion customizable to SUT
- Arrangement of test cases according to test specification
- Consideration of CharIN implementation guide
- Traceability to requirements from protocol specification
- Visibility of variant dependencies (PICS/PIXIT)
CANoe Test Package EV

CANoe

- Tracing of communication
- Interpretation of message details
- Selection of testcases for execution
- Setting of variant dependencies (PICS/PIXIT) for different SUT

PICS = protocol implementation conformance statement
PIXIT = protocol implementation extra information for testing
For more information about Vector and our products please visit

www.vector.com

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