INTERNATIONAL STANDARD

ISO 15765-4

Fourth edition
2021-07

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) —

Partie 4: Exigences applicables aux systèmes associés aux émissions

Reference number
ISO 15765-4:2021(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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.

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 ISO documents 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

This fourth edition cancels and replaces the third edition (ISO 15765-4:2016), which has been technically revised.

The main changes compared to the previous edition are as follows:

— changed all time-related parameters to $t_{\text{Parameter\_Name}}$;

— corrected all occurrences of ⊣⊨ $P2_{\text{CAN\_max}}$ and changed to $\Delta t_{\text{P2\_CAN\_Client\_Max}}$;

— Clause 6 title has been changed to application;

— subclause 6.1 title has been changed to vehicle communication initialisation sequence;

— subclause 6.2 title has been changed to external test equipment communication initialisation sequence;

— changed N_As to $t_{\text{N\_As}}$ and changed timeout value to 33 ms;

— changed N_Ar to $t_{\text{N\_Ar}}$ and changed timeout value to 33 ms;

— added clarification in 10.3.3 regarding the acceptance of physically addressed request messages.

A list of all parts in the ISO 15765 series can be found on the ISO website.

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.

Introduction

This document 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 11898-1 and ISO 11898-2. 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 specified in ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers.

When mapped on this model, the application protocol and lower OSI layers framework requirements specified/referenced in the ISO 15765 series are structured according to Figure 1.

Figure 1 illustrates a standards-based documentation concept, which consists of the lower OSI layers framework, which specifies requirements related to the transport layer, network layer, data link layer and physical layer standards of the OSI layers 4, 3, 2, and 1.

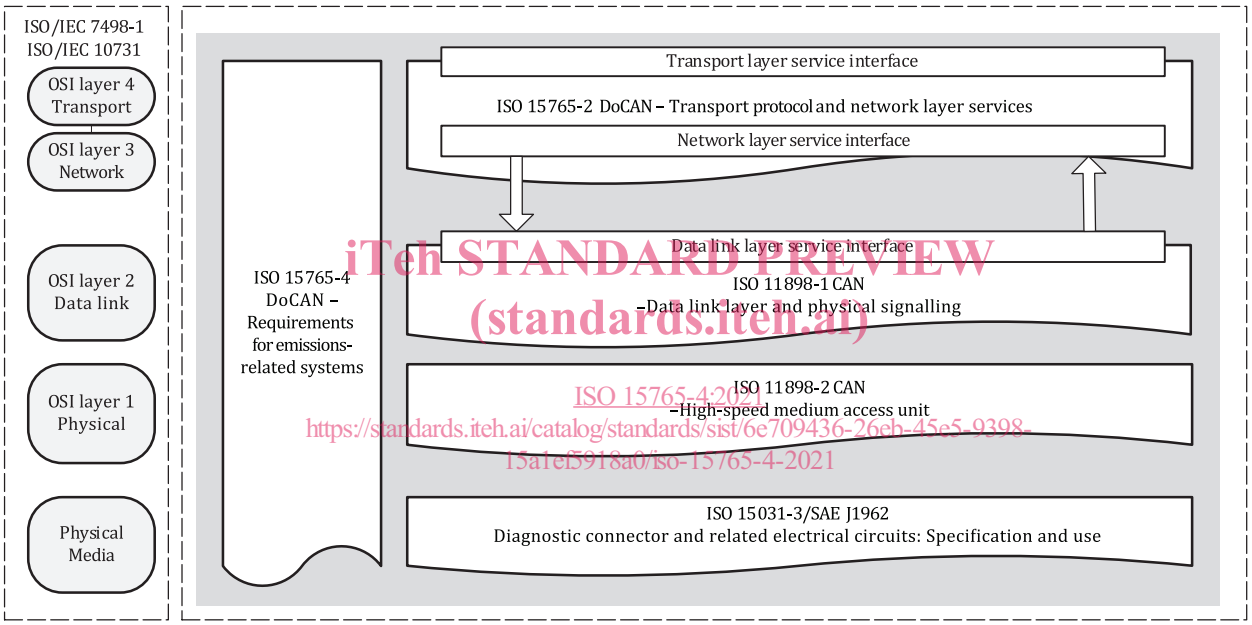


Figure 1 — DoCAN related OSI layers framework

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

Part 4: Requirements for emissions-related systems

1 Scope

This document specifies requirements for CAN-based communication systems between the in-vehicle network and the diagnostic link connector of the vehicle. This document does not specify any requirements related to the in-vehicle CAN network architecture. This document specifies the requirements to enable the in-vehicle CAN-based communication systems to establish, maintain, and terminate communication with the devices connected to the diagnostic link connector.

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/IEC 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

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 14229-2, *Road vehicles — Unified diagnostic services (UDS) — Part 2: Session layer services*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 7498-1, ISO 11898-1, ISO 11898-2, ISO 15765-2 and the following apply.

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

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

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

3.1
OBDonEDS
on-board diagnostics on emission diagnostic service
application protocol request and response messages defined in ISO 15031-5/SAE J1979[4] dedicated to the diagnostics of emissions-related systems

3.2
OBDonUDS
on-board diagnostics on unified diagnostic service
application protocol request and response messages defined in the ISO 14229 series and in ISO 27145-3 or SAE J1979-2[5] dedicated to the diagnostics of emissions-related systems

4 Symbols and abbreviated terms

4.1 Symbols

—	empty table cell or feature undefined
B_S	block size
C_{AC1}, C_{AC2}	capacitance of AC termination
C_{CAN_H}	capacitance between CAN_H and ground potential
C_{CAN_L}	capacitance between CAN_L and ground potential
C_{DIFF}	capacitance between CAN_H and CAN_L
ΔO_F	oscillator frequency tolerance
F_{CF}	consecutive frame
F_{FC}	flow control frame
F_{FF}	first frame
F_{FS}	frame flow status
F_{SF}	single frame
l_{CABLE}	maximum cable length between diagnostic link connector and external test equipment
R_{AC1}, R_{AC2}	resistance of AC termination
t_{BIT}	bit time
t_{BIT_RX}	receive bit time
t_{BIT_TX}	transmit bit time
t_{ETE}	external test equipment CAN interface propagation delay (without external test equipment cable delay)
t_{ETE_CABLE}	external test equipment cable propagation delay (without external test equipment CAN interface delay)
t_{N_Ar}	network layer timeout value (see ISO 15765-2)
t_{N_As}	network layer timeout value (see ISO 15765-2)
t_{N_Br}	network layer timeout value (see ISO 15765-2)
t_{N_Bs}	network layer timeout value (see ISO 15765-2)

t_{N_Cs}	network layer timeout value (see ISO 15765-2)
t_{N_Cr}	network layer timeout value (see ISO 15765-2)
$t_{P2\_CAN\_Client}$	client application wait time on server response on CAN
$t_{P2\_CAN\_Client\_Max}$	timeout value of the client application to receive a response on a request message
$t_{P2\_CAN\_Server}$	is the performance timing of the server to prepare the response information
$t_{P2\_CAN\_Server\_Max}$	is the timeout value of the server to respond on a request message
t_{SP}	nominal sample point position time
t_{SEG1}	timing segment 1
t_{SEG2}	timing segment 2
t_{SJW}	resynchronization jump width time
$t_{SYNCSEG}$	synchronization segment time
t_{STmin}	frame separation time
t_{Q}	time quantum

4.2 Abbreviated terms

CAN	controller area network
CBFF	Classical Base Frame Format
DID	data identifier
DLC	data length code
DoCAN	diagnostic communication over CAN
ECU	electronic control unit
ECM	engine control module
ETE	external test equipment
OBD	on-board diagnostics
PID	parameter identifier
PhaseSeg1	phase segment 1
PhaseSeg2	phase segment 2
PropSeg	propagation segment
SA	source address
SJW	synchronisation jump width
SP	nominal sample point

SyncSeg	synchronization segment
TA	target address
TCM	transmission control module

5 Conventions

This document is based on OSI service conventions as specified in ISO/IEC 10731.

6 Application

6.1 Vehicle communication initialisation sequence

6.1.1 OBDonUDS protocol identification

Vehicles that support OBDonUDS shall have ECUs that reply to the functional request service identifier 22_{16} and DID $F810_{16}$ for protocol identification.

6.1.2 OBDonEDS protocol identification

Vehicles that support OBDonEDS shall have ECUs that reply to the functional request service identifier 01_{16} and PID 00_{16} for protocol identification.

6.1.3 Others

Vehicles that do not respond to either request (6.1.1, 6.1.2) do not support OBD diagnostics specified in this document.

6.2 External test equipment communication initialisation sequence

The external test equipment shall support the initialisation sequence specified in this document.

The purpose of the external test equipment initialisation sequence is to automatically detect whether the vehicle supports OBDonUDS or OBDonEDS using CAN as the physical layer specified in Clause 12.

Furthermore, the initialisation sequence determines the communication conformance status of vehicles by analysing their responses as specified in 6.1.1 and 6.1.2.

For each OBDonUDS or OBDonEDS service that requires the determination of “supported” information, the external test equipment updates its list of expected responding ECUs prior to any data parameter requests.

The external test equipment initialisation sequence supports single bit rate initialisation (e.g. 500 kbit/s) and multiple bit rate initialisation (e.g. 250 kbit/s and 500 kbit/s) and is separated into the following tests:

a) 11-bit CAN identifier validation (see 6.4.1 and 6.4.2);

b) 29-bit CAN identifier validation (see 6.4.1 and 6.4.2).

The external test equipment initialisation sequence shall contain provisions for legacy vehicles using either CAN or a non-CAN protocol on the CAN pins of the ISO 15031-3 diagnostic link connector.

6.3 Bit rate validation procedure

6.3.1 bitrateRecord

The parameter “bitrateRecord” contains the bit rates as specified in 12.2.

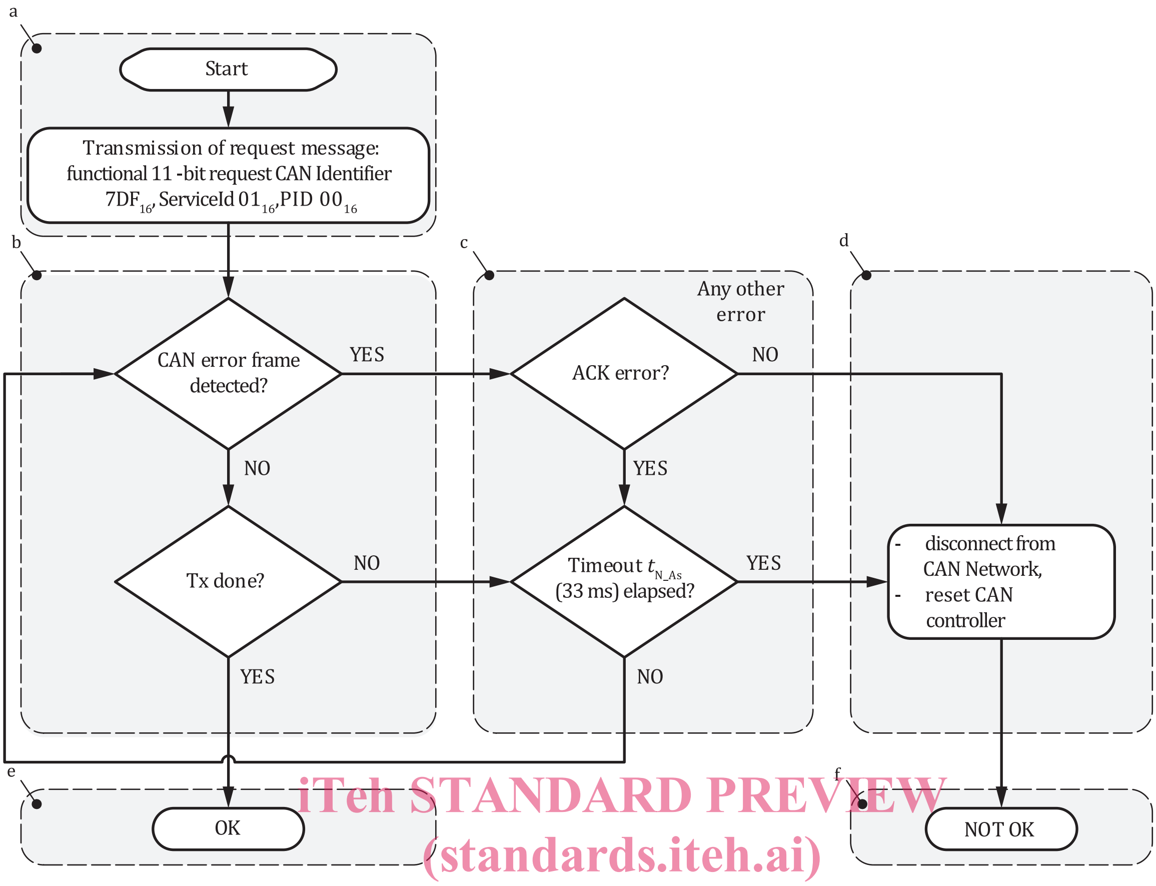
The bitrateRecord shall be used to specify the type of initialisation to be performed. If the bitrateRecord parameter contains a single bit rate, then a single bit rate initialisation sequence shall be performed using the specified single bit rate (e.g. 500 kbit/s). If the bitrateRecord parameter contains multiple bit rates, then a multiple bit rate initialisation sequence shall be performed including a bit rate detection procedure as defined in Figure 2.

Figure 2 shall be performed using the specified multiple bit rates (e.g. 250 kbit/s and 500 kbit/s). The external test equipment shall use the appropriate CAN bit timing parameter values specified in 12.3.

6.3.2 Bit rate validation

If multiple bit rates are specified in the bitrateRecord parameter, the procedure as defined in Figure 2 shall be used to determine the bit rate to be used in communication with the vehicle's emissions-related system.

The external test equipment shall set up its CAN interface using the first bit rate contained in the bitrateRecord. It shall use the CAN bit timing parameter values specified for this bit rate (see 6.3).



Key

a Following the CAN interface setup, the external test equipment shall connect to the CAN network and transmit a functionally addressed request message with service identifier 01_{16} and PID "supported PIDs" using the OBDonEDS 11-bit functional request CAN identifier as defined in 10.5.2.

NOTE The immediate transmission is needed in order to activate the CAN error frame monitoring, since initialising the CAN controller at the wrong bit rate without transmitting any data can leave the CAN controller in a state of generating error frames on the CAN network.

b The external test equipment shall check for any CAN error frame. If the request message is successfully transmitted onto the CAN network, the external test equipment shall indicate a successful transmission and proceed with the validation of the CAN identifier as specified in 6.4.1.

c If an acknowledge (ACK) check error is detected, then the external test equipment shall continue to retry the transmission of the request message until the t_{N_As} timeout has elapsed.

d If any other CAN error frame occurred, or an acknowledge check error still occurs after the t_{N_As} timeout has elapsed, then the external test equipment shall stop CAN communication on the CAN network.

e Proceed with sequence according to Figure 3, key 'a'.

f The external test equipment shall check whether more bit rates are contained in the bitrateRecord. If the end of the bitrateRecord is not reached, the external test equipment shall set up its CAN interface using the next bit rate in the bitrateRecord and restart the bit rate validation at key 'a' in Figure 2. If no further bit rate is contained in the bitrateRecord, it shall be assumed that the request was not transmitted successfully. This indicates that the vehicle does not comply with this document.

Figure 2 — Perform bit rate validation

6.3.3 External test equipment error detection provisions

Where the vehicle uses a physical layer different from that specified for OBDonEDS and OBDonUDS (see Clause 12) or a non-CAN protocol on the CAN pins of the diagnostic link connector, the transmit procedure, specified in this document, shall guarantee that in all cases, the external test equipment

