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Road vehicles — Diagnostics on Controller Area Networks (CAN) —

Part 4: Requirements for emissions-related systems

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

Partie 4: Exigences applicables aux systèmes associés aux émissions

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

ISO 15765 consists of the following parts, under the general title *Road vehicles — Diagnostics on Controller Area Networks (CAN)*:

— *Part 1: General information*

— *Part 2: Network layer services*

— *Part 3: Implementation of unified diagnostic services (UDS on CAN)*

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

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 specified in ISO/IEC 7498 and ISO/IEC 10731, which structures communication systems into seven layers. When mapped on this model, the services specified by ISO 15765 are divided into

— unified diagnostic services (layer 7), specified in ISO 15765-3,

— network layer services (layer 3), specified in ISO 15765-2,

— CAN services (layers 1 and 2), specified in ISO 11898,

in accordance with Table 1.

The application layer services covered by ISO 15765-3 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. ISO 15765-3 is also compatible with most diagnostic services defined in national standards or vehicle manufacturer's specifications.

The network layer services covered by ISO 15765-2 have been defined to be independent of the physical layer implemented, and a physical layer is only specified for legislated OBD.

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

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

Open Systems Interconnection (OSI) layers	Vehicle manufacturer enhanced diagnostics	Legislated on-board diagnostics (OBD)
Diagnostic application	User defined	ISO 15031-5
Application layer	ISO 15765-3	ISO 15031-5
Presentation layer	N/A	N/A
Session layer	ISO 15765-3	N/A
Transport layer	N/A	N/A
Network layer	ISO 15765-2	ISO 15765-4
Data link layer	ISO 11898-1	ISO 15765-4
Physical layer	User defined	ISO 15765-4

Road vehicles — Diagnostics on Controller Area Networks (CAN) —

Part 4: Requirements for emissions-related systems

1 Scope

This part of ISO 15765 specifies requirements for the emissions-related systems of legislated-OBD-compliant controller area networks (CAN), such communications networks consisting of a road vehicle equipped with a single or multiple emissions-related ECUs and external test equipment. It is based on the specifications of ISO 15765-2, ISO 11898-1 and ISO 11898-2, while placing restrictions on those standards for legislated-OBD purposes. It does not specify in-vehicle CAN bus architecture. Legislated-OBD-compliant vehicles are to comply with external test equipment requirements.

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 (all parts), *Road vehicles — Controller area network (CAN)*

ISO 14229-1, *Road vehicles — Unified diagnostic services (UDS) — Part 1: Specification and requirements* [1)]

ISO 15765-2, *Road vehicles — Diagnostics on Controller Area Networks (CAN) — Part 2: Network layer services*

ISO 15031-5, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services* [1)]

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO 14229-1 and the following symbols and abbreviated terms apply.

C_1, C_2	capacitance of a.c. 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

1) To be published.

L_{CABLE}	max. cable length between OBD connector and external test equipment
R_1, R_2	resistance of a.c. termination
t_{SEG1}	timing segment 1
t_{SEG2}	timing segment 2
$t_{SYNCSEG}$	synchronization segment
t_{BIT}	bit time
t_{BIT_RX}	receive bit time
t_{BIT_TX}	transmit bit time
t_{TOOL}	external test equipment CAN interface propagation delay (without external test equipment cable delay)
t_{CABLE}	external-test-equipment cable propagation delay (without external test equipment CAN interface delay)
t_Q	time quantum
Δf	oscillator tolerance
ECU	electronic control unit
OBD	on-board diagnostics
Prop_Seg	propagation segment
Phase_Seg1	phase segment 1
Phase_Seg2	phase segment 2
SA	source address
SJW	synchronization jump width
SP	nominal sample point
Sync_Seg	synchronization segment
TA	target address

4 External test equipment initialization sequence

4.1 General

The external test equipment shall support the initialization sequence specified in this part of ISO 15765. See Figure 1.

The purpose of the external test equipment initialization sequence is to automatically detect whether the vehicle supports legislated on-board diagnostics on CAN using the physical layer specified in Clause 8. Furthermore, the initialization sequence determines the legislated-OBD ECUs (CAN Id, see 6.3) expected to respond to ISO 15031-5 service 01 hex requests. Note that for each legislated-OBD service that requires the determination of “supported” information, the external test equipment has to update its list of expected responding legislated-OBD ECUs prior to any data parameter requests (see ISO 15031-5 for applicable services). 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

a) 11 bit CAN identifier verification procedure (see 4.2), and

b) 29 bit CAN identifier verification procedure (see 4.3).

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

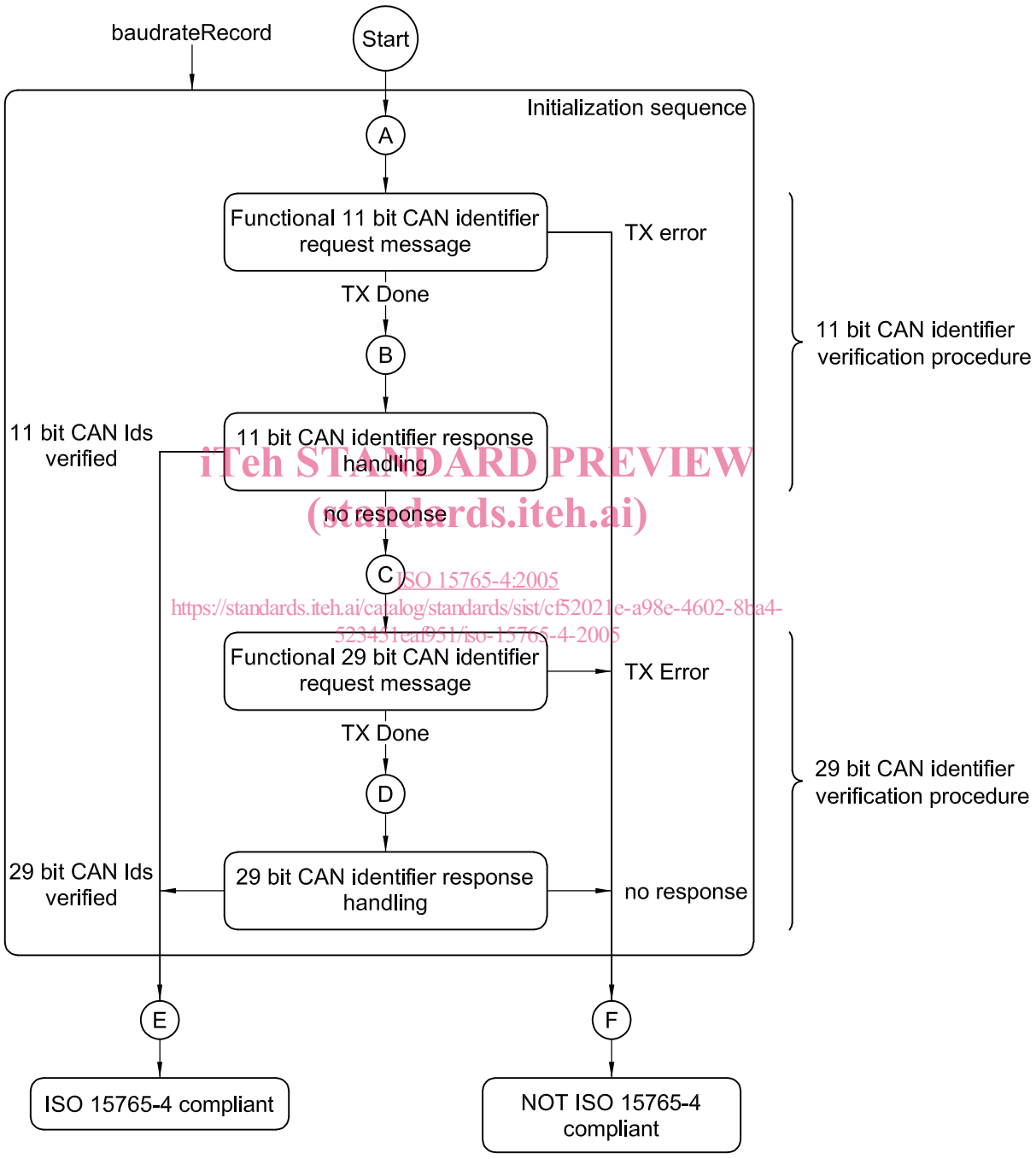

Figure 1 — Initialization sequence — Overview

The parameter baudrateRecord shall be used to specify the type of initialization to be performed. If the baudrateRecord parameter contains a single baudrate, then a single baudrate initialization sequence shall be performed using the specified single baudrate (e.g. 500 kBit/s). If the baudrateRecord parameter contains multiple baudrates, then a multiple baudrate initialization sequence including a baudrate detection procedure shall be performed using the specified multiple baudrates (e.g. 250 kBit/s and 500 kBit/s).

By default the baudrateRecord contains all baudrates specified in 8.3. The default content of the parameter baudrateRecord can be superseded by any other list of baudrates, e.g. single 500 kBit/s baudrate as specified in 8.3.3.

For legislated-OBD baudrates, the external test equipment shall use the appropriate CAN bit timing parameter values defined in 8.3.

The following descriptions of the external test equipment initialization make use of the connectors A to F as shown in Figure 1 to reference certain entry and exit points.

4.2 11 bit CAN identifier verification procedure

4.2.1 Request message transmit procedure

The purpose of the 11 bit CAN identifier verification procedure is to determine whether 11 bit CAN identifiers are being used in legislated-OBD communication and, if multiple baudrates are specified in the baudrateRecord parameter, to determine the baudrate to be used in such communication.

The following transmit procedure shall be used to transmit the request message of the 11 bit CAN identifier verification procedure. The transmit procedure contains provisions for legacy vehicles which use either CAN (same or different physical layer as defined for legislated OBD) or a different protocol (non CAN) on the CAN pins of the ISO 15031-3 diagnostic connector.

Where the vehicle uses a CAN with a physical layer different from that specified for legislated OBD (Clause 8) or a non-CAN protocol on the CAN pins of the OBD connector, the transmit procedure given as follows shall guarantee that in all cases the external test equipment will detect that the vehicle does not support CAN as specified for legislated OBD and will stop the transmission of the request message immediately.

Where the vehicle uses CAN and the physical layer according to Clause 8, the transmit procedure given as follows shall guarantee that in all cases the external test equipment will detect that it uses the wrong baudrate for the transmission of the request message and will stop disturbing the CAN bus immediately. Under normal in-vehicle conditions (i.e. no error frames during in-vehicle communication when the external test equipment is disconnected), the external test equipment will disable its CAN interface prior to the situation where the internal error counters of the OBD ECU(s) reach critical values.

To achieve this, the external test equipment shall support the following features.

- Possibility to stop sending immediately during transmission of any CAN frame. The CAN interface should be disconnected within 12 µs from reception of a bus error signal. The maximum time for the disconnection is 100 µs. With the CAN interface disconnected, the external test equipment shall not be able to transmit dominant bits on the CAN bus.

- Possibility to immediately detect any error on the CAN bus.

The procedure shall be performed as follows. See Figure 2.

a) The external test equipment shall set up its CAN interface using the first baudrate contained in the baudrateRecord. It shall use the CAN bit timing parameter values defined for this baudrate (see 8.3). Following the CAN Interface set-up, it shall connect the CAN Interface to the CAN bus.

b) The external test equipment shall transmit a functionally addressed service 01 hex request message (read-supported PIDs)[2] using the legislated-OBD 11 bit functional request CAN identifier according to 6.3.2.2.

2) See ISO 15031-5 for the request message definition of service 01 hex to read the supported PIDs.

c) The external test equipment shall check for any CAN error. If the request message is transmitted onto the CAN bus, it shall indicate a successful transmission (connector B).

d) If a CAN error occurred, the external test equipment shall disconnect its CAN Interface from the CAN bus. With a disconnected CAN interface, the external test equipment shall not be able to transmit dominant bits on the CAN bus. It shall check whether more baudrates are contained in the baudrateRecord. If no further baudrate is contained in the baudrateRecord, it shall indicate that the request was not transmitted successfully (connector F).

e) If the end of the baudrateRecord is not reached, the external test equipment shall set up its CAN interface using the next baudrate in the baudrateRecord and shall connect its CAN interface to the CAN bus. Following the setup, the external test equipment shall transmit the request message once again [continue from b)].

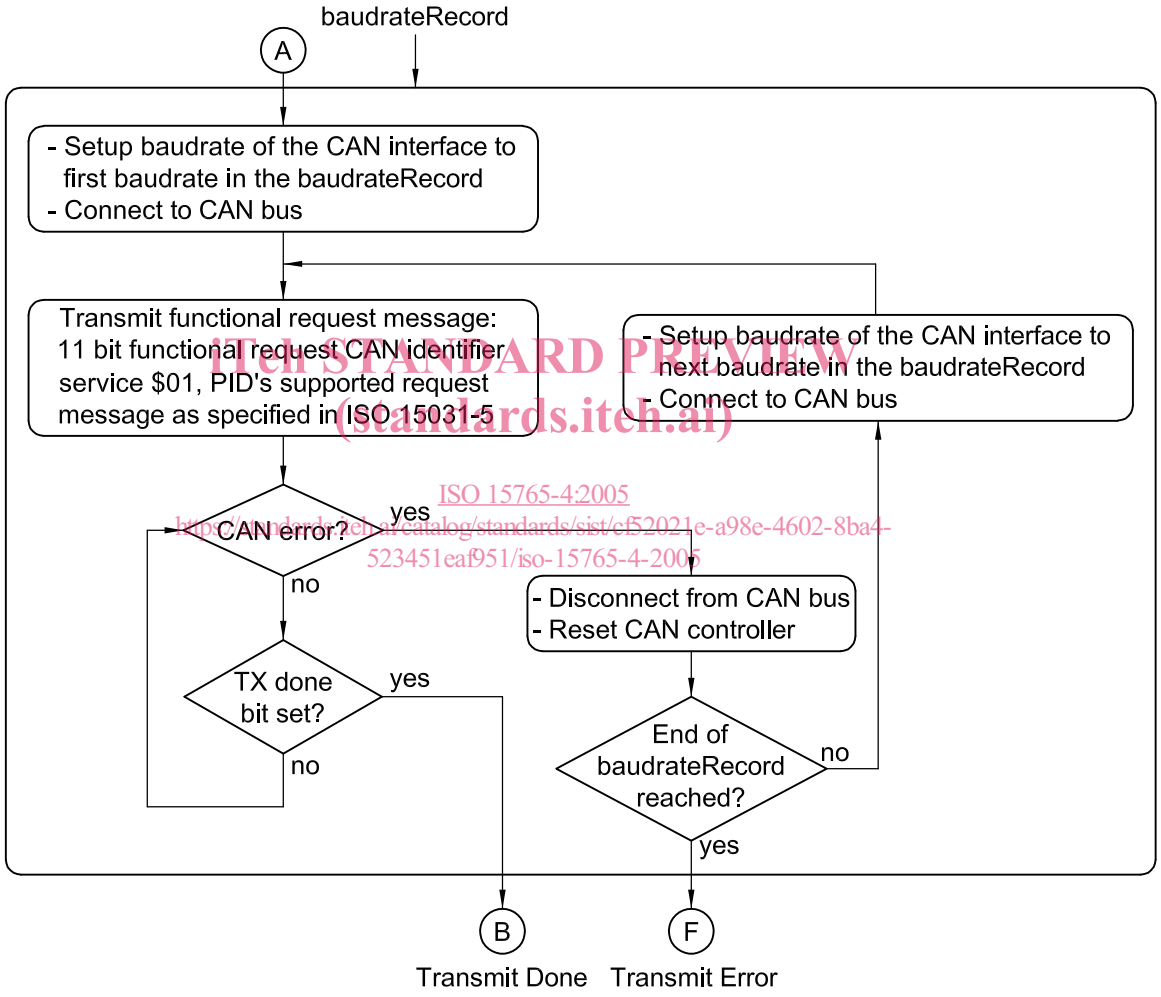

Figure 2 — Initialization sequence — 11 bit CAN identifier request transmission

4.2.2 Response handling procedure

The response handling procedure shall be used to receive 11 bit CAN identifier response messages and indicates that no response message has been received. It shall be performed immediately after the 11 bit CAN identifier request message transmit procedure (4.2.1), as follows. See Figure 3.

a) If the transmission of the request message was successful (connector B), the external test equipment shall start the $P2_{CAN}$ (see ISO 15031-5) application timer.