DRAFT INTERNATIONAL STANDARD
ISO/DIS 15765-4

ISO/TC **22**/SC **3**

Voting begins on:
2015-03-19

Secretariat: **DIN**

Voting terminates on:
2015-06-19

Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) —

Part 4:
Requirements for emissions-related systems

Véhicules routiers — Diagnostic sur gestionnaire de réseau de communication (DoCAN) —

PartieParte 4: Exigences applicables aux systèmes associés aux émissions

ICS: 43.040.15

Reference number
ISO/DIS 15765-4:2015(E)

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Foreword

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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 15765-4 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This third edition cancels and replaces the second edition (ISO 15765-4:2013) of which has been technically revised.

ISO 15765 consists of the following parts, under the general title *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN)*:

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

⎯ *Part 2: Transport protocol and network layer services*

⎯ *Part 3: Implementation of unified diagnostic services (UDS on CAN)*[1]

⎯ *Part 4: Requirements for emissions-related systems*

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1) ISO 15765-3 has benn replaced by ISO 14229-3.

Introduction

This part of ISO 15765 has been established in order to define common requirements for vehicle diagnostic systems implemented on a Controller Area Network (CAN) communication link, as specified in ISO 11898. Although primarily intended for diagnostic systems, it also meets requirements from other CAN-based systems needing a network layer protocol.

To achieve this, it is based on the Open Systems Interconnection (OSI) Basic Reference Model, in accordance with ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers as shown in Table 1.

Table 1 — Enhanced and legislated OBD diagnostic specifications applicable to the OSI layers

Applicability	OSI 7 layers	Vehicle manufacturer enhanced diagnostics	Legislated OBD (on-board diagnostics)	Legislated WWH-OBD (on-board diagnostics)	
Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731	Application (layer 7)	ISO 14229-1, ISO 14229-3	ISO 15031-5	ISO 27145-3, ISO 14229-1	
	Presentation (layer 6)	Vehicle manufacturer specific	ISO 15031-2, ISO 15031-5, ISO 15031-6, SAE J1930-DA, SAE J1979-DA, SAE J2012-DA	ISO/PAS 27145-2, SAE 1930-DA, SAE J1979-DA, SAE J2012-DA, SAE J1939 Appendix C (SPN), SAE J1939-73 Appendix A (FMI)	
	Session (layer 5)	ISO 14229-2		ISO 14229-2	
	Transport protocol (layer 4)	ISO 15765-2	ISO 15765-2, ISO 15765-4, ISO 11898-2	ISO 15765-4, ISO 15765-2	ISO 27145-4
	Network (layer 3)				
	Data link (layer 2)	ISO 11898-1		ISO 15765-4, ISO 11898-1, ISO 11898-2	
	Physical (layer 1)	User defined			

The application layer services covered by ISO 14229-3 have been defined in compliance with diagnostic services established in ISO 14229-1 and ISO 15031-5, but are not limited to use only with them.

The transport protocol and network layer services covered by this part of ISO 15765 have been defined to be independent of the physical layer implemented, and a physical layer is only specified for legislated on-board diagnostics (OBD).

For other application areas, ISO 15765 can be used with any CAN physical layer.

Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 4: Requirements for emissions-related systems

1   Scope

This part of ISO 15765 specifies requirements for controller area networks (CAN) where one or more controllers comply with on-board diagnostics (OBD) or world-wide harmonized on-board diagnostics (WWH-OBD) regulations. The network presumes the use of an external test equipment for inspection and repair diagnostics, as defined by the regulations. The CAN network requirements for the vehicle and the external test equipment are based on the specifications of ISO 15765-2, ISO 11898-1 and ISO 11898-2.

This part of ISO 15765 places restrictions on those International Standards for the fulfilment of the regulations. It does not specify in-vehicle CAN bus architecture, but seeks to ensure that the vehicle's regulated CAN communications comply with external test equipment requirements.

This part of ISO 15765 defines the requirements to successfully establish, maintain and terminate communication with a vehicle that implements the requirements of the OBD/WWH-OBD regulations. Plug-and-play communication capabilities among vehicles and test equipment are defined to assure the interoperation of external test equipment and vehicles. This part of ISO 15765 details all of the OSI layer requirements to achieve this goal.

This part of ISO 15765 is the entry point for DoCAN (Diagnostic communication over CAN). Based on the results of the initialization, the external test equipment determines which protocol and diagnostic services are supported by the vehicle's emissions-related system:

⎯ legislated OBD: ISO 15031 (all parts),

⎯ legislated WWH-OBD: ISO 27145 (all parts).

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 11898-1, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

ISO 11898-2, *Road vehicles — Controller area network (CAN) — Part 2: High-speed medium access unit*

ISO 15031-3, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electrical circuits, specification and use*

ISO 15031-5, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services*

ISO 15765-2, *Road vehicles — Diagnostic communication over Controller Area Networks (DoCAN) — Part 2: Transport protocol and network layer services*

ISO 27145-3, *Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements — Part 3: Common message dictionary*

ISO 27145-4, *Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements — Part 4: Connection between vehicle and test equipment*

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 15765-2 apply.

3.2　Symbols

Symbol	Definition	Unit
C_{AC1}, C_{AC2}	capacitance of a.c. termination	F
C_{CAN_H}	capacitance between CAN_H and ground potential	F
C_{CAN_L}	capacitance between CAN_L and ground potential	F
C_{DIFF}	capacitance between CAN_H and CAN_L	F
Δf	oscillator tolerance	Hz
I_{CABLE}	maximum cable length between OBD/WWH-OBD connector and external test equipment	m
Prop_Seg	propagation segment	
Phase_Seg1	phase segment 1	
Phase_Seg2	phase segment 2	
R_{AC1}, RA_{C2}	resistance of a.c. termination	Ω
Sync_Seg	synchronization segment	
t_{BIT}	bit time	µs
t_{BIT_RX}	receive bit time	µs
t_{BIT_TX}	transmit bit time	µs
t_{CABLE}	external-test-equipment cable propagation delay (without external test equipment CAN interface delay)	µs
t_{SEG1}	timing segment 1	µs
t_{SEG2}	timing segment 2	µs
t_{SJW}	resynchronization jump with	µs
$t_{SYNCSEG}$	synchronization segment	µs

Symbol	Definition	Unit
t_{TOOL}	external test equipment CAN interface propagation delay (without external test equipment cable delay)	µs
t_Q	time quantum	µs

3.3 Abbreviated terms

BS   block size

CAN   controller area networks

CF   consecutive frame

DLC   data length code

DoCAN   diagnostic communication over CAN

ECU   electronic control unit

ECM   engine control module

FC   flow control

FF   first frame

FS   flow status

OBD   on-board diagnostics

SA   source address

SF   single frame

SJW   synchronization jump width

SP   nominal sample point

TA   target address

TCM   transmission control module

WWH-OBD   world-wide harmonized on-board diagnostics

4 Conventions

ISO 15765 is based on the conventions specified in the OSI Service Conventions (ISO/IEC 10731:1994) as they apply for diagnostic services.

5 Document overview

Figure 1 illustrates the most applicable application implementations utilizing the DoCAN protocol.
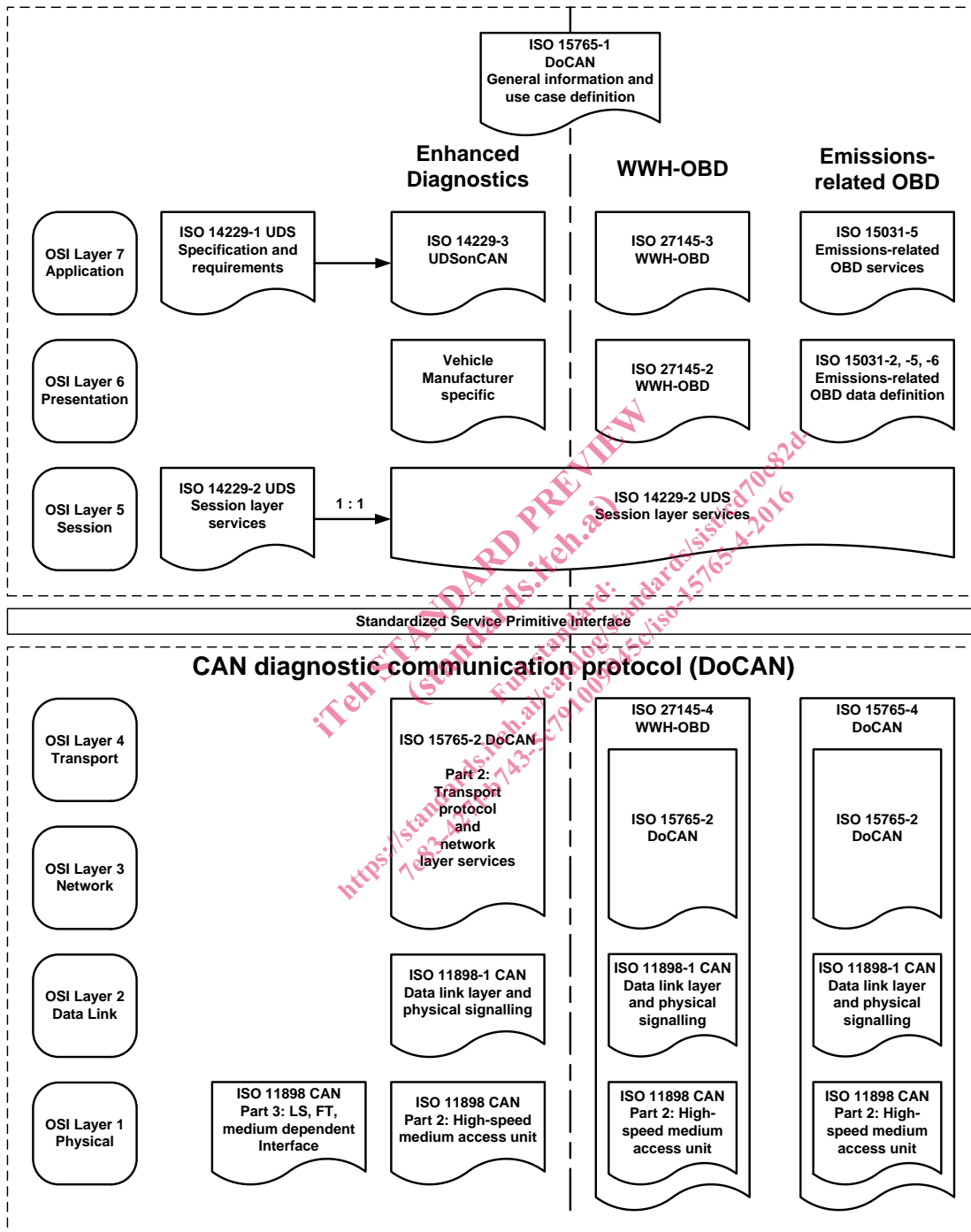

Figure 1 — Diagnostic communication over CAN document reference according to OSI model according to OSI model

6 External test equipment initialization sequence

6.1 General

The external test equipment shall support the initialization sequence specified in this part of ISO 15765. See Figure 2.

The purpose of the external test equipment initialization sequence is to automatically detect whether the vehicle supports legislated OBD or WWH-OBD on CAN using the physical layer specified in Clause 12.

Furthermore, the initialization sequence determines the communication compliance status of vehicles by analysing their responses to:

— ISO 15031-5 service 01_{16} 00_{16} (PID supported) requests, or

— ISO 27145-3 service 22_{16} F81$0_{16}$ (DID protocol identification) request with a positive response.

Only vehicles that follow the WWH-OBD regimen will have ECUs that reply to the functional request service 22_{16} DID F81$0_{16}$ for protocol identification. Vehicles that respond only to the functional request service 01_{16} PID 00_{16} support earlier OBD communication methods. Vehicles that do not respond to either request do not support regulated OBD diagnostics under this part of ISO 15765. Subclause 6.3 describes this procedure.

For each legislated OBD/WWH-OBD service that requires the determination of "supported" information, the external test equipment has to update its list of expected responding legislated OBD/WWH-OBD ECUs prior to any data parameter requests. For applicable services see either ISO 15031-5 (for legislated OBD) or ISO 27145-3 (for legislated WWH-OBD).

The external test equipment initialization sequence supports single baudrate initialization (e.g. 500 kBit/s) and multiple baudrate initialization (e.g. 250 kBit/s and 500 kBit/s) and is separated into the following tests:

a) 11 bit CAN identifier validation, and

b) 29 bit CAN identifier validation.

NOTE   See 6.2.2.

The external test equipment initialization sequence contains provisions for legacy vehicles using either CAN (same or different physical layer as defined for legislated OBD/WWH-OBD) or a different protocol (non-CAN) on the CAN pins of the ISO 15031-3 diagnostic connector.