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Road vehicles— FlexRay communications system —

Part 5: Electrical physical layer conformance test specification

Véhicules routiers — Système de communications FlexRay — Partie 5: Spécification d'essai de conformité de la couche d'application électrique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17458-5 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 17458 consists of the following parts, under the general title *Road vehicles — FlexRay communications system*:

— *Part 1: General information and use case definition*

— *Part 2: Data link layer specification*

— *Part 3: Data link layer conformance test specification*

— *Part 4: Electrical physical layer specification*

— *Part 5: Electrical physical layer conformance test specification*

Introduction

The FlexRay communications system is an automotive focused high speed network and was developed with several main objectives which were defined beyond the capabilities of established standardized bus systems like CAN and some other proprietary bus systems. Some of the basic characteristics of the FlexRay protocol are synchronous and asynchronous frame transfer, guaranteed frame latency and jitter during synchronous transfer, prioritization of frames during asynchronous transfer, single or multi-master clock synchronization, time synchronization across multiple networks, error detection and signalling, and scalable fault tolerance.

The FlexRay communications system is defined for advanced automotive control applications. It serves as a communication infrastructure for future generation high-speed control applications in vehicles by providing:

— A message exchange service that provides deterministic cycle based message transport;

— Synchronization service that provides a common time base to all nodes;

— Start-up service that provides an autonomous start-up procedure;

— Error management service that provides error handling and error signalling;

— Wakeup service that addresses the power management needs.

This bus system has been developed with several main objectives which were defined beyond the capabilities of existing bus systems like CAN and some other proprietary bus systems. This advanced automotive communication system specifies support for:

— Scalable static and dynamic message transmission (deterministic and flexible);

— High net data rate of 5 Mbit/sec; gross data rate approximately 10 Mbit/sec;

— Scalable fault-tolerance (single and dual channel);

— Error containment on the physical layer through an independent Bus Guardian;

— Fault tolerant clock synchronisation (global time base).

Since start of development the automotive industry world wide supported the specification development. The FlexRay communications system has been successfully implemented in production vehicles today.

The ISO 17458 series specifies the use cases, the communication protocol and physical layer requirements of an in-vehicle communication network called "FlexRay communications system".

This part of ISO 17458 has been established in order to define the use cases for vehicle communication systems implemented on a FlexRay data link.

To achieve this, it is based on the Open Systems Interconnection (OSI) Basic Reference Model specified in ISO/IEC 7498-1 [1] and ISO/IEC 10731 [6], which structures communication systems into seven layers. When mapped on this model, the protocol and physical layer requirements specified by ISO 17458 are broken into:

— Diagnostic services (layer 7), specified in ISO 14229-1 [7], ISO 14229-4 [9];

— Presentation layer (layer 6), vehicle manufacturer specific;

— Session layer services (layer 5), specified in ISO 14229-2 [8];

— Transport layer services (layer 4), specified in ISO 10681-2 [5];

— Network layer services (layer 3), specified in ISO 10681-2 [5];

— Data link layer (layer 2), specified in ISO 17458-2, ISO 17458-3;

— Physical layer (layer 1), specified in ISO 17458-4, ISO 17458-5;

in accordance with Table 1.

Table 1 — FlexRay communications system specifications applicable to the OSI layers

Applicability	OSI 7 layers	FlexRay communications system	Vehicle manufacturer enhanced diagnostics
Seven layer according to ISO 7498-1 and ISO/IEC 10731	Application (layer 7)	vehicle manufacturer specific	ISO 14229-1, ISO 14229-4
	Presentation (layer 6)	vehicle manufacturer specific	vehicle manufacturer specific
	Session (layer 5)	vehicle manufacturer specific	ISO 14229-2
	Transport (layer 4)	vehicle manufacturer specific	ISO 10681-2
	Network (layer 3)	vehicle manufacturer specific	
	Data link (layer 2)	ISO 17458-2, ISO 17458-3	
	Physical (layer 1)	ISO 17458-4, ISO 17458-5	

Table 1 shows ISO 17458 Parts 2 – 5 being the common standards for the OSI layers 1 and 2 for the FlexRay communications system and the vehicle manufacturer enhanced diagnostics.

The FlexRay communications system column shows vehicle manufacturer specific definitions for OSI layers 3 – 7.

The vehicle manufacturer enhanced diagnostics column shows application layer services covered by ISO 14229-4 which have been defined in compliance with diagnostic services established in ISO 14229-1, but are not limited to use only with them. ISO 14229-4 is also compatible with most diagnostic services defined in national standards or vehicle manufacturer's specifications. The presentation layer is defined vehicle manufacturer specific. The session layer services are covered by ISO 14229-2. The transport protocol and network layer services are specified in ISO 10681.

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IMPORTANT — According to ISO 17458-4, the FlexRay communications system was specified focusing on a data rate of 10 Mbit/s. Therefore this conformance test specification regards the use of systems with a data rate of 10 Mbit/s only whereas the physical layer also works properly in systems with data rates in the range from 2,5 Mbit/s to 10 Mbit/s according to ISO 17458-4.

1 Scope

This part of ISO 17458 specifies the conformance test for the electrical physical layer of the FlexRay communications system.

This part of ISO 17458 defines a test that considers ISO 9646 and ISO 17458-4.

The purpose of this part of ISO 17458 is to provide a standardized way to verify whether FlexRay Bus Driver and Active Star products are compliant to ISO 17458-4. The primary motivation is to ensure a level of interoperability of FlexRay Bus Drivers and Active Stars from different sources in a system environment.

This part of ISO 17458 provides all necessary technical information to ensure that test results will be identical even on different test systems, provided that the particular test suite and the test system are compliant to the content of this part of ISO 17458.

2 Normative references

The following referenced documents are indispensable for the application 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 17458-1, *Road vehicles — FlexRay communications system — Part 1: General information and use case definition*

ISO 17458-2, *Road vehicles — FlexRay communications system — Part 2: Data link layer specification*

ISO 17458-4, *Road vehicles — FlexRay communications system — Part 4: Electrical physical layer specification*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17458-1, ISO 17458-2, ISO 17458-4 and the following apply.

3.1.1
bus driver – communication controller interface
BD-CC-interface
see "*BD-BD interface*" when replacing one *BD* by a *CC*

3.1.2
cable
term that summarises all necessary components to implement a FlexRay *transmission line*:
two twisted or untwisted wires to be connected to *BP* and *BM*, isolators to mount the wires, an optional shield, an optional wire to strengthen the shield, an optional sheath, etc.

3.1.3
communication controller – bus driver interface
CC-BD-interface
see "*BD-CC-interface*"

3.1.4
communication channel
FlexRay allows a single *CC* to distribute data-frames independent from each other on two different hardware paths or *topologies*. From an abstract view each path is named "*communication channel*".

3.2 Abbreviated terms

LT	lower tester
UT	upper tester

4 Document reference according to OSI model

Figure 1 depicts the FlexRay document reference according to OSI model.

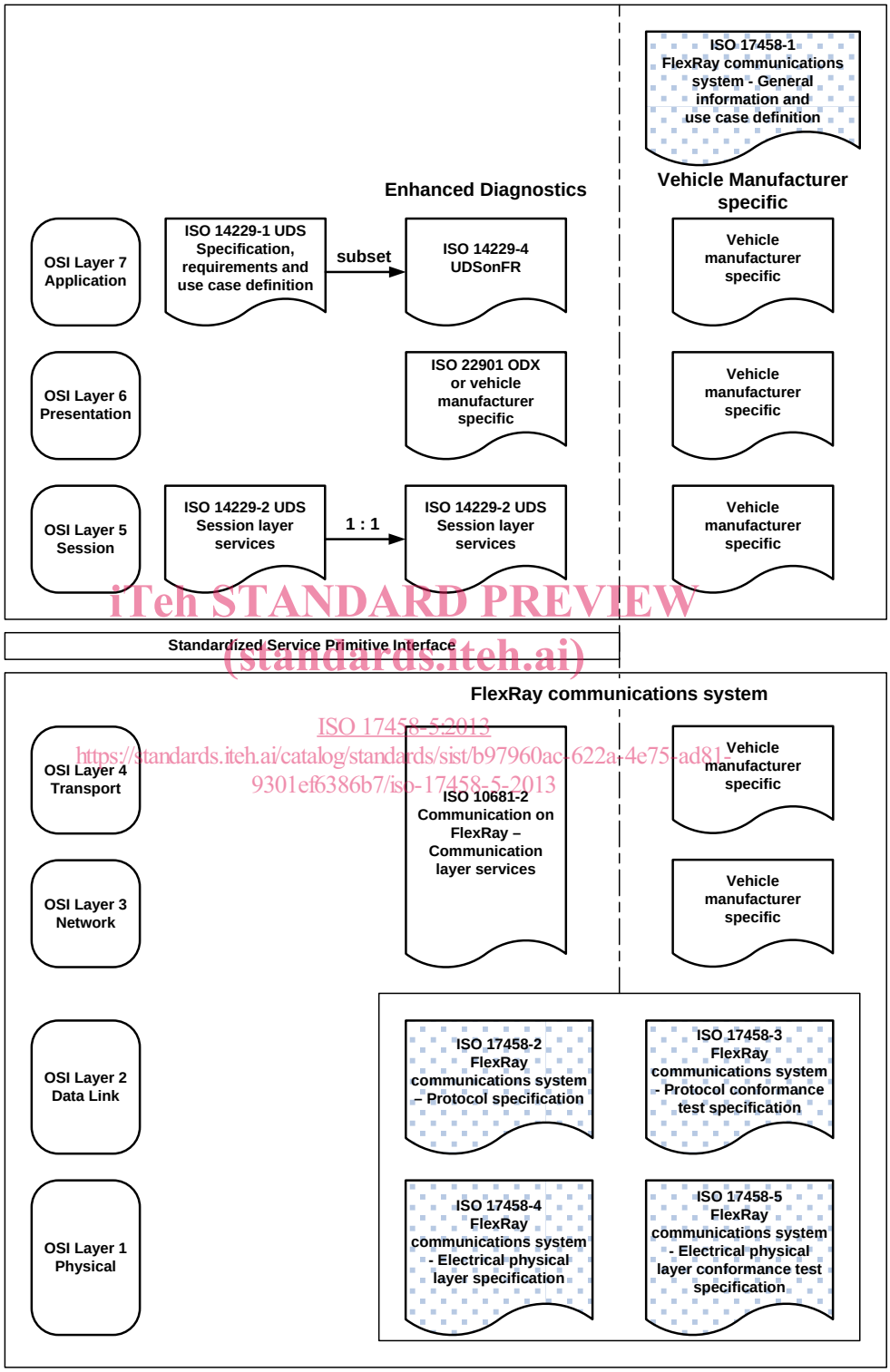


Figure 1 — FlexRay document reference according to OSI model

5 Conventions

5.1 General

ISO 17458, ISO 10681 and ISO 14229-4 are based on the conventions specified in the OSI Service Conventions (ISO/IEC 10731) as they apply for physical layer, protocol, network & transport protocol and diagnostic services.

5.2 Notational conventions

Notational conventions are listed in ISO 17458-4.

6 Test environment

6.1 Test case architecture

Each test case is specified with the following parts that must all be described unambiguous:

— Test case name
a name for this test case.

— Test purpose
a description of the motivation for this test case.

— Configuration
the state of the test environment for this test case.

— Preamble (setup state)
the steps to do before the specified test case could be executed.

— Test execution
the description of the execution of this test case.

— Postamble
the steps to do after the specified test case in order to have a defined state.

— Pass criteria
the criteria to judge the test result.

— Test instances
this is an optional part and contains test cases, that are summarised in tabular form because they are executed separately with only minor changes in comparison to the first test case within this group.

Every test case is independent from the other test cases.

Several test cases are performed with the presence of stress conditions in order to check the robustness of the IUT. These stress conditions are specified in detail in Clause 7.

The test parameters are FlexRay variables or constants that are defined in ISO 17458-4. These test parameters are specified in detail in Clause 8.

Every test case starts at the beginning of the preamble and ends after the postamble. There is no delay between the preamble and the test execution and between the test execution and the postamble.

The pass criteria are related only to the test execution.

Product specific items are not part of this International Standard.

6.2 Test method

6.2.1 General

The FlexRay BD has several interfaces, that are supplied by specified power supplies and stimuli and observed by external components (signal measurements). The requirements for those generators and signal measurements are specified in 6.5.

The interfaces of the BD are separated in two parts:

— Analog interface
bus (service provider) and supply pins.

— Digital interface
the pins for connecting the BD with the FlexRay protocol components.

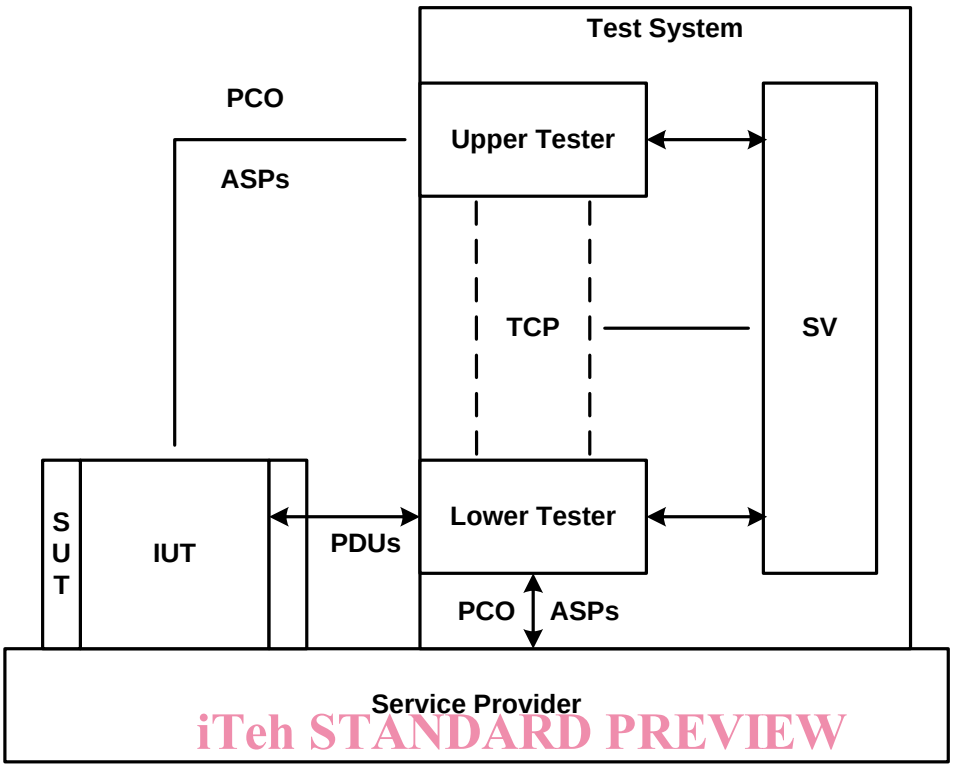
Each test case describes the used pins for supplying, stimulation and observation.

The used test method for the FlexRay PL regarding [2] is the local test method, see also Figure 2.

The local test method contains a Lower Tester (LT) for the analog interface (bus) and an Upper Tester (UT) for the digital interface. Both are part of the test system. The coordination of the test cases is done by the test coordination procedure (TCP).

The whole test is controlled by the supervisor (SV) that is also part of the test system. The SV controls the UT and LT with the TCP.

Figure 2 depicts the local test method of ISO 9646-1:1994.



Key

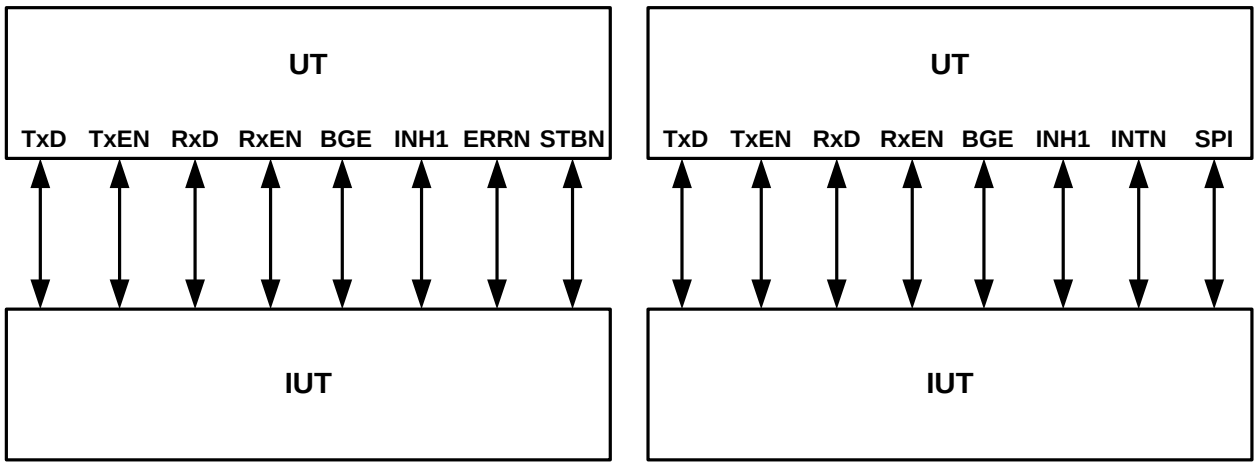
ASP	Abstract service primitive
IUT	Implementation under test
PCO	Point of control and observation
PDU	Prodocol data unit
SV	Supervisor
SUT	System under test
TCP	Test control procedure

Figure 2 — Local test method

6.2.2 Upper Tester

The UT has to provide test data, control and observe the IUT at its upper interface. The implementation has to keep in mind the possibility of two different host interfaces of the IUT as specified in ISO 17458-4.

Figure 3 shows the mandatory signals of the IUT that the conformance test considers:



a) Option A **b) Option B**

Components

IUT	Implementation Under Test
UT	Upper Tester

Connections and supplies

BGE	Bus guardian enable
ERRN	Error not
INH1	Inhibit 1
INTN	Inhibit n
RxD	Receive data
RxEN	Receive enable
SPI	Serial peripheral interface
STBN	Standby not
TxD	Transmit data
TxEN	Transmit enable not

Figure 3 — Upper Tester

The tasks of the UT are:

— Provide test data streams

— Change the mode of the IUT

— Observe and acquire the error line

— Observe and acquire the received data stream

— Provide IUT functions to the supervisor

— Provide test system functionality to the IUT