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Road vehicles — Vehicle to grid communication interface —

Part 23: Second generation network layer and application layer requirements conformance test plan for DC charging

Véhicules routiers — Interface de communication entre véhicule et réseau électrique —

Partie 23: Plan de test de conformité aux exigences de la couche réseau et de la couche application de deuxième génération pour la charge en courant continu

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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This document was prepared jointly by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*, and Technical Committee IEC/TC 69, *Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks*.

A list of all parts in the ISO 15118 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

Resulting from the 2nd generation network layer and application layer requirements defined in ISO 15118-20, a corresponding set of abstract test cases is necessary to verify the conformance of implementations. This document, therefore, defines a conformance test suite for the 2nd generation network layer and application layer protocols to derive a common basis for conformance tests. The resulting test suite is a prerequisite for downstream interoperability tests. Since interoperability tests furthermore involve the actual application logic of an implementation, such tests are beyond the scope of this document (see NOTE 1 in the Introduction). Therefore, this document focuses on the communication interface aspects and the corresponding requirements given in ISO 15118-20 only.

The layered structure of the conformance test documents for ISO 15118-20 is shown in Figure 1. The complete set of relevant conformance test documents per charging type is composed of all documents within its column according to Figure 1.

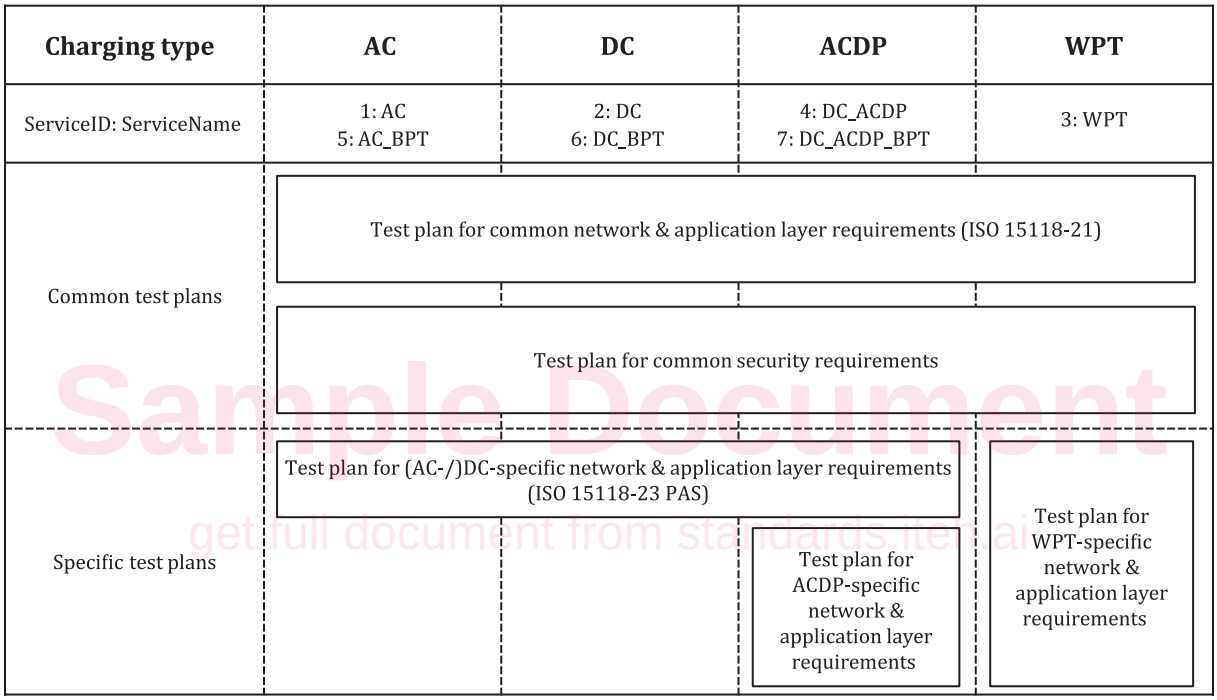

Figure 1 — Overview of mandatory set of conformance test plan documents per charging type

EXAMPLE For a SUT supporting DC-charging the following conformance test plan documents apply:

— test plan for common network & application layer requirements;

— test plan for common security requirements;

— test plan for AC-/DC-specific network and application layer requirements (only DC-specific subset applies, this document).

NOTE 1 Practical limitations make it impossible to define an exhaustive test suite, and economic considerations can restrict testing even further. Hence, the purpose of this document is to increase the probability that different implementations are able to interwork. This is achieved by verifying them by means of a protocol test suite, thereby increasing the confidence that each implementation conforms to the protocol specification. However, the specified protocol test suite cannot guarantee conformance to the specification since it detects errors rather than their absence. Thus, conformance to a test suite alone cannot guarantee interworking. Instead, it gives confidence that an implementation has the required capabilities and that its behaviour conforms consistently in representative instances of communication.

NOTE 2 This document generally refers to SUT instead of implementation under test (IUT), due to the black box testing paradigm adopted in this document and related certification processes.

Road vehicles — Vehicle to grid communication interface —

Part 23:
Second generation network layer and application layer requirements conformance test plan for DC charging

1 Scope

This document specifies conformance tests in the form of an abstract test suite (ATS) for a system under test (SUT) that implements an electric-vehicle communication controller (EVCC) or a supply-equipment communication controller (SECC) for all direct current (DC)-specific requirements specified in ISO 15118-20 that are associated to the DC charging type. These conformance tests specify the testing of capabilities and behaviours of an SUT, as well as checking what is observed against the conformance requirements specified in ISO 15118-20 and against what the implementer states the SUT implementation's capabilities are.

The capability tests within the ATS check that the observable capabilities of the SUT are in accordance with the static conformance requirements defined in ISO 15118-20. The behaviour tests of the ATS examine an implementation as thoroughly as practical over the full range of dynamic conformance requirements defined in ISO 15118-20 and within the capabilities of the SUT.

The test architecture for this document is inherited from the test architecture specified in ISO 15118-21. If further aspects for DC-specific requirements are necessary, they extend this architecture and are specified in this document. The abstract test cases in this document are described leveraging this test architecture and are specified in descriptive tabular format covering the ISO/OSI layer 3 to 7 (network to application layers).

In terms of coverage, this document only covers normative sections and requirements in ISO 15118-20. This document can additionally refer to specific tests for requirements on referenced standards (e.g. IETF RFCs, W3C Recommendation, etc.) if they are relevant in terms of conformance for implementations according to ISO 15118-20. However, it is explicitly not intended to widen the scope of this conformance specification to such external standards, if it is not technically necessary for the purpose of conformance testing for ISO 15118-20. Furthermore, the conformance tests specified in this document do not include the assessment of performance nor robustness or reliability of an implementation. They cannot provide judgments on the physical realization of abstract service primitives, how a system is implemented, how it provides any requested service, nor the environment of the protocol implementation. Furthermore, the abstract test cases defined in this document only consider the communication protocol and the system's behaviour defined ISO 15118-20. Power flow between the EVSE and the EV is not a prerequisite for the test cases specified in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15118-1, *Road vehicles — Vehicle to grid communication interface — Part 1: General information and use-case definition*

ISO 15118-20:2022, *Road vehicles — Vehicle to grid communication interface — Part 20: 2nd generation network layer and application layer requirements*

ISO 15118-21:2025, *Road vehicles — Vehicle to grid communication interface — Part 21: Common 2nd generation network layer and application layer requirements conformance test plan*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15118-1, ISO 15118-20 and ISO 15118-21 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply:

ATS	abstract test suite
CP	control pilot
ETT	energy transfer types
EV	electric vehicle
EVCC	electric vehicle communication controller
EVSE	electric vehicle supply equipment
IUT	implementation under test
MTC	maint test component
PICS	protocol implementation conformance statement
PIXIT	protocol implementation extra information for testing
PLC	powerline communication
PTC	parallel test component
SECC	supply equipment communication controller
SUT	system under test
TC	test case
TCP	transport control protocol
TS	test system
TSS	test suite structure
TTCN-3	testing and test control notation version 3
V2G	vehicle-to-grid

5 Conventions

5.1 Requirement structure

For the purposes of this document, the following abbreviated terms apply:

This document uses unique number identifiers for each individual requirement. This requirement structure allows for easier requirement tracking and management. The following format is used throughout this document:

'[V2G'Y'-'XXX']' requirement text

Where:

— 'V2G' represents the ISO 15118 series;

— Y represents the document part of the ISO 15118 series, for this document Y = 23;

— XXX represents the individual requirement number; and

— 'requirement text' includes the actual text of the requirement.

5.2 Test system description

TTCN-3 is used in this document to define/specify the test system architecture and test suite conventions, where applicable. TTCN-3 is, however, not mandatory for the implementation of a conformance test system according to this document.

[V2G23-001] The implementers of conformance tests shall verify that the test purposes implemented in their executable test cases are identical to the abstract test cases described in this document.

NOTE In this document, test cases are not programmatically specified in TTNC-3 core language.

6 Test architecture reference model

6.1 General information

ISO 15118-21:2025, 6.1 is applicable.

6.2 Platform adapter

ISO 15118-21:2025, 6.2 is applicable.

6.3 SUT adapters

6.3.1 General information

ISO 15118-21:2025, 6.3.1 is applicable.

6.3.2 IEC 61851-1 SUT adapter

ISO 15118-21:2025, 6.3.2 is applicable.

6.3.2.1 Requirements of IEC 61851-1 SUT adapter for SECC or EVCC testing

ISO 15118-21:2025, 6.3.2.1 is applicable.

6.3.2.2 Requirements of IEC 61851-1 SUT adapter for SECC testing

ISO 15118-21:2025, 6.3.2.2 is applicable.

6.3.2.3 Requirements of IEC 61851-1 SUT adapter for EVCC testing

ISO 15118-21:2025, 6.3.2.3 is applicable.

6.3.3 ISO 15118-20 SUT adapter

ISO 15118-21:2025, 6.3.3 is applicable.

6.3.4 ISO 15118-3 SUT adapter

ISO 15118-21:2025, 6.3.4 is applicable.

6.4 Codecs

ISO 15118-21:2025, 6.4 is applicable.

6.5 Test system timer handling

ISO 15118-21:2025, 6.5 is applicable.

6.5.1 Definition of test system timers and timeouts

ISO 15118-21:2025, 6.5.1 is applicable.

Besides that, Table 1 lists all additional test system specific observation and termination timers in this document.

Table 1 — ISO/PAS 15118-23 Test system timers

Time/Timeout	Description
SECC_StopEnergyTransfer_Observation_Timer	Energy transfer stop observation timer in the SECC

Table 2 lists all additional test system specific timeouts in this document.

Table 2 — ISO 15118-23 Test system timings and timeouts

Time/Timeout	Value in sec	Description
SECC_StopEnergyTransfer_Timeout	10	Timeout for EVCC reaction to user initiated stop of energy transfer

6.5.2 Test system timer scenarios for SUT SECC

ISO 15118-21:2025, 6.5.2 is applicable.

6.5.3 Test system timer scenarios for SUT EVCC

ISO 15118-21:2025, 6.5.3 is applicable. In addition, the following test system timer scenarios are specified.

Figure 2 shows the TS timer handling for multi-message sequence termination scenarios for EVCC (e.g. involving ongoing message loops).

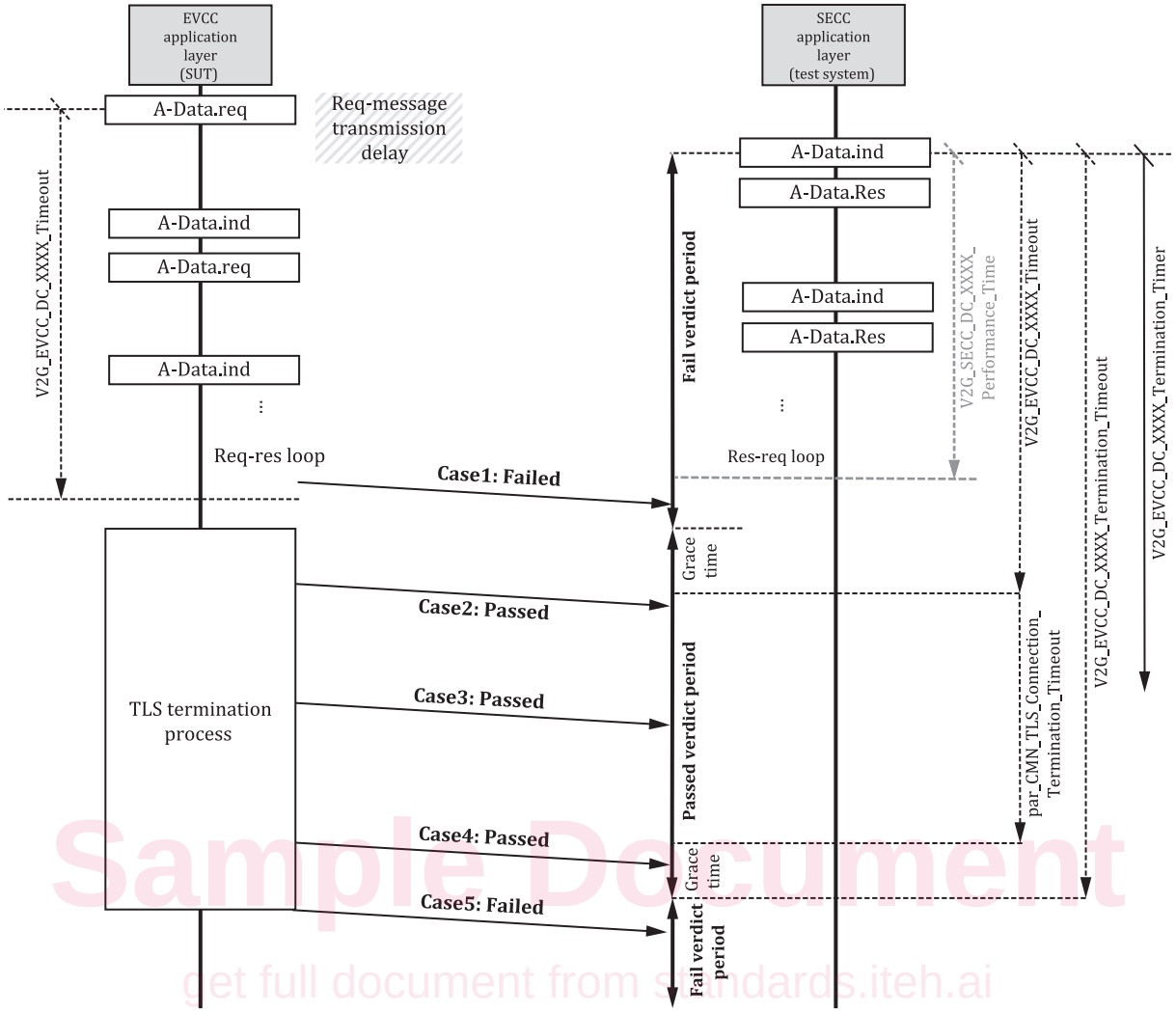

Figure 2 — Test system timer handling for multi-message sequence termination scenarios for EVCC

7 Test suite conventions

7.1 General information

ISO 15118-21:2025, 7.1 is applicable.

7.2 Test suite structure (TSS)

ISO 15118-21:2025, 7.2 is applicable.

7.3 Test profiles

ISO 15118-21:2025, 7.3 is applicable.

7.3.1 General information

ISO 15118-21:2025, 7.3.1 is applicable.

7.3.2 Test configurations

ISO 15118-21:2025, 7.3.2 is applicable, except as follows:

Replace “Table 4 – Test configurations” in ISO 15118-21:2025, 7.3.2 with Table 3 in this document.

Table 3 — Test configurations

CF_ID	SUT	MTC	PTC
CF_21_001	SECC with ISO 15118-20 protocol support and ISO 15118-3 HPGP PLC communication interface and IEC 61851-1 signalling	EVCC with ISO 15118-20 SUT adapter ISO 15118-3 SUT adapter (HPGP)	PTC with IEC 61851-1 SUT adapter (CP, PP)
CF_21_002	EVCC with ISO 15118-20 protocol support and ISO 15118-3 HPGP PLC communication interface and IEC 61851-1 signalling	SECC with ISO 15118-20 SUT adapter ISO 15118-3 SUT adapter (HPGP)	PTC with IEC 61851-1 SUT adapter (CP, PP)
CF_21_003	SECC with ISO 15118-20 protocol support and ISO 15118-8 WLAN communication interface and IEC 61851-1 signalling	EVCC with ISO 15118-20 SUT adapter ISO 15118-8 SUT adapter (WLAN)	PTC with IEC 61851-1 SUT adapter (CP, PP)
CF_21_004	EVCC with ISO 15118-20 protocol support and ISO 15118-8 WLAN communication interface and IEC 61851-1 signalling	SECC with ISO 15118-20 SUT adapter ISO 15118-8 SUT adapter (WLAN)	PTC with IEC 61851-1 SUT adapter (CP, PP)

7.3.3 Protocol implementation conformance statement (PICS) definition

ISO 15118-21:2025, 7.3.3 is applicable.

Besides that, Table 4 lists all additional PICS parameter for EVCC tests in this document.

Table 4 — PICS for test system configuration CF_21_002 (SUT equals EVCC)

PICS	Capability description	Test parameter
`PICS_EVCC_EVV2XEnergyRequest`	Specifies whether a preferred operational V2X range is supported by the SUT. The corresponding feature is enabled by usage of the parameters EVMaximumV2XEnergyRequest and EVMinimumV2XEnergyRequest. Possible values to choose from are: — True or False — True — False	Parameter `evv2xenergyrequest_value` indicates if the parameters EVMaximumV2XEnergyRequest and EVMinimumV2XEnergyRequest are included in DC_ChargeLoopReq message. One of the following values can be assigned to `evv2xenergyrequest_value`: — True — False

7.3.4 Protocol implementation extra information for testing (PIXIT) definition

ISO 15118-21:2025, 7.3.4 is applicable.

7.3.5 Test control

For test control, the following requirements or recommendations apply for this document:

Test case description for test control shall execute all applicable test cases listed in 8.2 for SUT SECC under consideration of all PICS and PIXIT for that particular SUT.

[V2G23-002] Test control shall execute all applicable test cases listed in 8.2 for SUT SECC under consideration of all PICS and PIXIT for that particular SUT.

[V2G23-003] Test control shall execute all applicable test cases listed in 8.3 for SUT EVCC under consideration of all PICS and PIXIT for that particular SUT.

[V2G23-004] Test control shall implement the test parameters derived from all PICS and PIXIT parameters as specified in 7.3.3 and 7.3.4.

7.3.6 Test system template messages

ISO 15118-21:2025, 7.3.6 is applicable.

7.4 Test suite identifiers

ISO 15118-21:2025, 7.4 is applicable.

7.4.1 General information

ISO 15118-21:2025, 7.4.1 is applicable.

7.4.2 Test case identifiers

ISO 15118-21:2025, 7.4.2 is applicable.

7.4.3 PICS/PIXIT identifiers

ISO 15118-21:2025, 7.4.3 is applicable.

7.4.4 Verdict types

ISO 15118-21:2025, 7.4.4 is applicable.

7.5 Test case specification

Apply ISO 15118-21:2025, 7.5 is applicable.

8 Test case specification for DC charging ISO 15118-20 requirements

8.1 General information

Subclause 8.2 covers all test cases (Tables 5 to 42) for SECC according to ISO 15118-20 while subclause 8.3 covers all test cases (Tables 43 to 90) for EVCC according to ISO 15118-20. (Table A.1 shows how the requirements in ISO 15118-20 are mapped against the test cases specified in 8.2 and 8.3.)

8.2 Test cases for SUT SECC

8.2.1 SECC V2GTP test case specifications

8.2.1.1 SECC V2GTP test case specifications with DC V2G message payload

Table 5 — Test case description for TC23_SECC_V2GTPDCMessages_001

TC Id	TC23_SECC_V2GTPDCMessages_001
Test purpose	In case the SUT supports DC or ACDP (PICS_CMN_ETT), this TC observes whether the SUT sends a DC_CableCheckRes message with V2GTP header information ProtocolVersion set to '01'H, InvProtocolVersion set to 'FE'H and PayloadType set to '8004'H after receiving a DC_CableCheckReq message from the test system.
Pre-condition	The SUT and TS are initialized to a state where the data link and TLS connection are successfully established and the V2G message sequence is succeeded until the ScheduleExchangeRes message with EVSEProcessing set to 'Finished' (ett_value := DC) or the ACDP_ConnectRes message with EVSEProcessing set to 'Finished' (ett_value := ACDP) is received.

Test behaviour	The test system starts the V2G_EVCC_Msg_Observation_Timer when sending a DC_CableCheckReq message and the corresponding V2GTP header with all elements and values from default parameter set according to ISO 15118-21:2025, Annex C.
	
	For verdict 'pass' the test system then checks whether a DC_CableCheckRes message with V2GTP header is received within V2G_EVCC_Msg_Timeout according to ISO 15118-20:2022, Table 215 and the test system timer handling as specified in ISO 15118-21:2025, 6.5 with the following format:
	
	V2GTP := {
	Header := {
	ProtocolVersion := '01'H
	InvProtocolVersion := 'FE'H
	PayloadType := '8004'H
	PayloadLength := ?
	}
	Payload :=
	DC_CableCheckRes := ?
	}
	}

Document reference	ISO 15118-20:2022, 7.8.3.1
Referenced requirement(s)	[V2G20-2307]
Config Id	CF_21_001, CF_21_003
PICS	PICS_CMN_ETT contains (ett_value = DC|ACDP)
PIXIT	-

Table 6 — Test case description for TC23_SECC_V2GTPDCMessages_002

TC Id	TC23_SECC_V2GTPDCMessages_002
Test purpose	In case the SUT supports DC or ACDP (PICS_CMN_ETT), this TC observes whether the SUT sends a DC_CableCheckRes message whose TCP destination port number is in range of V2G_DST_TCP_DATA after receiving a DC_CableCheckReq message from the test system.
Pre-condition	The SUT and TS are initialized to a state where the data link and TLS connection are successfully established and the V2G message sequence is succeeded until the ScheduleExchangeRes message with EVSEProcessing set to 'Finished' (ett_value := DC) or the ACDP_ConnectRes message with EVSEProcessing set to 'Finished' (ett_value := ACDP) is received.
Test behaviour	The test system starts the V2G_EVCC_Msg_Observation_Timer when sending a DC_CableCheckReq message with all elements and values from default parameter set according to ISO 15118-21:2025, Annex C. For verdict 'pass' the test system then checks whether the used TCP destination port number of DC_CableCheckRes message is in the range of Dynamic Ports (49152-65535).
Document reference	ISO 15118-20:2022, 7.8.2
Referenced requirement(s)	[V2G20-078], [V2G20-080]
Config Id	CF_21_001, CF_21_003
PICS	PICS_CMN_ETT contains (ett_value = DC|ACDP)
PIXIT	-

Table 7 — Test case description for TC23_SECC_V2GTPDCMessages_003

TC Id	TC23_SECC_V2GTPDCMessages_003
Test purpose	In case the SUT supports DC or ACDP (PICS_CMN_ETT), this TC observes whether the SUT ignores a DC_CableCheckReq message with invalid V2GTP header information ProtocolVersion set to 'FF'H.
Pre-condition	The SUT and TS are initialized to a state where the data link and TLS connection are successfully established and the V2G message sequence is succeeded until the ScheduleExchangeRes message with EVSEProcessing set to 'Finished' (ett_value := DC) or the ACDP_ConnectRes message with EVSEProcessing set to 'Finished' (ett_value := ACDP) is received.
Test behaviour	The test system starts the V2G_SECC_Sequence_Observation_Timer upon receiving a ScheduleExchangeRes message with EVSEProcessing set to 'Finished' (ett_value := DC) or ACDP_ConnectRes message with EVSEProcessing set to 'Finished' (ett_value := ACDP) and the V2G_EVCC_Msg_Observation_Timer when sending a DC_CableCheckReq message and the corresponding V2GTP header with all elements and values from default parameter set according to ISO 15118-21:2025, Annex C with consideration of the following parameter adjustment: ProtocolVersion := 'FF'H For verdict 'pass' the test system then checks whether the SUT does not respond to a DC_CableCheckReq message with invalid V2GTP header within V2G_EVCC_Msg_Timeout according to ISO 15118-20:2022, Table 215 and the test system timer handling as specified in ISO 15118-21:2025, 6.5. Furthermore, the test system checks whether the SUT does not terminate the TLS connection within V2G_SECC_Sequence_Timeout according to ISO 15118-20:2022, Table 215, and the test system timer handling as specified in ISO 15118-21:2025, 6.5.
Document reference	ISO 15118-20:2022, 8.6.4.6.3.1
Referenced requirement(s)	[V2G20-800]
Config Id	CF_21_001, CF_21_003
PICS	PICS_CMN_ETT contains (ett_value = DC|ACDP)
PIXIT	-