

BS ISO 15031-5:2015



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Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics

Part 5: Emissions-related diagnostic services

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National foreword

This British Standard is the UK implementation of ISO 15031-5:2015. It supersedes BS ISO 15031-5:2011 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AUE/16, Data Communication (Road Vehicles).

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Date	Text affected
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**Road vehicles — Communication
between vehicle and external
equipment for emissions-related
diagnostics —**

**Part 5:
Emissions-related diagnostic services**

*Véhicules routiers — Communications entre un véhicule et un
équipement externe pour le diagnostic relatif aux émissions —*

Partie 5: Services de diagnostic relatif 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.

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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

This third edition cancels and replaces the second edition (ISO 15031-5:2011), which has been technically revised.

ISO 15031 consists of the following parts, under the general title *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics*:

- *Part 1: General information and use case definition*
- *Part 2: Guidance on terms, definitions, abbreviations and acronyms*
- *Part 3: Diagnostic connector and related electrical circuits, specification and use*
- *Part 4: External test equipment*
- *Part 5: Emissions-related diagnostic services*
- *Part 6: Diagnostic trouble code definitions*
- *Part 7: Data link security*

Introduction

Overview

ISO 15031 consists of a number of parts which, taken together, provide a coherent self-consistent set of specifications to facilitate emissions-related diagnostics. ISO 15031-1 provides an introduction to the series of International Standards. ISO 15031-2 through ISO 15031-7 are based on SAE recommended practices. This part of ISO 15031 is based on SAE J1979.

This International Standard includes the communication between the vehicle's On-Board Diagnostic (OBD) systems and test equipment implemented across vehicles within the scope of the legislated emissions-related OBD.

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. When mapped on this model, the services specified by this International Standard are broken into the following layers in accordance with [Table 1](#).

- Diagnostic services (layer 7), specified in the following:
 - this part of ISO 15031;
 - ISO 27145-3 (WWH-OBD).
- Presentation layer (layer 6), specified in the following:
 - ISO 15031-2, SAE J1930-DA;
 - this part of ISO 15031, SAE J1979-DA;
 - ISO 15031-6, SAE J2012-DA;
 - ISO 27145-2, SAE J2012-DA.
- Session layer services (layer 5), specified in the following:
 - ISO 14229-2 supports ISO 15765-4 DoCAN and ISO 14230-4 DoK-Line protocols;
 - ISO 14229-2 is not applicable to the SAE J1850 and ISO 9141-2 protocols.
- Transport layer services (layer 4), specified in the following:
 - ISO 15765-2;
 - SAE J1850 defined in this part of ISO 15031;
 - ISO 9141-2 defined in this part of ISO 15031;
 - ISO 14230-4, defined in this part of ISO 15031.
- Network layer services (layer 3), specified in the following:
 - ISO 15765-2;
 - SAE J1850 defined in this part of ISO 15031;
 - ISO 9141-2 defined in this part of ISO 15031;
 - ISO 14230-4 defined in this part of ISO 15031.
- Data link layer (layer 2), specified in the following:
 - ISO 15765-4, ISO 11898-1, and ISO 11898-2;

- SAE J1850;
- ISO 9141-2;
- ISO 14230-2.
- Physical layer (layer 1), specified in the following:
 - ISO 15765-4, ISO 11898-1, and ISO 11898-2;
 - SAE J1850;
 - ISO 9141-2;
 - ISO 14230-1.

Table 1 — Legislated emissions-related OBD/WWH^a-OBD diagnostic specifications applicable to the OSI layers

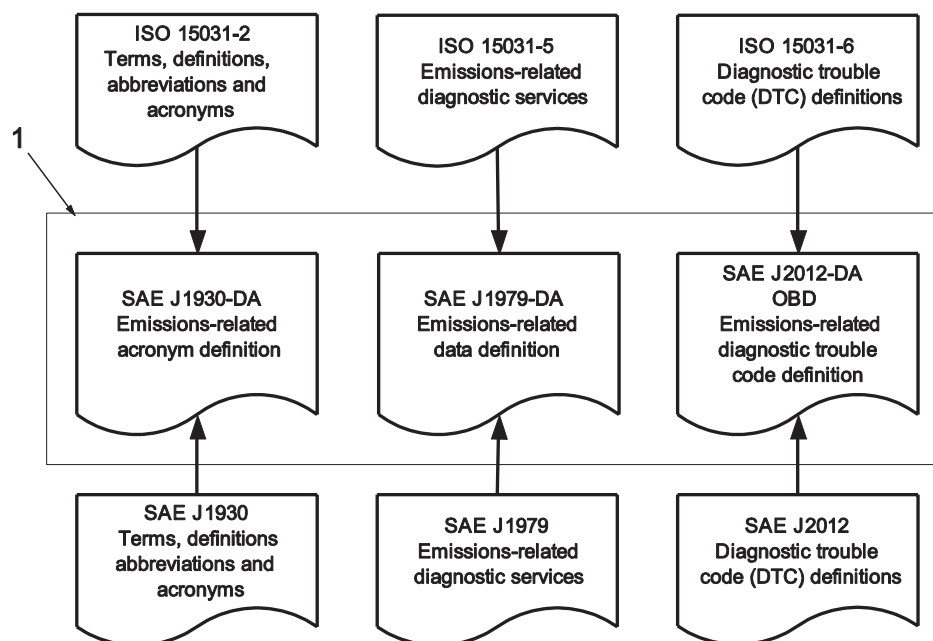
Applicability	OSI 7 layers	Emissions-related OBD communication requirements					Emissions-related WWH-OBD communication requirements		
Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731	Application (layer 7)	ISO 15031-5/SAE J1979					ISO 27145-3		
	Presentation (layer 6)	ISO 15031-2, ISO 15031-5, ISO 15031-6					ISO 27145-2		
		SAE J1930-DA, SAE J1979-DA, SAE J2012-DA					SAE J1930-DA, SAE J1979-DA, SAE J2012-DA		
	Session (layer 5)	Not applicable		ISO 14229-2					
	Transport (layer 4)	ISO 15031-5		ISO 14230-4	ISO 15765-2	ISO 15765-4	ISO 15765-2	ISO 15765-4	ISO 13400-2
	Network (layer 3)								
	Data link (layer 2)	SAE J1850	ISO 9141-2	ISO 14230-2	ISO 11898-1, ISO 11898-2		ISO 11898-1, ISO 11898-2	ISO 13400-3	
	Physical (layer 1)			ISO 14230-1					
^a World-Wide Harmonized.									

SAE document reference concept

ISO 15031 references several SAE documents which contain all terms, data, and DTC (diagnostic trouble code) definitions. This is illustrated in [Figure 1](#).

Additional information on the content of the referenced documents is given below:

- SAE J1930: the document is concerned with a procedure for naming objects and systems and with the set of words from which names are built. It references SAE J1930-DA which contains all standardized naming objects, terms, and abbreviations.
- SAE J1979: the document is concerned with the definition of emissions-related diagnostic services (diagnostic test modes). It references SAE J1979-DA which contains all standardized data items such as PIDs, Test IDs, Monitor IDs, and INFOTYPE IDs.
- SAE J2012: the document is concerned with the procedure for defining emissions-related DTCs. It references SAE J2012-DA which contains all standardized data items such as DTCs and FTBs (failure type bytes).



Key

1 SAE Digital Annexes

Figure 1 — SAE Digital Annex document reference

OBD regulations require passenger cars and light, medium, and heavy duty trucks to support a minimum set of diagnostic information to external (off-board) “generic” test equipment.

SAE J1979-DA (OBD) Digital Annex

This part of ISO 15031 references SAE J1979-DA. SAE J1979-DA is concerned with the definition of the following:

- Parameter Identifiers (PIDs);
- Test Identifiers (TIDs);
- OBD Monitor Identifiers (OBDMIDs);
- Unit and Scaling Identifiers (UASIDs);
- INFOTYPES (INFOTYPES).

SAE Digital Annex revision procedure

New emissions-related regulatory requirements drive new in-vehicle technology to lower emissions. New technology-related OBD monitor data and DTCs need to be standardized to support the external (off-board) “generic” test equipment. All relevant information is proposed by the automotive industry represented by members of the appropriate SAE task force.

The revision request form and instructions for updating the registers to this part of ISO 15031 can be obtained on the Registration Authority’s website at:

<http://www.sae.org/servlets/works/committeeHome.do?comtID=TEVDS14>

The column titled “Resources” shows a document with the title: J1979-DA_Revision_Request_Form.doc. Double click on the name and you will be asked to download the document with the file name:

SAE_J1979-DA_Revision_Request_Form.doc

Fill out the revision request form with your request.

Please send an e-mail with the completed revision request form as an attachment to:

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Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics —

Part 5: Emissions-related diagnostic services

1 Scope

This part of ISO 15031 is intended to satisfy the data reporting requirements of On-Board Diagnostic (OBD) regulations in the United States and Europe and any other region that may adopt similar requirements in the future. This part of ISO 15031 specifies

- a) message formats for request and response messages,
- b) timing requirements between request messages from external test equipment and response messages from vehicles and between those messages and subsequent request messages,
- c) behaviour of both the vehicle and external test equipment if data are not available, and
- d) a set of diagnostic services, with corresponding content of request and response messages, to satisfy OBD regulations.

This part of ISO 15031 includes capabilities required to satisfy OBD requirements for multiple regions, model years, engine types, and vehicle types. Those regulations are not yet final for some regions and are expected to change in the future. This part of ISO 15031 makes no attempt to interpret the regulations and does not include applicability of the included diagnostic services and data parameters for various vehicle applications. The user of this part of ISO 15031 is responsible for verifying the applicability of each clause of this part of ISO 15031 for a specific vehicle, engine, model year, and region.

This part of ISO 15031 specifies diagnostic services and functionally addressed request/response messages required to be supported by motor vehicles and external test equipment for diagnostic purposes which pertain to motor vehicle emission-related data. Any external test equipment meeting the requirements of ISO 15031-4 use these messages to retrieve emissions-related information from the vehicle.

Each clause in this part of ISO 15031 which specifies additional details to existing clauses of ISO 9141-2, ISO 14230-4, SAE J1850, and ISO 15765-4 supersede those specifications.

This part of ISO 15031 references SAE J1979-DA (Digital Annex), which includes all definitions of PIDs, OBDMIDs, TIDs, and INFOTYPES.

This part of ISO 15031 provides the mechanism to satisfy the requirements included in the country-specific regulations and not all capabilities included in this part of ISO 15031 are required by the country-specific regulations. This part of ISO 15031 is not considered a final authority for interpretation of the regulations. Therefore, readers should determine the applicability of capabilities defined in this part of ISO 15031 for their own specific needs.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9141-2:1994, *Road vehicles — Diagnostic systems — Part 2: CARB requirements for interchange of digital information*

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

ISO 14230-2, *Road vehicles — Diagnostic communication over K-Line (DoK-Line) — Part 2: Data link layer*

ISO 14230-4:2000, *Road vehicles — Diagnostic systems — Keyword Protocol 2000 — Part 4: Requirements for emission-related systems*

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

ISO 15765-4, *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 4: Requirements for emissions-related systems*

ISO 15031-2, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 2: Guidance on terms, definitions, abbreviations and acronyms*

SAE J1930-DA, *Digital Annex of Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms*

SAE J1979-DA, *Digital Annex of E/E Diagnostic Test Modes*

SAE J2012-DA, *Digital Annex of Diagnostic Trouble Code Definitions and Failure Type Byte Definitions*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14229-2, ISO 14230-2, ISO 15031-2, and ISO 15765-2 and the following apply.

3.1.1

absolute throttle position sensor

value intended to represent the throttle opening

Note 1 to entry: For systems where the output is proportional to the input voltage, this value is the percent of maximum input signal. For systems where the output is inversely proportional to the input voltage, this value is 100 % minus the percent of maximum input signal. Throttle position at idle usually indicates greater than 0 % and throttle position at wide open throttle usually indicates less than 100 %.

3.1.2

bank

specific group of cylinders sharing a common control sensor

Note 1 to entry: Bank 1 always contains cylinder number 1 and bank 2 the opposite bank.

Note 2 to entry: If there is only one bank, the DTCs for bank #1 DTCs are used and the word bank may be omitted. With a single “bank” system utilizing multiple sensors, bank #1 DTCs are used in identifying the sensors as #1, #2, and #3 in order as they move further away from the cylinder.

3.1.3

base fuel schedule

fuel calibration schedule programmed into the powertrain control module or PROM when manufactured or when updated by an off-board source, prior to any learned on-board correction

3.1.4

calculated load value

(spark ignition vehicles) typically an indication of the current airflow divided by peak airflow at wide open throttle as a function of rpm, where airflow is corrected for altitude and ambient temperature

Note 1 to entry: Both spark ignition and compression ignition vehicles can use an alternate definition that substitutes engine torque in place of airflow in the calculation.

Note 2 to entry: This definition provides a number (without unit) and provides the service technician with an indication of the percent engine capacity that is being used.

3.1.5

client

function that is part of the tester and that makes use of the diagnostic services

Note 1 to entry: A tester normally makes use of other functions such as database management, specific interpretation, and man-machine interface.

3.1.6

continuous monitoring

sampling at a rate no fewer than two samples per second

Note 1 to entry: If, for control purposes, a computer input is sampled less frequently, the signal of the component may instead be evaluated each time sampling occurs.

3.1.7

convention

Cvt

column integrated in each message table which marks each parameter included

Note 1 to entry: The following conventions are used: C = Conditional: the parameter marked "C" in a request/response message is present only under a condition specified in the bottom row of the message table; M = Mandatory: the parameter marked "M" in a request/response message table is always present; U = User (optional): the parameter marked "U" in a request/response message table is supplied depending on dynamic usage by the manufacturer. The convention recommends a mnemonic, which might be used for implementation. In no case is the specified mnemonic ever a mandatory requirement for any implementation.

3.1.8

electronic control unit

ECU

generic term for any electronic control unit

3.1.9

emissions-related DTC

DTC which is set when a malfunction causes vehicle emissions to exceed legislated emission thresholds or is otherwise required to be set as specified by on-board diagnostics legislation (e.g. disables another part of the diagnostic system)

Note 1 to entry: Normally, the malfunction indicator (MI) is illuminated at the same time as the emissions-related DTC is set. The determination of which DTCs are emissions-related is made by the vehicle manufacturer for each vehicle, as specified by on-board diagnostic legislation.

3.1.10

fuel trim

FT

feedback adjustments to the base fuel schedule

Note 1 to entry: Short-term fuel trim refers to dynamic or instantaneous adjustments. Long-term fuel trim refers to much more gradual adjustments to the fuel calibration schedule than short-term trim adjustments. These long-term adjustments compensate for vehicle differences and gradual changes that occur over time.

3.1.11

negative numbers

signed binary, the most significant bit (MSB) of the binary number used to indicate positive (0)/negative (1)

Note 1 to entry: 2's complement: negative numbers are represented by complementing the binary number and then adding 1.

EXAMPLE $-0,99 = 8001_{16} = 1000\ 0000\ 0000\ 0001_2$

$0 = 0000_{16} = 0000\ 0000\ 0000\ 0000_2$

$+0,99 = 7FFF_{16} = 0111\ 1111\ 1111\ 1111_2$

Note 2 to entry: $(-0,99) + (+0,99) = 0$.

3.1.12

number

expressed by this symbol “#”

3.1.13

P2, P3 timing parameter

application timing parameters for the ECU(s) and the external test equipment

3.1.14

P2_{CAN_min} timing parameter

CAN application timing parameter with the minimum value for the ECU(s) and the external test equipment to start the response message

3.1.15

P2_{CAN_max} timing parameter

CAN application timing parameter with the maximum value for the ECU(s) and the external test equipment to indicate a response message

3.1.16

P2_{reload} timing parameter

CAN application timing parameter with the maximum value (P2_{CAN_max}) for external test equipment only

3.1.17

server

function that is part of an ECU that provides the diagnostic services

Note 1 to entry: This part of ISO 15031 differentiates between the server, i.e. the function, and the electronic control unit so that it remains independent from the implementation.

3.1.18

service

information exchange initiated by a client (external test equipment) in order to require diagnostic information from a server (ECU) and/or to modify its behavior for diagnostic purposes

Note 1 to entry: This is also the equivalent of test mode or mode.

3.2 Abbreviated terms

.con confirmation

.ind indication

.req request

CRC	cyclic redundancy check
CVN	calibration verification number
DTC	diagnostic trouble code
ECM	engine control module
ERR	error detection byte
EWMA	exponential weighted moving average
FF	first frame
ISR	interrupt service routine
LSB	least significant bit
MI	malfunction indicator
MIL	malfunction indicator light
MSB	most significant bit
N_PDU	network protocol data unit
N/A	not applicable
NRC	negative response code
NVRAM	non-volatile memory
OBDMID OBD	monitor identifier
PID	parameter identifier
PCI	protocol control information
RSP	in-frame response
SF	single frame
SOM	start of message
T_AE	virtual transport interface address extension
T_Data []	virtual transport interface data field
T_Mtype	virtual transport interface message type
T_Length	virtual transport interface length information
T_PDU	virtual transport interface protocol data unit
T_Result	virtual transport interface result
T_SA	virtual transport interface source address
T_TA	virtual transport interface target address
T_Tatype	virtual transport interface target address type

TCM	transmission control module
TID	test identifier
UASID	unit and scaling identifier
VIN	vehicle identification number

4 Conventions

This International Standard is based on the conventions specified in the OSI Service Conventions (ISO/IEC 10731) as they apply for diagnostic services.

5 Document overview

[Figure 2](#) illustrates the emissions-related OBD in ISO 15765-4, SAE J1850, ISO 9141-2, and ISO 14230-4. The protocol initialization identifies whether ISO 15765-4 DoCAN or SAE J1850 or ISO 14230-4 DoK-Line or ISO 9141-2 is the data link layer supported by the vehicle. This International Standard references the standards as an applicable data link for emissions-related OBD.

This part of ISO 15031 specifies the applicable emissions-related diagnostic services. It specifies the data record structures and references SAE J1930-DA, SAE J1979-DA, and SAE J2012-DA which include all emissions-related OBD data definitions.

6 Technical requirements

6.1 General requirements

The requirements specified in this Clause are necessary to ensure proper operation of both the external test equipment and the vehicle during diagnostic procedures. External test equipment, when using the messages specified, shall not affect normal operation of the emission control system.

IMPORTANT — New emissions-related vehicle technology required the definition of new PIDs and INFOTYPEs. The data parameter set for several new definitions exceed the specified limit of message length for ISO 9141-2, ISO 14230-4, and SAE J1850 protocols. It is the vehicle manufacturer's responsibility to implement the ISO 15765-4 DoCAN protocol in order to achieve legislative compliance of the emissions-related OBD systems in the vehicle.

6.2 Diagnostic service requirements

6.2.1 Multiple responses to a single data request

The request messages are functional messages, which means that the external test equipment will request data without knowledge of which ECU(s) on the vehicle will respond. In some vehicles, multiple ECUs might respond with the information requested. Any external test equipment requesting information shall therefore have provisions for receiving multiple responses.

IMPORTANT — All emissions-related OBD ECUs, which at least support one of the services defined in this part of ISO 15031, shall support service 01₁₆ and PID 00₁₆. Service 01₁₆ with PID 00₁₆ is defined as the universal "initialization/keep alive/ping" message for all emissions-related OBD ECUs.

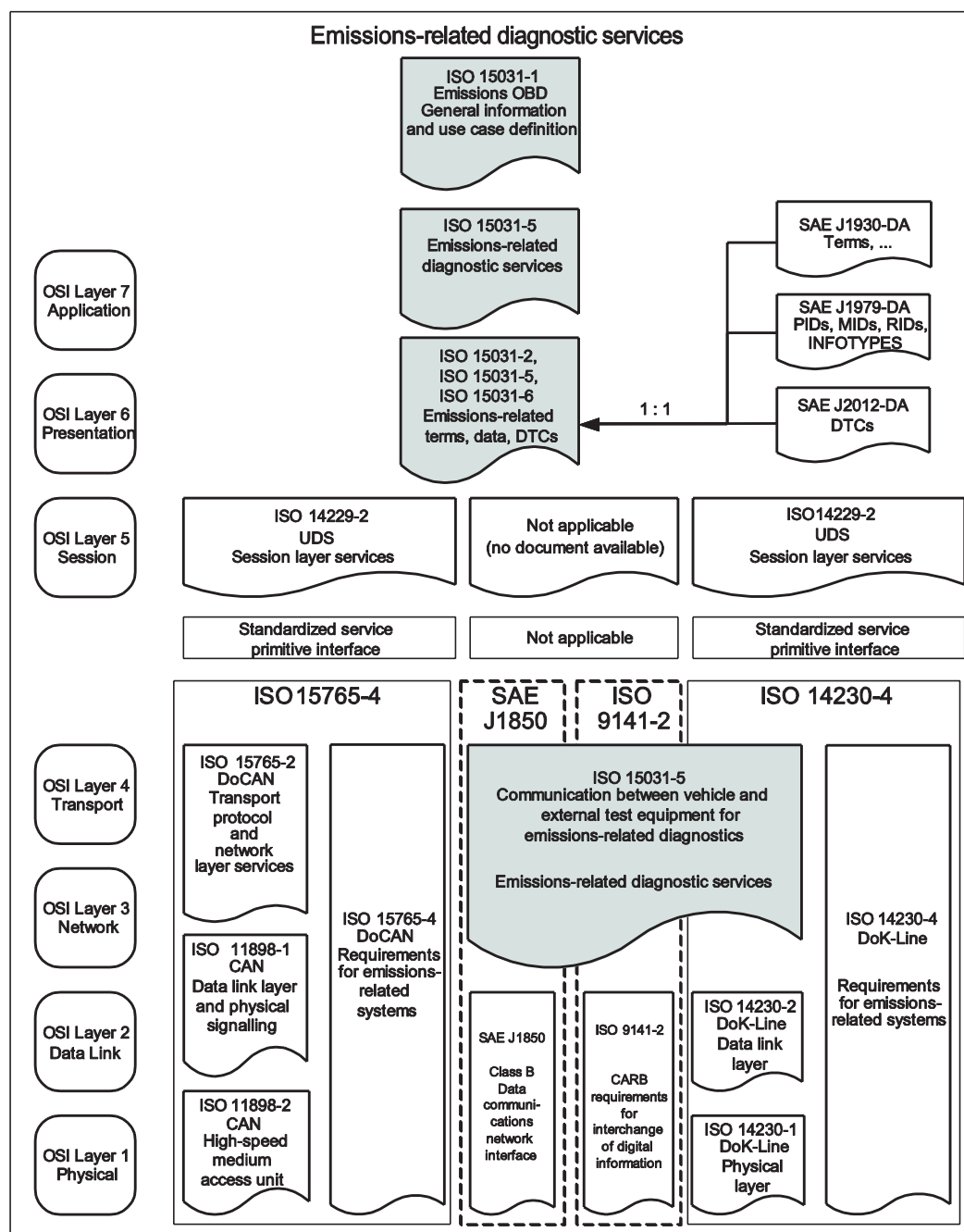


Figure 2 — Emissions-related OBD in ISO 15765-4, SAE J1850, ISO 9141-2, and ISO 14230-4 according to OSI model

6.2.2 Application timing parameter definition

6.2.2.1 Overview

The definition of P2 and P3 is included in this Clause. A subscript is added to each timing parameter to identify the following protocol:

- P2_{K-line}, P3_{K-line}: P2, P3 for ISO 9141-2 and ISO 14230-4 protocols;
- P2_{J1850}: P2 for SAE J1850 protocol;
- P2_{CAN}: P2 for ISO 15765-4 protocol.

IMPORTANT — The vehicle manufacturer is responsible for specifying a shorter P2 timing window than specified in this part of ISO 15031 for each emission-related server/ECU in the vehicle in order to make sure that network topology delays of the vehicle architecture are considered.

6.2.2.2 Definition for ISO 9141-2

For ISO 9141-2 interfaces, data link layer response time requirements (P1, P4) are specified in ISO 9141-2.

[Table 2](#) specifies the application timing parameter values for P2 and P3.

Table 2 — Definition of ISO 9141-2 application timing parameter values

Parameter	Minimum value ms	Maximum value ms	Description
P2 _{K-line} Key Bytes: 08 ₁₆ 08 ₁₆	25	50	Time between external test equipment request message and the transmission of the ECU(s) response message(s). Each OBD ECU shall start sending its response message within P2 _{K-line} after the request message has been correctly received. Subsequent response messages shall also be transmitted within P2 _{K-line} of the previous response message for multiple message responses.
P2 _{K-line} Key Bytes: 94 ₁₆ 94 ₁₆	0	50	Time between external test equipment request message and the transmission of the ECU response message(s). The OBD ECU shall start sending its response message within P2 _{K-line} after the request message has been correctly received. Subsequent response messages shall also be transmitted within P2 _{K-line} of the previous response message for multiple message responses.
P3 _{K-line}	55	5 000	Time between the end of an ECU(s) successful transmission of response message(s) and start of new external test equipment request message. The external test equipment may send a new request message if all response messages related to the previously sent request message have been received and if P3 _{K-line} minimum time has expired. ECU implementation guideline: TX (transmit) and RX (receive) lines are connected. Each transmitted byte is read back by the receiver in the ECU. Upon the reception of a received byte, e.g. last byte of a request message (checksum) from the tester, the ECU shall reset the P3 timer value to zero. If the ECU supports the request message, it will start transmitting the response message within the P2 timing window. Each transmitted byte will cause the P3 timer value to be reset. If the ECU does not support the request and does not send a response message, then in a single OBD ECU system, the P3 is started after the last byte received of the request message. In a multiple OBD ECU system, a response message by one or more ECUs shall cause the P3 timer value to be reset in all ECUs including any ECU not supporting the request message.

6.2.2.3 Definition for ISO 14230-4

For ISO 14230-4 interfaces, data link layer response time requirements are specified in ISO 14230-4.

[Table 3](#) specifies the application timing parameter values for P2 and P3.

Table 3 — Definitions of ISO 14230-4 application timing parameter values

Parameter	Minimum value ms	Maximum value ms	Description
P2 _{K-line}	25	50	Time between external test equipment request message and the transmission of the ECU(s) response message(s). Each OBD ECU shall start sending its response message within P2 _{K-line} after the request message has been correctly received. Subsequent response messages shall also be transmitted within P2 _{K-line} of the previous response message for multiple message responses.
P3 _{K-line}	55	5 000	Time between the end of an ECU(s) successful transmission of response message(s) and start of new external test equipment request message. The external test equipment may send a new request message if all response messages related to the previously sent request message have been received and if P3 _{K-line} minimum time has expired. ECU implementation guideline: TX (transmit) and RX (receive) line are connected. Each transmitted byte is read back by the receiver in the ECU. Upon the reception of a received byte, e.g. last byte of a request message (checksum) from the tester, the ECU shall reset the P3 timer value to zero. If the ECU supports the request message, it will start transmitting the response message within the P2 timing window. Each transmitted byte will cause the P3 timer value to be reset. If the ECU does not support the request and does not send a response message, then in a single OBD ECU system, the P3 is started with the last byte received of the request message. In a multiple OBD ECU system, a response message by any one or more ECUs shall cause the P3 timer value to be reset in all ECUs including any ECU not supporting the request message.

6.2.2.4 Data link layer interface adaptation

6.2.2.4.1 General information

This part of ISO 15031 makes use of the data link layer services defined in ISO 14230-2 for the transmission and reception of diagnostic messages. This section defines the mapping of the virtual data link PDU (T_PDU) in ISO 14229-2 onto the K-Line data link layer PDU (DL_PDU) in ISO 14230-2.

NOTE The data link layer services are used to perform the application layer and diagnostic session management timing.

6.2.2.4.2 Mapping of data link independent service primitives onto K-Line data link dependent service primitives

[Table 4](#) specifies the mapping interface between the ISO 14230-2 DoK-Line Part 2: Data link layer services and the ISO 14229-2 UDS Part 2.

Table 4 — Mapping of T_PDU service primitives onto DL_PDU service primitives

Transport/network layer service primitives (data link independent according to ISO 14229-2)	DoK-Line data link layer service primitives (data link dependent according to ISO 14230-2)
T_Data.indication	DL_Data.indication
T_DataSOM.indication	DL_DataFB.indication
T_Data.confirm	DL_Data.confirm
T_Data.request	DL_Data.request

6.2.2.4.3 Mapping of T_PDU onto DL_PDU for message transmission

The parameters of the application layer protocol data unit defined to request the transmission of a diagnostic service request/response are mapped in accordance with [Table 5](#) onto the parameters of the data link layer protocol data unit for the transmission of a message in the client/server.

Table 5 — Mapping of T_PDU parameter onto DL_PDU parameter

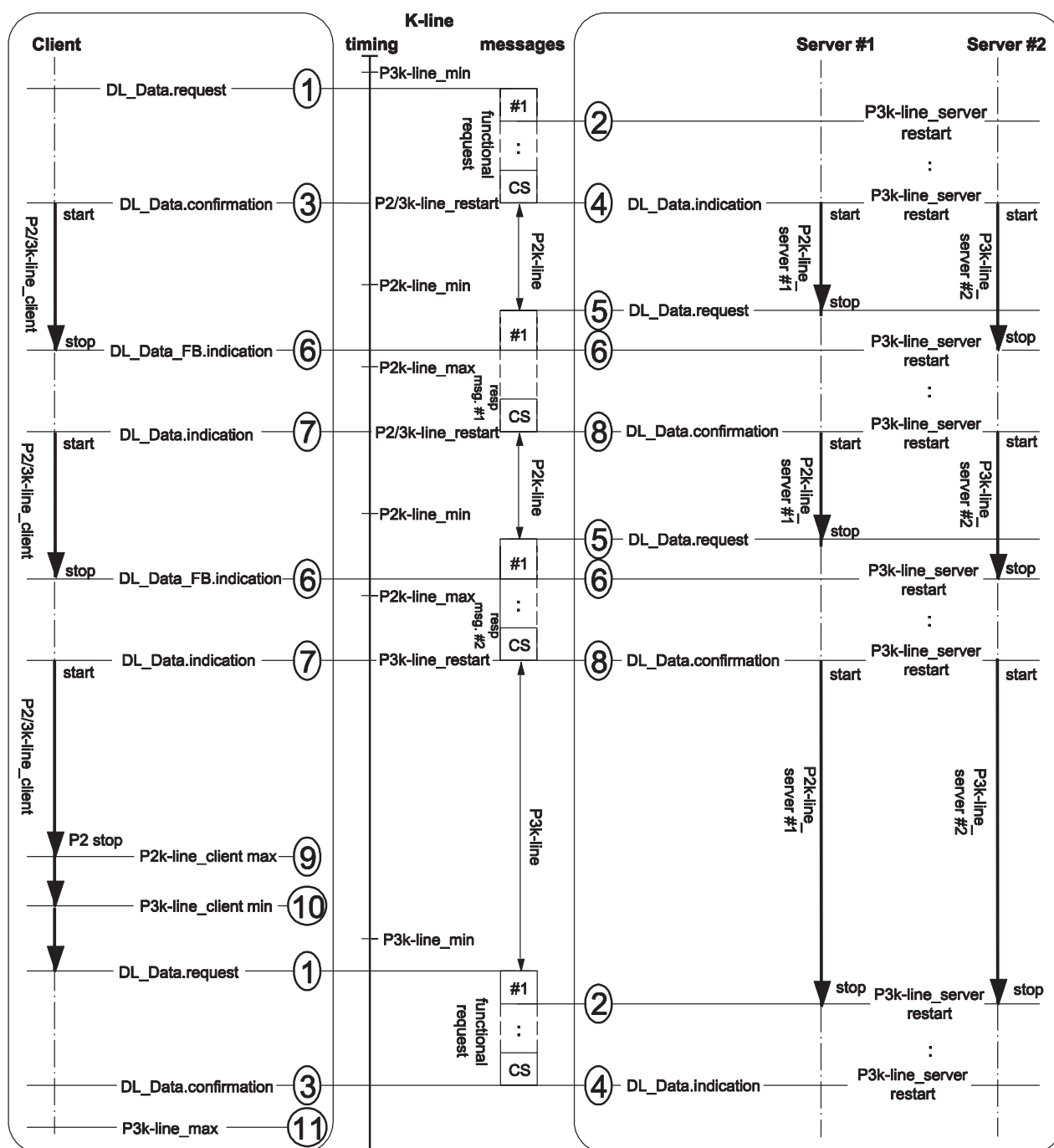
T_PDU parameter (data link independent according to ISO 14229-2)	DL_PDU parameter (DoK-Line data link dependent according to ISO 14230-2)
T_Mtype	N/A (always set to “diagnostics”)
T_SA	DL_SA
T_TA	DL_TA
T_TAtype	DL_TAtype
T_AE	N/A
T_Data []	< MessageData >
T_Length	< Length >
T_Result	< DL_Result >

6.2.2.5 Implementation guidance example for ISO 9141-2 and ISO 14230-4 protocols

This subclause provides an implementation example for client/external test equipment and server/ECU. It is assumed that the client (external test equipment) communicates to a vehicle with two (2) emission-related OBD servers (ECUs). The client requests a CVN, which is only supported by server #1 (ECU#1) with two (2) response messages. Server #2 (ECU#2) is not flash programmable. [Figure 3](#) graphically depicts the timing handling in the client and two (2) servers for a functionally addressed request message. A description following [Figure 3](#) references the points marked in the figure.

From a server point of view, there is no difference in the timing handling compared to a physically addressed request message. The server shall reset the P3_{K-line} timer value on each received byte regardless of whether the byte is part of a request message or a response message from any other server or an echo from its transmit line. There are several methods in which a server can implement the timing handling. The implementation of timing parameters is not part of this part of ISO 15031 but has an important system supplier responsibility. Some general server timing parameter implementation guidelines are described in this subclause. The server time stamps each receiver interrupt event and restarts/resets the P3_{K-line}_{server} timer or timing value, e.g. ISR time stamps received byte, and processing of the received information is performed outside the ISR. For simplification of the diagram, [Figure 3](#) only shows a P3_{K-line}_{server} restart after the reception of the first byte and last byte (checksum) of a received message. The P3_{K-line}_{server} restart is required on each received byte. The received message can be either a request message from the client or a response message from any other server connected and initialized by the 33₁₆ address. If the server has received a complete message, it compares the target address with the 33₁₆ address.

[Figure 3](#) shows the client and two (2) initialized servers connected via K-line (either ISO 9141-2 or ISO 14230-4 protocol). The relevant events for the client and both servers are marked and described.



Key

- 1 The diagnostic application of the client starts the transmission of a functionally addressed request message by issuing a T_Data.request to its data link layer. The data link layer transmits the request message to the servers.
- 2 Both servers and the client receive a byte of a message via a receive interrupt by the UART. The ISR (interrupt service routine) either restarts the P2_{K-line}/P3_{K-line} timers or time stamps the received byte.
- 3 The completion of the request message is indicated in the client with T_Data.confirmation. When receiving the T_Data.confirmation, the client starts its P2_{K-line} and P3_{K-line} timer using the default reload values P2_{K-line_max} and P3_{K-line_max}.

- 4 If the last message byte is received, each server checks whether the received message includes a target address which matches the 33₁₆ address. If the result is a match (server #1 and #2), then the completion of the request message is indicated in the servers via T_Data.indication and each server determines whether it supports the request and has a message available to respond with. If a server determines that the address in the received message is different from 33₁₆ or if the address is a match but no response needs to be sent (server #2), the P2 timer is stopped. Since the P3_{K-line} timer has already been restarted, no further action is required. If a response message is available and has to be sent (server #1, but not server #2), then the transmission of the response message shall be started after P2_{K-line_min} timing is expired.
- 5 Server #1 starts the response message by indicating a T_Data.request from the application to the data link layer and at the same time stops its P2_{K-line} timer.
- 6 Both servers and the client receive a byte of a message via a receive interrupt by the UART. The ISR (interrupt service routine) restarts the P2_{K-line}/P3_{K-line} timers or time stamps the received byte and the client issues a T_Data_FB.indication to the application layer.
- 7 The completion of the response message is indicated in the client with T_Data.indication. When receiving the T_Data.indication, the client starts its P2_{K-line} and P3_{K-line} timer using the default reload values P2_{K-line_max} and P3_{K-line_max}.
- 8 Both servers have received the last byte of a message via a receive interrupt by the UART. The ISR (interrupt service routine) either resets the P2_{K-line}/P3_{K-line} timers or time stamps the received byte. The completion of the response message (e.g. length and checksum check) is indicated in server #1 via T_Data.confirmation. If server #1 does not want to send further response messages, it stops its P2 timer. In server #2, the message is received and the P3_{K-line} timer is restarted, but no T_Data.indication is forwarded to the application because the target address does not match the 33₁₆ (target address of this message is the tester address F1₁₆).
- 9 The client application detects a P2_{K-line_max} timeout, which indicates that all response messages from all servers are received.
- 10 The client application indicates that P3_{K-line_min} is reached and that the P3_{K-line} timing window is now open to send a new request message (see 1).
- 11 P3_{K-line_max} timeout indicates that the client is required to start a new initialization prior to sending a new request message.

Figure 3 — ISO 9141-2 and ISO 14230-4 protocol client and server timing behaviour

6.2.2.6 Definition for SAE J1850

For SAE J1850 network interfaces, the on-board systems shall respond to a request within P2_{J1850} of a request or a previous response message. With multiple response messages possible from a single request message, this allows as much time as is necessary for all ECUs to access the data link and transmit their response message(s). If there is no response message within this time period, the external test equipment can either assume no response message will be received, or if a response message has already been received, that no more response messages will be received. The application timing parameter value P2_{J1850} is specified in [Table 6](#).

Table 6 — Definition of SAE J1850 application timing parameter values

Parameter	Minimum value ms	Maximum value ms	Description
P2 _{J1850}	0	100	Time between external test equipment request message and the successful transmission of the ECU(s) response message(s). Each OBD ECU shall attempt to send its response message (or at least the first of multiple response messages) within P2 _{J1850} after the request message has been correctly received. Subsequent response messages shall also be transmitted within P2 _{J1850} of the previous response message for multiple message responses.

6.2.2.7 Definition for ISO 15765-4

For CAN bus systems based on ISO 15765-4, the (all) responding ECU(s) of the on-board system shall start the response message to a request message within $P2_{CAN}$. [Table 7](#) specifies the application timing parameter values for $P2$.

Table 7 — Definition of ISO 15765-4 application timing parameter values

Parameter	Minimum value $P2_{CAN_min}$ ms	Maximum value $P2_{CAN_max}$ ms	Description
$P2_{CAN}$	0	50	This is a system-wide parameter related to diagnostic response times. Each server (ECU) is required to respond to a request between $P2_{CAN_min}$ and $P2_{CAN_max}$. A client (tester) shall wait for at least $P2_{CAN_max}$ for the single-frame (SF) or first-frame (FF) of a response. $P2_{CAN}$ is the time until the first indication of a multiple-frame response message (FirstFrame). The client shall not process the response until the complete message (last ConsecutiveFrame) has been received. For clients (testers) which also support UDSONCAN for enhanced diagnostics, a $P2_{reload}$ mechanism is required. Upon receiving the SF or FF, the client (tester) shall reload its $P2_{CAN}$ timer with a value of at least $P2_{CAN_max}$ and restart the timer. Once the client's (tester's) $P2_{CAN}$ timer expires without receiving a SF or FF, the client (tester) may assume no more responses are forthcoming.
$P2^*_{CAN}$	0	5 000	Time between the successful reception of a negative response message with NRC 78₁₆ and the next response message (positive or negative message). See Table 11 for a list of which services support the use of NRC 78₁₆.

NOTE The network layer timing parameters for the multiple-frame response are not shown. Network layer timing requirements for legislated diagnostic messages are specified in ISO 15765-4.

6.2.2.8 Transport/Network layer interface adaptation

6.2.2.8.1 General information

This part of ISO 15031 makes use of the network layer services defined in ISO 15765-2 for the transmission and reception of diagnostic messages. This section defines the mapping of the virtual data link PDU (T_PDU) onto the independent transport/network layer protocol data units of the CAN data link specific network layer (N_PDU).

NOTE The transport/network layer services are used to perform the application layer and diagnostic session management timing.

6.2.2.8.2 Mapping of data link independent service primitives onto CAN data link dependent service primitives

[Table 8](#) specifies the mapping interface between the ISO 15765-2 DoCAN Part 2 and the ISO 14229-2 UDS Part 2.

Table 8 — Mapping of T_PDU service primitives onto N_PDU service primitives

Transport/network layer service primitives (data link independent according to ISO 14229-2)	DoCAN network layer service primitives (data link dependent according to ISO 15765-2)
T_Data.indication	N_USData.indication
T_DataSOM.indication	N_USDataFF.indication
T_Data.confirm	N_USData.confirm
T_Data.request	N_USData.request

6.2.2.8.3 Mapping of T_PDU onto N_PDU for message transmission

The parameters of the application layer protocol data unit defined to request the transmission of a diagnostic service request/response are mapped in accordance with [Table 9](#) onto the parameters of the network layer protocol data unit for the transmission of a message in the client/server.

The network layer confirmation of the successful transmission of the message (N_USData.con) is forwarded to the application because it is needed in the application for starting those actions, which shall be executed immediately after the transmission of the request/response message (ECUReset, BaudrateChange, etc.).

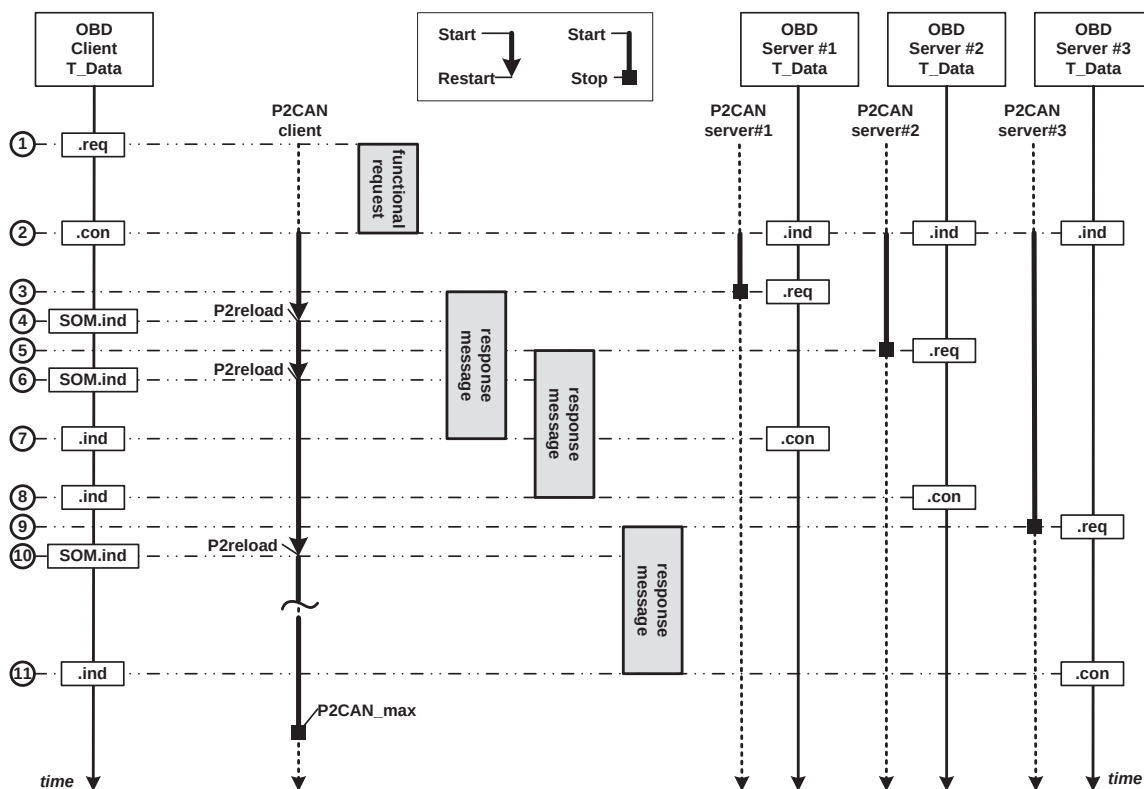
Table 9 — Mapping of T_PDU parameter onto N_PDU parameter

T_PDU parameter (data link independent according to ISO 14229-2)	N_PDU parameter (CAN data link dependent according to ISO 15765-2)
T_Mtype	N_Mtype
T_SA	N_SA
T_TA	N_TA
T_TAtype	N_TAtype
T_AE	N_AE
T_Data []	<MessageData>
T_Length	<Length>
T_Result	<N_Result>

6.2.2.9 Implementation guidance example for ISO 15765-4 protocol

6.2.2.9.1 Functional OBD communication during default session

[Figure 4](#) graphically depicts the timing handling in the client and three servers for a functionally addressed request message during the default session. A description following [Figure 4](#) references the points marked in the figure.



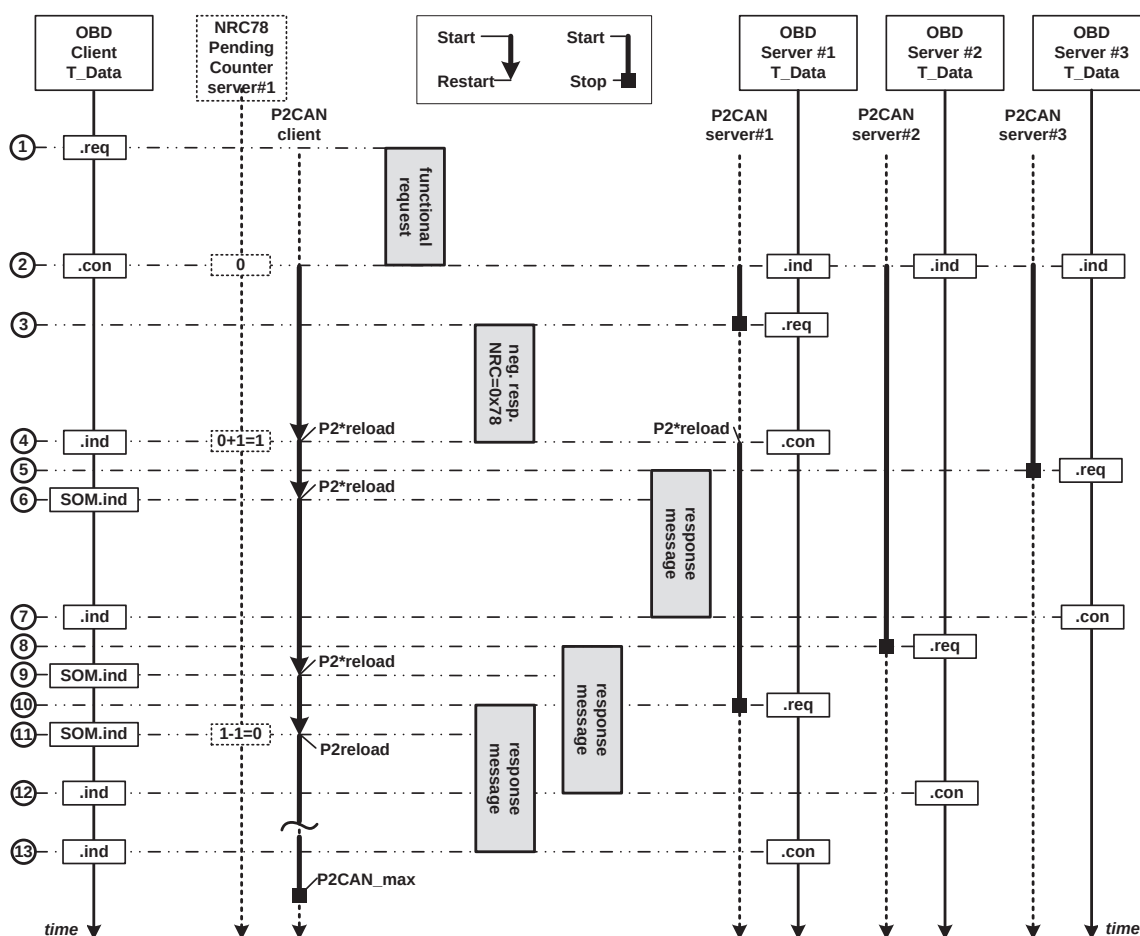
Key

- 1 Client T_Data.req: diagnostic application issues functionally addressed request message to network layer.
- 2 All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the P2_{CAN} timer using the value of P2_{CAN} = P2_{CAN_max}.
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. Client starts its P2_{CAN_Client} timer using the default reload value P2_{CAN} = P2_{CAN_max}.
- 3 Server #1 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2_{CAN}. The response message can be a multi-frame or single-frame response message.
- 4 Client T_DataSOM.ind: network layer issues to diagnostic application the reception of a StartOfMessage which is initiated by the reception of a FirstFrame indication on CAN (see ISO 15765-2). Reload P2_{CAN} with P2_{CAN_max} value.
- 5 Server #2 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2_{CAN}. The response message can be a multi-frame or single-frame response message
- 6 Client T_DataSOM.ind: network layer issues to diagnostic application the reception of a StartOfMessage which is initiated by the reception of a FirstFrame indication on CAN (see ISO 15765-2). Reload P2_{CAN} with P2_{CAN_max} value.
- 7 Server #1 T_Data.con: network layer issues to diagnostic application the completion of the response message. Client T_Data.ind: network layer issues to diagnostic application the completion of the response message.
- 8 Server #2 T_Data.con: network layer issues to diagnostic application the completion of the response message. Client T_Data.ind: network layer issues to diagnostic application the completion of the response message.
- 9 Server #3 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2_{CAN}. The response message can be a multi-frame or single-frame response message.
- 10 Client T_DataSOM.ind: network layer issues to diagnostic application the reception of a StartOfMessage which is initiated by the reception of a FirstFrame indication on CAN (see ISO 15765-2). Reload P2_{CAN} with P2_{CAN_max} value.
- 11 Server #2 T_Data.con: network layer issues to diagnostic application the completion of the response message. Client T_Data.ind: network layer issues to diagnostic application the completion of the response message.

Figure 4 — Functional OBD communication — Default response timing

6.2.2.9.2 Functional OBD communication with enhanced response timing

[Figure 5](#) illustrates the timing handling in the client and three (3) servers for a functionally addressed request message during the default session, where one server requests an enhanced response timing via a negative response message including NRC 78₁₆. A description following [Figure 5](#) references the points marked in the figure.



Key

- 1 Client T_Data.req: diagnostic application issues functionally addressed request message to network layer.
- 2 All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the P2CAN timer using the value of $P2_{CAN} = P2_{CAN_max}$.
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. Client starts its P2CAN timer using the default reload value $P2_{CAN} = P2_{CAN_max}$. All NRCPendingCounter = 0.
- 3 Server #1 T_Data.req: diagnostic application does not have the positive response message ready and issues negative response message with NRC = 78₁₆ by a T_Data.req to the network layer within P2CAN.
- 4 Server #1 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the reception of a message. Since the received response message is a negative response message with NRC = 78₁₆, the NRCPendingCounter server #1 is incremented by 1 ($0+1 = 1$).
Reload P2CAN with P2*CAN_max value. Server#1 reloads P2CAN with P2*CAN_max value.
- 5 Server #3 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2CAN.
- 6 Client T_DataSOM.ind: network layer issues to diagnostic application the reception of a StartOfMessage which is initiated by the reception of a FirstFrame indication on CAN (see ISO 15765-2). Reload P2CAN with P2*CAN_max value.
- 7 Server #3 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message.
- 8 Server #2 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2CAN.
- 9 Client T_DataSOM.ind: network layer issues to diagnostic application the reception of a StartOfMessage which is initiated by the reception of a FirstFrame indication on CAN (see ISO 15765-2). Client reloads P2CAN with P2*CAN_max value.

- 10 Server #1 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2_{CAN}
- 11 Client T_DataSOM.ind: network layer issues to diagnostic application the reception of a StartOfMessage which is initiated by the reception of a FirstFrame indication on CAN (see ISO 15765-2). Since the received response message is a positive response message, the NRCPendingCounter server #1 is decremented by 1 (1-1 = 0). Client reloads P2_{CAN} with P2_{CAN_max} value.
- 12 Server #2 T_Data.con: network layer issues to diagnostic application the completion of the response message. Client T_Data.ind: network layer issues to diagnostic application the completion of the response message.
- 13 Server #1 T_Data.con: network layer issues to diagnostic application the completion of the response message. Client T_Data.ind: network layer issues to diagnostic application the completion of the response message

Figure 5 — Functional OBD communication — Enhanced response timing

6.2.3 Minimum time between requests from external test equipment

6.2.3.1 ISO 9141-2, ISO 14230-4 — Minimum time between requests from external test equipment

For ISO 9141-2 (K-line) interfaces, the required times between request messages are specified in ISO 9141-2.

For ISO 14230-4 (K-line) interfaces, the required times between request messages are specified in ISO 14230-4. [Figure 6](#) shows an example of a request message followed by four (4) response messages and another request message.

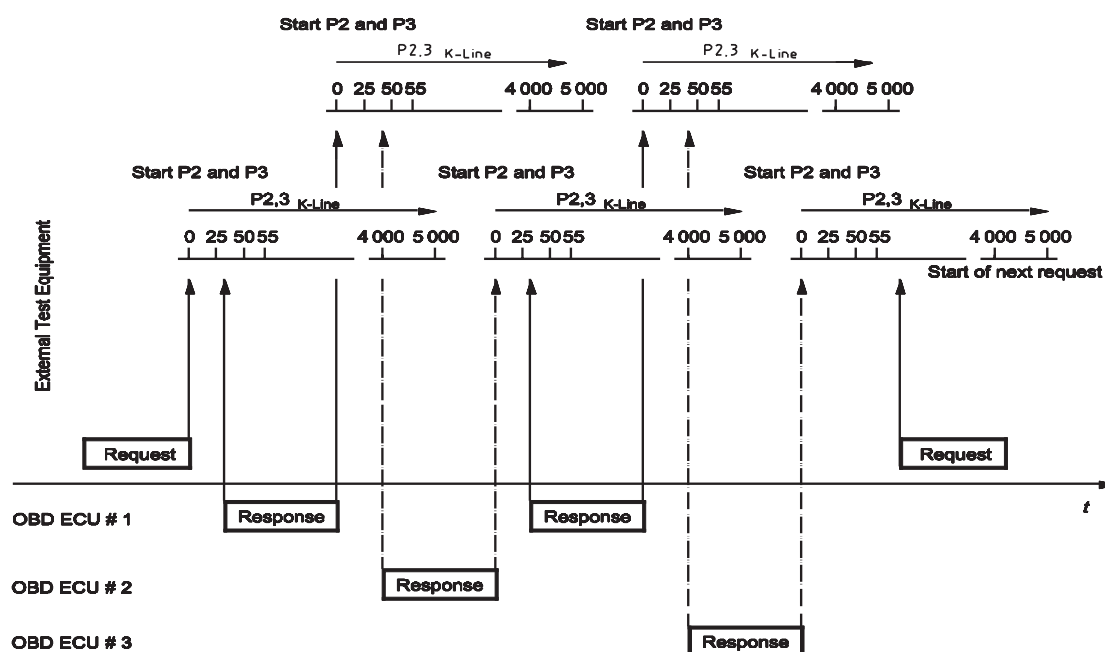


Figure 6 — ISO 9141-2 (Key bytes: 08₁₆ 08₁₆) and ISO 14230-4 application timing parameter overview

6.2.3.2 SAE J1850 — Minimum time between requests from external test equipment

For SAE J1850 network interfaces, external test equipment shall always wait for a response message from the previous request or “no response” time-out before sending another request message. If the number of response messages is known and all response messages have been received, then the external test equipment is permitted to send the next request message immediately. If the number of

response messages is not known, then the external test equipment shall wait at least $P2_{J1850}$ maximum time.

Figure 7 illustrates an example of a request message followed by four (4) response messages and another request message.

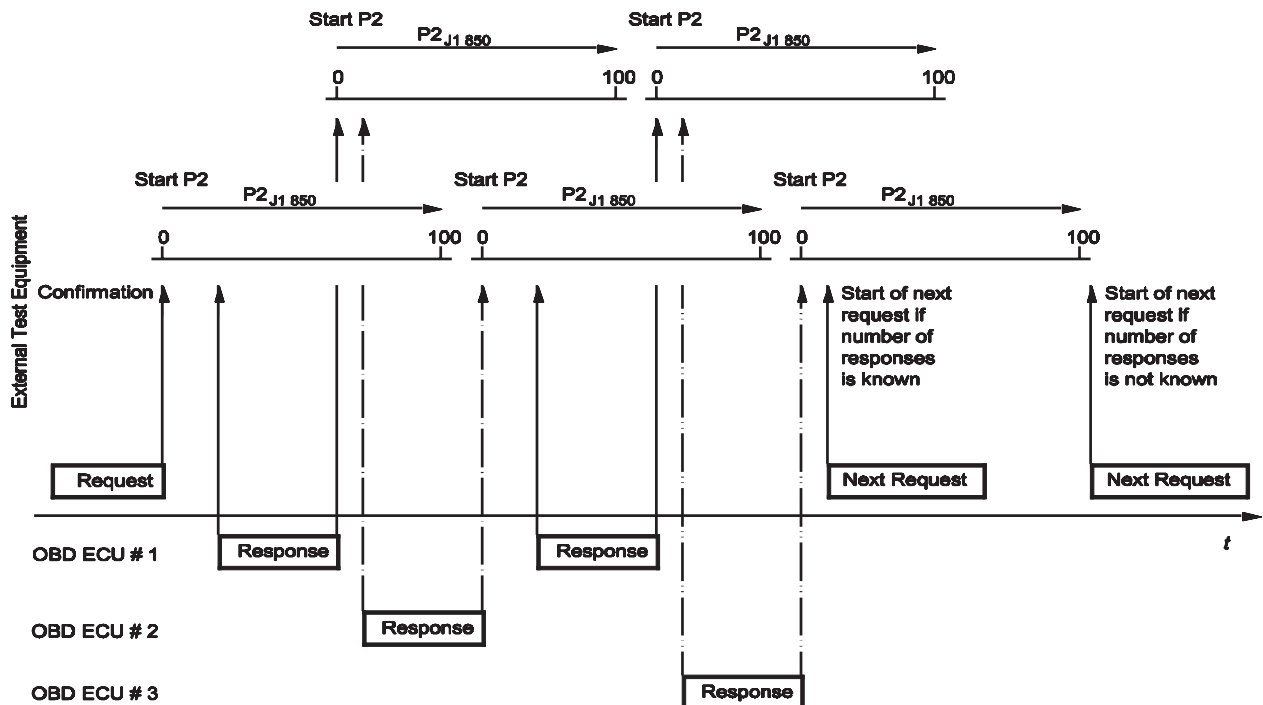


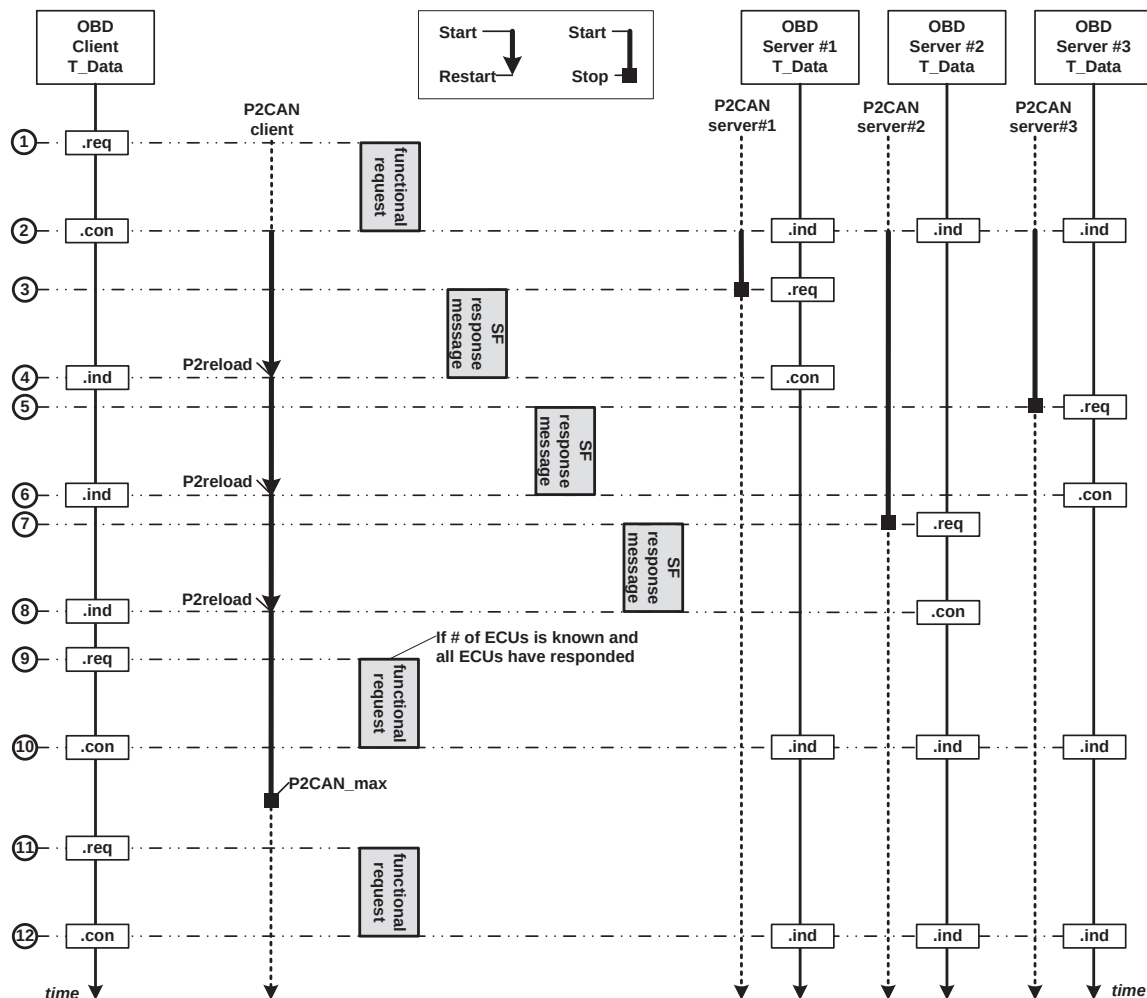
Figure 7 — SAE J1850 application timing parameter overview

6.2.3.3 ISO 15765-4 — Minimum time between requests from external test equipment

For ISO 15765-4 network interfaces, the external test equipment may send a new request message immediately after it has determined that all responses related to the previously sent request message have been received. If the external test equipment does not know whether it has received all response messages, (e.g. after sending the initial OBD request message: Service 01₁₆, PID 00₁₆), it shall wait until $P2_{CAN_max}$ expires before sending another request. The timer $P2_{CAN}$ of the external test equipment starts with the confirmation of a successful transmission of the request message.

Figure 8 illustrates an example of a request message followed by three (3) single-frame response messages and another request message.

IMPORTANT — The $P2_{CAN_reload}$ is performed by the client to identify whether more emissions-related OBD ECUs will send a response message. The $P2_{CAN_reload}$ is not defined to check whether the entire response message is sent within $P2_{CAN_max}$ timing.



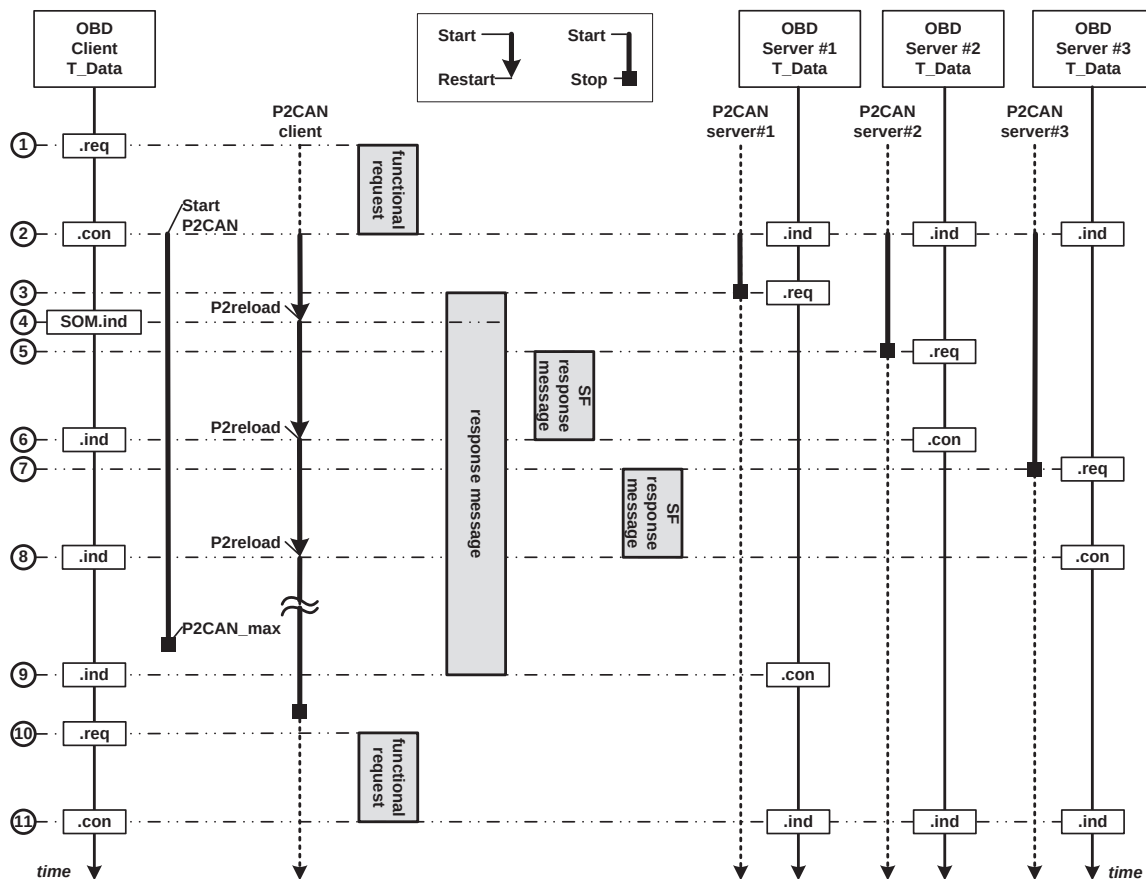
Key

- Client T_Data.req: diagnostic application issues functionally addressed request message to network layer.
- All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the P2CAN timer using the value of $P2CAN = P2CAN_{max}$.
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. Client starts its P2CAN timer using the default reload value $P2CAN = P2CAN_{max}$.
- Server #1 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2CAN. The response message is a single-frame message.
- Server #1 T_Data.con: network layer issues to diagnostic application the completion of the response message. Client T_Data.ind: network layer issues to diagnostic application the completion of the response message. Client reloads P2CAN with P2CAN_max value.
- Server #3 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2CAN. The response message is a single-frame message.
- Server #3 T_Data.con: network layer issues to diagnostic application the completion of the response message. Client T_Data.ind: network layer issues to diagnostic application the completion of the response message. Client reloads P2CAN with P2CAN_max value.
- Server #2 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2CAN. The response message is a single-frame message.
- Server #2 T_Data.con: network layer issues to diagnostic application the completion of the response message. Client T_Data.ind: network layer issues to diagnostic application the completion of the response message. Client reloads P2CAN with P2CAN_max value.
- Client T_Data.req: diagnostic application issues functionally addressed request message to network layer. The client knows the number of ECUs which shall have responded to the previous request. Since all response messages have been received, the client is already allowed to issue a new functional request message.

- 10 All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the $P2_{CAN}$ timer using the value of $P2_{CAN} = P2_{CAN_max}$.
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. Client starts its $P2_{CAN}$ timer using the default reload value $P2_{CAN} = P2_{CAN_max}$ (not shown in figure).
- 11 Client T_Data.req: diagnostic application issues functionally addressed request message to network layer. The client does not know the number of ECUs which shall have responded to the previous request. Therefore, the client shall wait until $P2_{CAN} = P2_{CAN_max}$ before it issues a new functional request message.
- 12 All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the $P2_{CAN}$ timer using the value of $P2_{CAN} = P2_{CAN_max}$ (not shown in figure).
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. Client starts its $P2_{CAN}$ timer using the default reload value $P2_{CAN} = P2_{CAN_max}$ (not shown in figure).

Figure 8 — ISO 15765-4 application timing parameter (single-frame response messages) overview

[Figure 9](#) illustrates an example of a request message followed by one (1) multiple-frame response message and two (2) single frames and another request message. The next request message can be sent immediately by the external test equipment after completion of all response messages in case the transmission of the response messages takes longer than $P2_{CAN_max}$, even if the external test equipment does not know the number of responding ECUs.



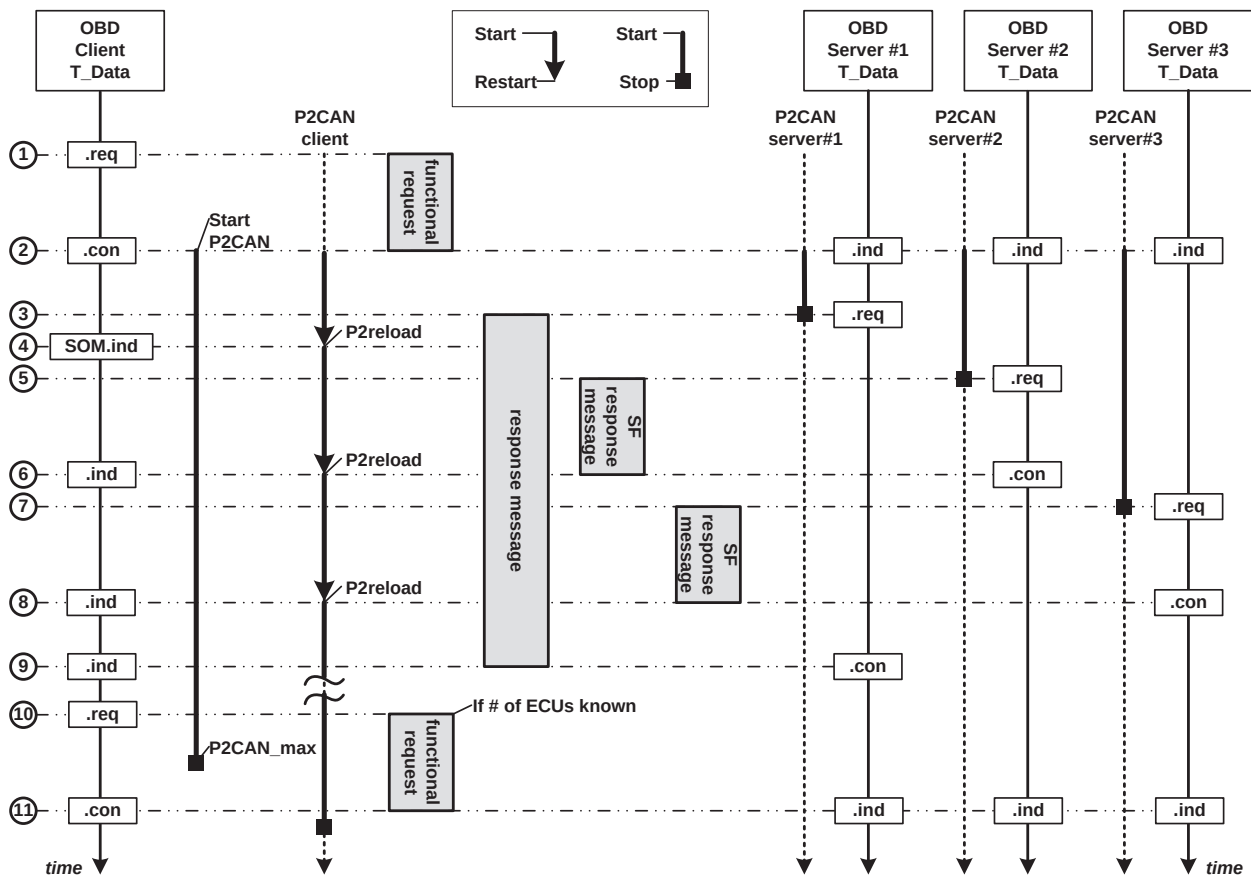
Key

- 1 Client T_Data.req: diagnostic application issues functionally addressed request message to network layer.
- 2 All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the P2CAN timer using the value of $P2_{CAN} = P2_{CAN_max}$.
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. Client starts its P2CAN timer using the default reload value $P2_{CAN} = P2_{CAN_max}$.
- 3 Server #1 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2CAN.
- 4 Client T_DataSOM.ind: network layer issues to diagnostic application the reception of a StartOfMessage which is initiated by the reception of a FirstFrame indication on CAN (see ISO 15765-2). Client reloads P2CAN with P2CAN_max value.
- 5 Server #2 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2CAN. The response message is a single-frame message.
- 6 Server #2 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message. Client reloads P2CAN with P2CAN_max value.
- 7 Server #3 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2CAN. The response message is a single-frame message.
- 8 Server #3 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message. Client reloads P2CAN with P2CAN_max value.
- 9 Server #1 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message.

- 10 Client T_Data.req: diagnostic application issues functionally addressed request message to network layer. The client does not know the number of ECUs which shall have responded to the previous request. Therefore, the client shall wait until $P2_{CAN} = P2_{CAN_max}$ before it issues a new functional request message.
- 11 All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the $P2_{CAN}$ timer using the value of $P2_{CAN} = P2_{CAN_max}$.
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. Client starts its $P2_{CAN}$ timer using the default reload value $P2_{CAN} = P2_{CAN_max}$.

Figure 9 — ISO 15765-4 functional OBDonCAN communication — Multiple-frame response not finished within $P2_{CAN}$

[Figure 10](#) illustrates an example of a request message followed by one (1) multiple-frame response message and two (2) single frames (completion within $P2_{CAN_max}$) and another request message. The next request message can be sent immediately by the external test equipment after completion of all response messages if the external test equipment knows the number of responding ECUs. If not, it needs to wait with the next request message to send until $P2_{CAN_max}$ is expired.



Key

- 1 Client T_Data.req: diagnostic application issues functionally addressed request message to network layer.
- 2 All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the $P2_{CAN}$ timer using the value of $P2_{CAN} = P2_{CAN_max}$.
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. Client starts its $P2_{CAN}$ timer using the default reload value $P2_{CAN} = P2_{CAN_max}$.
- 3 Server #1 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within $P2_{CAN}$.
- 4 Client T_DataSOM.ind: network layer issues to diagnostic application the reception of a StartOfMessage which is initiated by the reception of a FirstFrame indication on CAN (see ISO 15765-2). Client reloads $P2_{CAN}$ with $P2_{CAN_max}$ value.
- 5 Server #2 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within $P2_{CAN}$. The response message is a single-frame message.
- 6 Server #2 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message. Client reloads $P2_{CAN}$ with $P2_{CAN_max}$ value.
- 7 Server #3 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within $P2_{CAN}$. The response message is a single-frame message.
- 8 Server #3 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message. Client reloads $P2_{CAN}$ with $P2_{CAN_max}$ value.
- 9 Server #1 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message.

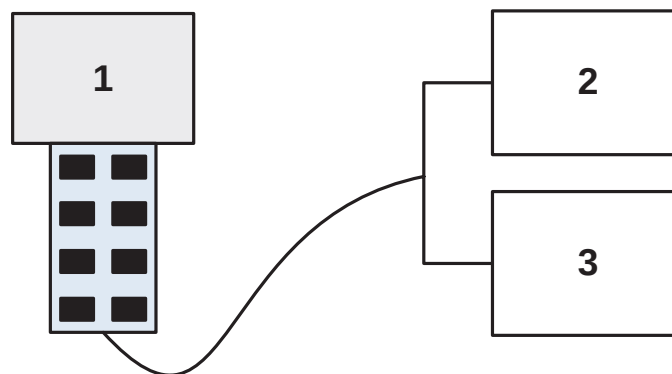
- 10 Client T_Data.req: diagnostic application issues functionally addressed request message to network layer. The client knows the number of ECUs which shall have responded to the previous request. Therefore, the client is not required to wait until the time window has reached $P2_{CAN_max}$ before it issues a new functional request message.
- 11 All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the $P2_{CAN}$ timer using the value of $P2_{CAN} = P2_{CAN_max}$.
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. Client starts its $P2_{CAN}$ timer using the default reload value $P2_{CAN} = P2_{CAN_max}$.

Figure 10 — ISO 15765-4 functional OBDonCAN communication — Multiple-frame response finished within $P2_{CAN}$

NOTE The network layer timing parameters for the multiple-frame response are not shown. Network layer timing requirements for legislated diagnostic messages are specified in ISO 15765-4.

6.2.3.4 ECU behaviour to a request for supported/non-supported OBD information

[Figure 11](#) illustrates an example of a typical vehicle OBD configuration.



Key

- 1 external test equipment
- 2 ECM (engine control module)
- 3 TCM (transmission control module)

Figure 11 — Example of external test equipment connected to two (2) OBD ECUs

A service shall only be implemented by an ECU if supported with data (e.g. PID/OBD Monitor ID/Test ID/INFOTYPE supported), except for Service 01₁₆ and PID 00₁₆ which shall be supported by all emissions-related ECUs.

Typically, the ECM supports OBD Monitor IDs, which the TCM does not support. In case the external test equipment requests the status of such OBD Monitor ID supported by the ECM, the ECM sends a positive response message and the TCM does not send a response message (no negative response message allowed). The external test equipment knows that the TCM will not send a positive response message based on the OBD Monitor ID supported information retrieved prior to the latter request.

This shall be implemented to enhance the overall diagnostic communication performance between the external test equipment and the vehicle ECUs (see [6.2.3.3](#)).

6.2.4 Data not available

6.2.4.1 ISO 9141-2, ISO 14230-4, and SAE J1850 — Data not available

There are two conditions for which data are considered not available. One condition is that the service is not supported and the other is that the service is supported but data are currently not available.

For SAE J1850 and ISO 9141-2 interfaces, there will be no reject message to a functional request message if the request is not supported by the ECU. This prevents response messages from all ECUs that do not support a service or a specific data value.

For ISO 14230-4 interfaces, there will be a response message to every request message either positive (with data) or negative. In order to avoid unnecessary communication, the ECU(s) which does (do) not support a functionally requested PID, TID, or INFOTYPE is permitted not to send a negative response message because another ECU will send a positive response message. Format and possible codes of negative responses are specified in [6.3.4](#).

Some services are supported by a vehicle but data might not always be available when requested. For Services 05₁₆ and 06₁₆, if the test has not been run since test results were cleared, or for Service 02₁₆, if freeze frame data has not been stored, or for Service 09₁₆, if the engine is running, valid data will not be available. For these conditions, the manufacturer has the option either to not respond or to respond with data that are invalid (ISO 9141-2 and SAE J1850 only). The functional description for these services discusses the method to determine if the data are valid.

6.2.4.2 ISO 15765-4 — Data not available

There are five (5) conditions for which data are considered not available:

- a) Request message is not supported: The ECU(s) which does (do) not support the functional request message shall not send any response message;
- b) Request message is supported but data are not supported: The ECU(s) which does (do) support the functional request message but does (do) not support the requested data (e.g. PID, OBD Monitor ID, TID, or INFOTYPE) is (are) not allowed to send a negative response message because another ECU will send a positive response message. If the external test equipment sends a message including multiple PIDs and each emission-related ECU does not support all requested PIDs, then each ECU shall send a positive response message including the supported PID(s) and data values and shall not send a negative response message. If an ECU does not support any of the PIDs requested, it is not allowed to send a negative response message;
- c) Request message is supported but data are currently not available: The ECU(s) which does (do) support the functional request message but does (do) not currently have the requested data available shall respond with a negative response message with NRC 22₁₆ - ConditionsNotCorrect (negative response message format is specified in [6.3.3](#)). For Services 01₁₆, 02₁₆, 03₁₆, 06₁₆, 07₁₆, and 0A₁₆, the use of a negative response message including NRC 22₁₆ is not permitted. For Services 04₁₆, 08₁₆, and 09₁₆, the use of a NRC 22₁₆ is allowed. Use of 22₁₆ for Service 09₁₆ CVN request may be restricted by OBD regulations;
- d) Request message is supported but data are not available within P2 timing: The behaviour of the ECU(s) and the external test equipment is specified in [6.2.4.3](#);
- e) Request message is supported but service cannot be performed within P2 timing: The behaviour of the ECU(s) and the external test equipment is specified in [6.2.4.3](#). For Services 04₁₆ and 09₁₆, the use of an NRC 78₁₆ is allowed.

6.2.4.3 Data not available within P2 timing

6.2.4.3.1 Overview

The following subclauses specify the request/response message handling for each protocol if the data are not available within the P2 timing in the ECU(s). The description in the subsection only applies to Service 09₁₆, INFOTYPE 06₁₆ calibration verification numbers.

6.2.4.3.2 ISO 9141-2 — Data not available within P2 timing

If an ECU(s) supports the functional request message but does not have the requested data available within P2 timing, then a retry message handling routine shall be performed as follows:

- If the response message is not received within P2_{K-Line}, the external test equipment shall stop retrying the request message after one (1) minute from the original request;
- The retry message shall be sent at least every four (4) seconds (between 55 ms and 4 000 ms). The retry message keeps the bus alive and prevents the external test equipment from having to re-initialize the bus (P3_{K-Line} time out);
- The ECUs, which either have already sent a positive response message or have not sent a positive response message, shall not restart the requested internal routine again;
- The external test equipment shall record if all ECUs have sent the expected number of response messages;
- After successful completion of all response messages, the external test equipment shall send a request message which is “not equal” to the “Repeated Request” message.

Additional description is included in the functional description of the corresponding service.

Figure 12 illustrates the ISO 9141-2 (key bytes: 08₁₆ 08₁₆) data not available within P2 timing handling overview.

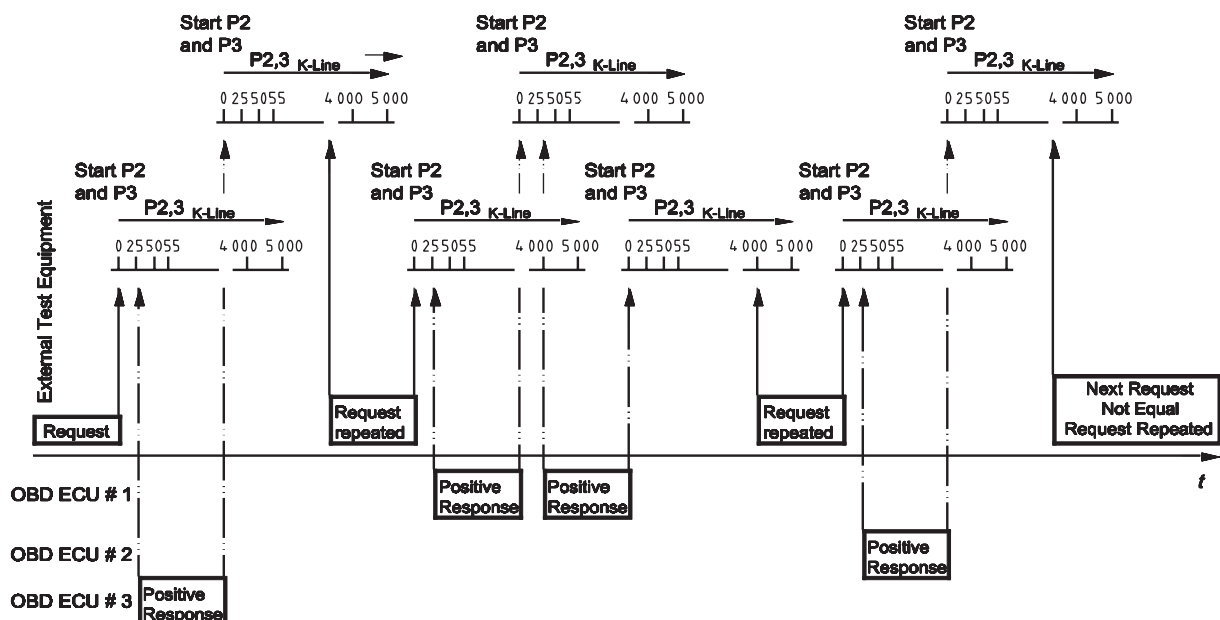


Figure 12 — ISO 9141-2 (key bytes: 08₁₆ 08₁₆) data not available within P2 timing handling overview

For the ISO 9141-2 protocol, the response message timing $P2_{K-Line}$ shall be in accordance with [Table 2](#). The $P2_{K-line_min}$ application timing parameter value depends on the key bytes as listed:

- Key bytes: $08_{16} 08_{16}$: $P2_{K-line_min} = 25 \text{ ms}$;
- Key bytes: $94_{16} 94_{16}$: $P2_{K-line_min} = 0 \text{ ms}$.

6.2.4.3.3 ISO 14230-4 — Data not available within P2 timing

If an ECU(s) supports the functional request message but does not have the requested data available within P2 timing, handling shall be performed as follows:

- a) The ECU(s) shall respond with a negative response message with NRC 78_{16} - RequestCorrectlyReceived-ResponsePending within P2 timing;
- b) ECUs which require more time than $P2_{K-Line}$ to perform the requested action shall repeat the negative response message with NRC 78_{16} prior to expiration of $P2_{K-Line}$ until the positive response message is available;
- c) After all positive response messages have been received or a time out $P2_{K-Line_max}$ has occurred, the external test equipment shall wait until $P3_{K-Line_min}$ is reached to send a new request message.

[Figure 13](#) illustrates the ISO 14230-4 negative response code RC = 78_{16} handling overview.

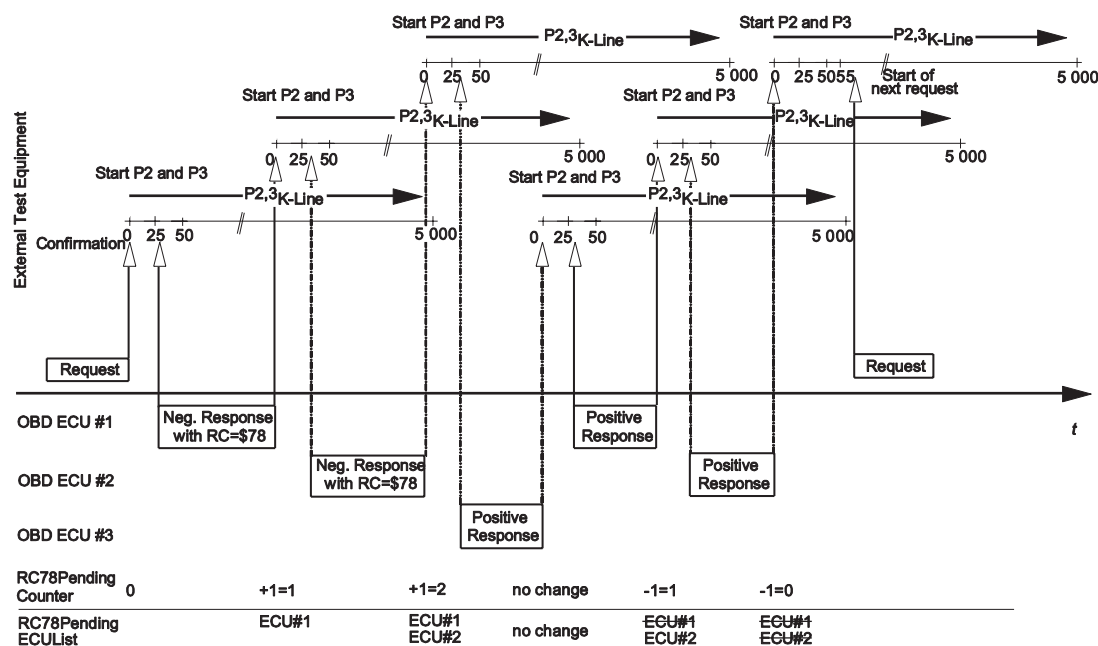


Figure 13 — ISO 14230-4:— Negative response code RC = 78_{16} handling overview

6.2.4.3.4 SAE J1850 — Data not available within P2 timing

If an ECU(s) supports the functional request message but does not have the requested data available within P2 timing, then a retry message handling routine shall be performed as follows:

- a) If the response message is not received within $P2_{J1850}$, the external test equipment shall wait $30 (30 \pm 1) \text{ s}$ and then retry the request message;
- b) The retry message shall be stopped after one (1) minute from the original request;
- c) The external test equipment shall record if all ECUs have sent the expected number of response messages.

An additional description is included in the functional description of the corresponding service.

[Figure 14](#) illustrates the SAE J1850 data not available within P2 timing handling overview.

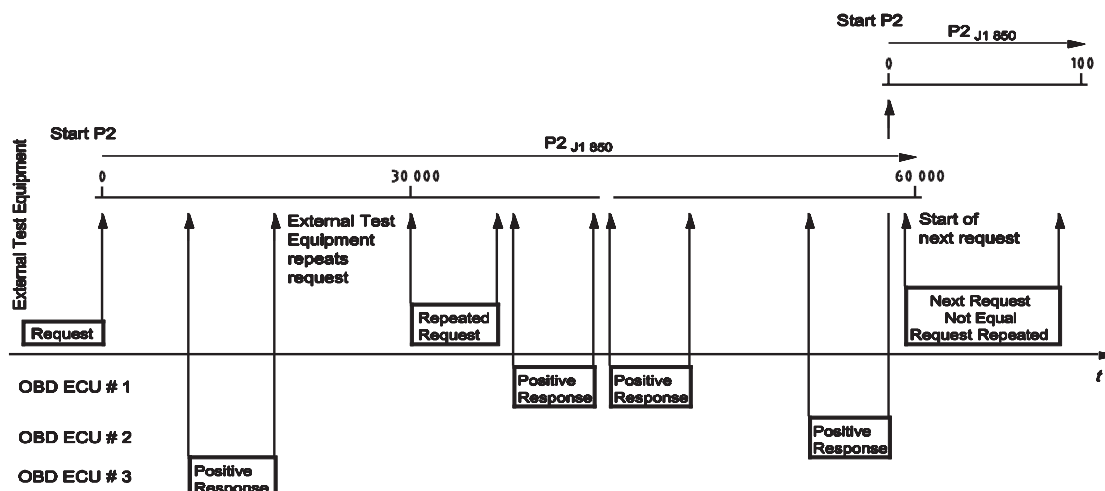


Figure 14 — SAE J1850 — Data not available within P2 timing handling overview

6.2.4.3.5 Data not available test conditions for protocols: ISO 9141-2, ISO 14230-4, and SAE J1850

There are two conditions for which data are considered not available:

- Service is not supported;
- Service is supported but data are not available at the time that the request is made.

[Table 10](#) indicates the proper server/ECU response for each protocol as detailed in [6.2.4.1](#).

Table 10 — Proper response from server/ECU with ISO 9141-2, ISO 14230-4, and SAE J1850 protocol

Service	Condition	ISO 9141-2	SAE J1850	ISO 14230-4	NRC
00 ₁₆ or 0A ₁₆ -0F ₁₆	Not allowed	The ECU shall not respond.	The ECU shall not respond.	ECU can either not respond or send a negative response.	11
01 ₁₆	Not supported	All ECUs shall respond to Service 01 ₁₆ PID 00 ₁₆ if Service 01 ₁₆ is supported. If Service 01 ₁₆ is not supported, no response is allowed.	All ECUs shall respond to Service 01 ₁₆ PID 00 ₁₆ if Service 01 ₁₆ is supported. If Service 01 ₁₆ is not supported, no response is allowed.	All ECUs shall respond to Service 01 ₁₆ PID 00 ₁₆ if Service 01 ₁₆ is supported. If Service 01 ₁₆ is not supported, ECU can either not respond or send a negative response.	11 ₁₆
	Unsupported PID requested	No response preferred, positive response is allowed.	No response preferred, positive response is allowed.	ECU can either not respond or send a negative response.	12 ₁₆
	Supported PID requested	Positive response is required.	Positive response is required.	Positive response is required.	N/A

Table 10 (continued)

Service	Condition	ISO 9141-2	SAE J1850	ISO 14230-4	NRC
02 ₁₆	Not supported	The ECU shall not respond.	The ECU shall not respond.	ECU can either not respond or send a negative response.	11 ₁₆
	Supported PID requested, no Freeze Frame stored	PID 02 ₁₆ indicates 0000 ₁₆ , but if PIDs are requested, ECU can either not respond or send invalid data, except if supported PIDs (00 ₁₆ , 20 ₁₆ , ...) have been requested, then the ECU shall send a response with the supported PID and data bytes.	PID 02 ₁₆ indicates 0000 ₁₆ , but if PIDs are requested, ECU can either not respond or send invalid data, except if supported PIDs (00 ₁₆ , 20 ₁₆ , ...) have been requested, then the ECU shall send a response with the supported PID and data bytes.	PID 02 ₁₆ indicates 0000 ₁₆ , but if PIDs are requested, ECU can either not respond or send a negative response, except if supported PIDs (00 ₁₆ , 20 ₁₆ , ...) have been requested, then the ECU shall send a response with the supported PID and data bytes.	12 ₁₆
	Unsupported PID requested, no Freeze Frame stored	No response preferred, positive response is allowed.	No response preferred, positive response is allowed.	ECU can either not respond or send a negative response.	12 ₁₆
	Supported PID requested, Freeze Frame stored	Positive response is required.	Positive response is required.	Positive response is required.	N/A
	Unsupported PID requested, Freeze Frame stored	No response preferred, positive response is allowed.	No response preferred, positive response is allowed.	ECU can either not respond or send a negative response.	12 ₁₆
03 ₁₆ /07 ₁₆	Not supported	The ECU shall not respond.	The ECU shall not respond.	ECU can either not respond or send a negative response.	11 ₁₆
	Supported, no DTCs stored	No response preferred, positive response indicating no DTCs is allowed.	No response preferred, positive response indicating no DTCs is allowed.	Positive response indicating no DTCs is required.	N/A
	Supported, DTCs stored	Positive response is required.	Positive response is required.	Positive response is required.	N/A
04 ₁₆	Not supported	The ECU shall not respond.	The ECU shall not respond.	ECU can either not respond or send a negative response.	11 ₁₆
	Supported, conditions not correct	The ECU shall not respond.	The ECU shall not respond.	Negative response is required.	22 ₁₆
	Supported, conditions correct	Positive response is required.	Positive response is required.	Positive response is required.	N/A

Table 10 (continued)

Service	Condition	ISO 9141-2	SAE J1850	ISO 14230-4	NRC
05 ₁₆ /06 ₁₆	Not supported	The ECU shall not respond.	The ECU shall not respond.	ECU can either not respond or send a negative response.	16 ₁₁
05 ₁₆ /06 ₁₆	Supported TID requested, no stored data available	If TIDs are requested, ECU can either not respond or send invalid data.	If TIDs are requested, ECU can either not respond or send invalid data.	If TIDs are requested, ECU can either not respond or send invalid data or send negative response.	12 ₁₆
	Unsupported TID requested, no stored data available	No response preferred, positive response is allowed.	No response preferred, positive response is allowed.	ECU can either not respond or send a negative response.	12 ₁₆
	Supported TID requested, stored data available	Positive response is required.	Positive response is required.	Positive response is required.	N/A
	Unsupported TID requested, stored data available	No response preferred, positive response is allowed.	No response preferred, positive response is allowed.	ECU can either not respond or send a negative response.	12 ₁₆
08 ₁₆	Not supported	The ECU shall not respond.	The ECU shall not respond.	ECU can either not respond or send a negative response.	11 ₁₆
	Supported TID requested, conditions correct	Respond within P2 timing.	Respond within P2 timing.	Respond within P2 timing.	N/A
	Supported TID requested, conditions not correct	The ECU shall not respond or may respond with a manufacturer-specified value as DATA A, which corresponds to the reason the test cannot be run.	The ECU shall not respond or may respond with a manufacturer-specified value as DATA A, which corresponds to the reason the test cannot be run.	Negative response is required or may respond with a manufacturer-specified value as DATA A which corresponds to the reason the test cannot be run.	22 ₁₆
	Unsupported TID requested	No response preferred, positive response is allowed.	No response preferred, positive response is allowed.	ECU can either not respond or send a negative response.	12 ₁₆
09 ₁₆	Not supported	The ECU shall not respond.	The ECU shall not respond.	ECU can either not respond or send a negative response.	11 ₁₆
	Supported INFOTYPE requested, data available (VIN, CVN, CALID)	Positive response is required.	Positive response is required.	Positive response is required.	N/A

Table 10 (continued)

Service	Condition	ISO 9141-2	SAE J1850	ISO 14230-4	NRC
	Supported INFOTYPE requested, data not available, conditions correct (CVN)	Respond within 1 min; do not restart CVN calculation. Test tool sends retry message every 0,055 to 4,0 s.	Respond within 1 min; do not restart CVN calculation. Test tool sends retry message after 30 s.	One or multiple negative response message(s) required within $P2_{\max}$ (25 – 50 ms) until positive response is sent.	78 ₁₆
	Supported INFOTYPE requested, data not available, conditions not correct (CVN), prior to 2005 MY only	The ECU shall not respond.	The ECU shall not respond.	Negative response is required.	22 ₁₆
	Unsupported INFOTYPE requested	No response preferred, positive response is allowed.	No response preferred, positive response is allowed.	ECU can either not respond or send a negative response.	12 ₁₆

NOTE 1 ISO 9141-2 and SAE J1850 do not support negative response codes.

NOTE 2 Negative response structure follows the scheme: 7F₁₆, ServiceID, NRC (e.g. 7F₁₆, 01₁₆, 11₁₆).

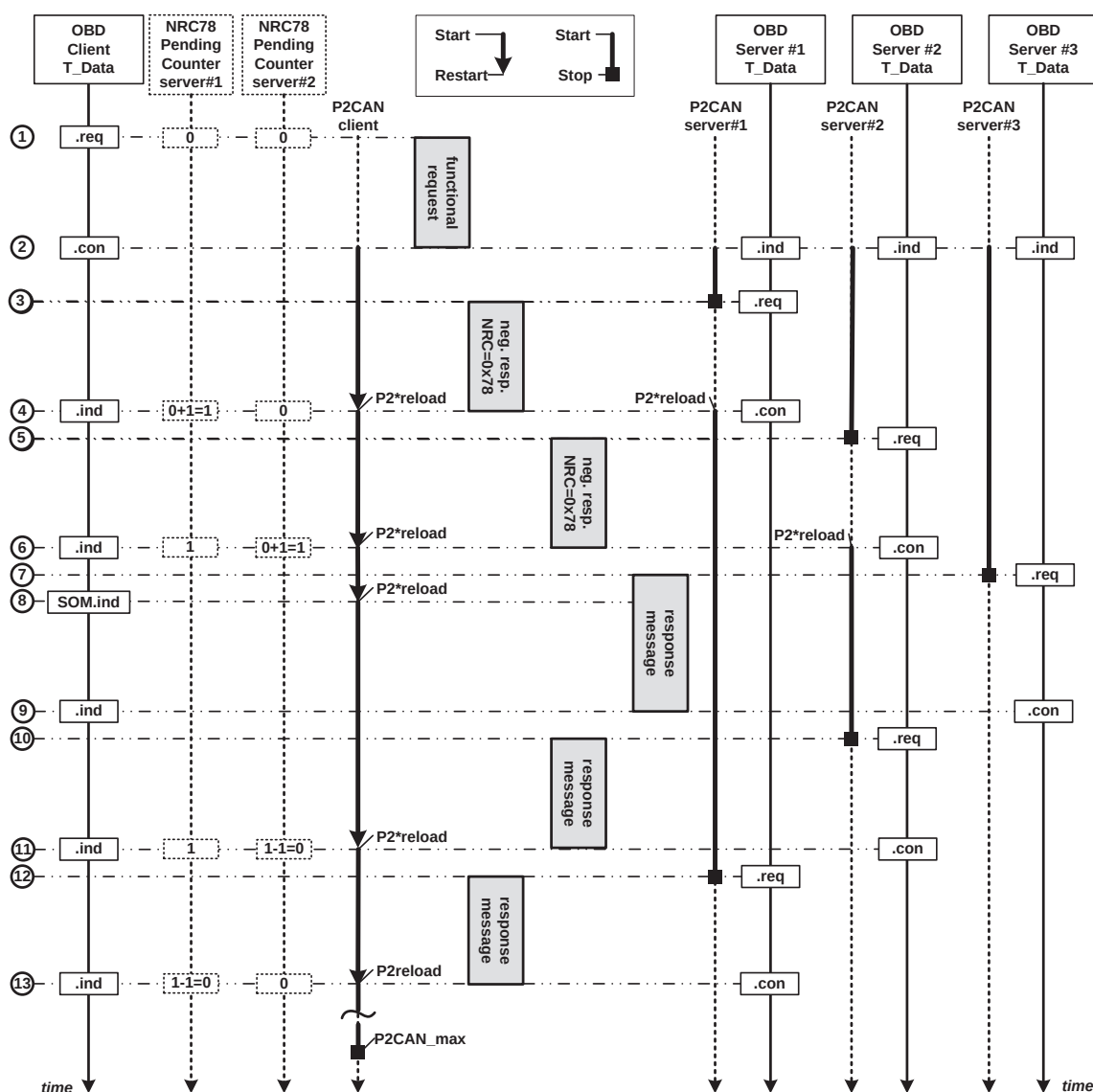
6.2.4.3.6 ISO 15765-4 — Data not available within P2 timing or service cannot be performed within P2 timing

The ECU(s) which does (do) support the functional request message but does (do) not have the requested data available within P2 timing or cannot perform the requested service within P2 timing shall perform the following handling:

- The ECU(s) shall respond with a negative response message with NRC 78₁₆ - RequestCorrectlyReceived-ResponsePending within P2 timing (not allowed for Service 01₁₆, 02₁₆, 03₁₆, 06₁₆, 07₁₆, and 0A₁₆ requests);
- After correct reception of the negative response message with NRC 78₁₆, the $P2_{\text{CAN_max}}$ parameter timing value shall be set to $P2^*_{\text{CAN_max}}$ (5 000 ms) by the external test equipment and the ECU which has sent the negative response message;
- If another ECU also sends a negative response message with NRC 78₁₆, the $P2_{\text{CAN_max}}$ timing parameter value shall be reloaded to $P2^*_{\text{CAN_max}}$;
- ECUs which require more than $P2^*_{\text{CAN_max}}$ to perform the requested action shall repeat the negative response message with NRC 78₁₆ prior to expiration of $P2^*_{\text{CAN_max}}$ until correct reception of the positive response message;
- After all positive response messages have been received or timed out, $P2^*_{\text{CAN_max}}$ has occurred, the $P2_{\text{CAN_max}}$ timing parameter shall be reset to the values specified in [Table 7](#).

The vehicle manufacturer is responsible to ensure that the network architecture of the vehicle does not cause timing delays that exceed $P2_{\text{CAN_max}}$ timing when responding to Services 01₁₆, 02₁₆, 03₁₆, 06₁₆, 07₁₆, 08₁₆, and 0A₁₆ requests because a negative response message with NRC 78₁₆ shall not be allowed.

[Figure 15](#) illustrates the negative response message handling with NRC 78₁₆ for the ISO 15765-4 interface.



Key

- 1 Client T_Data.req: diagnostic application issues functionally addressed request message to network layer.
- 2 All server T_Data.ind: network layer issues to diagnostic application the reception of a request message. All servers start the $P2_{CAN}$ timer using the value of $P2_{CAN} = P2_{CAN_max}$.
Client T_Data.con: network layer issues to diagnostic application the confirmation of the completion of the request message. All NRCPendingCounter = 0. Client starts its $P2_{CAN}$ timer using the default reload value $P2_{CAN} = P2_{CAN_max}$.
- 3 Server #1 T_Data.req: diagnostic application does not have the positive response message ready and issues negative response message with $NRC = 78_{16}$ by a T_Data.req to the network layer within $P2_{CAN}$.
- 4 Client T_Data.ind: network layer issues to diagnostic application the reception of a message. Since the received response message is a negative response message with $NRC = 78_{16}$, the NRCPendingCounter for server #1 is incremented by 1 ($0+1=1$).
Client reloads $P2_{CAN}$ with $P2_{CAN_max}$ value.
Server #1 T_Data.con: network layer issues to diagnostic application the completion of the response message.
- 5 Server #2 T_Data.req: diagnostic application does not have the positive response message ready and issues negative response message with $NRC = 78_{16}$ by a T_Data.req to the network layer within $P2_{CAN}$.
- 6 Client T_Data.ind: network layer issues to diagnostic application the reception of a message. Since the received response message is a negative response message with $NRC = 78_{16}$, the NRCPendingCounter server #2 is incremented by 1 ($0+1=1$).
Client reloads $P2_{CAN}$ with $P2_{CAN_max}$ value.
Server #2 T_Data.con: network layer issues to diagnostic application the completion of the response message.

- 7 Server #3 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2_{CAN}.
- 8 Client T_DataSOM.ind: network layer issues to diagnostic application the reception of a StartOfMessage which is initiated by the reception of a FirstFrame indication on CAN (see ISO 15765-2). Client reloads P2_{CAN} with P2*_{CAN_max} value.
- 9 Server #3 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message.
- 10 Server #2 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2_{CAN}. The response message is a single-frame message.
- 11 Server #2 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message. Since the received response message is a positive response message, the NRCPendingCounter server #2 is decremented by 1 (1-1 = 0). Client reloads P2_{CAN} with P2*_{CAN_max} value.
- 12 Server #1 T_Data.req: diagnostic application has prepared the response message and issues a T_Data.req to network layer within P2_{CAN}. The response message is a single-frame message.
- 13 Server #1 T_Data.con: network layer issues to diagnostic application the completion of the response message.
Client T_Data.ind: network layer issues to diagnostic application the completion of the response message. Since the received response message is a positive response message, the NRCPendingCounter server #1 is decremented by 1 (1-1 = 0). Client reloads P2_{CAN} with P2*_{CAN_max} value.

Figure 15 — ISO 15765-4:— Negative response code NRC = 78₁₆ handling overview

6.2.4.3.7 Data not available — Test conditions for protocol: ISO 15765-4 Diagnostic communication over CAN

The following are the five (5) conditions for which data are considered not available:

- service is not supported;
- service is supported but data are not supported;
- service is supported but data are not available at the time that the request is made;
- service is supported but data are not available within P2 timing;
- service is supported but cannot be performed within P2 timing.

[Table 11](#) indicates the proper server/ECU response as detailed in [6.2.4.2](#).

Table 11 — Proper response from server/ECU for ISO 15765-4 protocol

Service	Condition	ISO 15765-4	NRC
01 ₁₆	Not supported	All ECUs shall respond to Service 01 ₁₆ PID 00 ₁₆ if Service 01 ₁₆ is supported. If Service 01 ₁₆ is not supported, no response is allowed.	N/A
	Unsupported PID requested	The ECU shall not respond.	N/A
	Supported PID requested	Positive response is required (no negative response message with NRC 78 ₁₆ allowed).	N/A
	Support PID 00 ₁₆ requested during initialization	Positive response is required or negative response for max of 5 times.	21 ₁₆

Table 11 (continued)

Service	Condition	ISO 15765-4	NRC
02 ₁₆	Not supported	The ECU shall not respond.	N/A
	Supported PID, frame XX ₁₆ requested, no Freeze Frame stored	1) The ECU shall respond to PID 02 ₁₆ frame XX ₁₆ ; PID 02 ₁₆ frame XX ₁₆ shall indicate 0000 ₁₆ . 2) The ECU shall respond with support PIDs for frame XX ₁₆ (00 ₁₆ , 20 ₁₆ , ...). 3) If PIDs other than support PIDs or PID 02 ₁₆ are requested, the ECU shall not respond.	N/A
	Unsupported PID, frame XX ₁₆ requested, no Freeze Frame stored	PID 02 ₁₆ frame XX ₁₆ indicates 0000 ₁₆ , but if any other PIDs are requested, ECU shall not respond.	N/A
	Supported PID, frame XX ₁₆ requested, Freeze Frame stored	1) The ECU shall respond to PID 02 ₁₆ frame XX ₁₆ within P2 timing. 2) The ECU shall respond with support PIDs for frame XX ₁₆ (00 ₁₆ , 20 ₁₆ ...) within P2 timing and shall respond to PIDs frame XX ₁₆ indicated as supported within P2 timing.	N/A
	Unsupported PID, frame XX ₁₆ requested, Freeze Frame stored	The ECU shall not respond.	N/A
03 ₁₆ / 07 ₁₆ / 0A ₁₆	Not supported	The ECU shall not respond.	N/A
	Supported, no DTCs stored	Positive response indicating no DTCs is required.	N/A
	Supported, DTCs stored	Positive response including the stored DTCs is required.	N/A
04 ₁₆	Not supported	The ECU shall not respond.	N/A
	Supported, conditions not correct	Negative response is required.	22 ₁₆
	Supported, conditions correct	Positive response message required. Multiple negative response messages allowed within a maximum time of 5 000 ms after request until positive response is required.	78
06 ₁₆	Not supported	The ECU shall not respond.	N/A
	Supported OBDMID requested, no stored data available	Positive response required; test values, min and max limits shall be set to 00 ₁₆ .	N/A
	Unsupported OBDMID requested, no stored data available	The ECU shall not respond.	N/A
	Supported OBDMID requested, stored data available	Positive response is required.	N/A
	Unsupported OBDMID requested, stored data available	The ECU shall not respond.	N/A
08 ₁₆	Not supported	The ECU shall not respond.	N/A
	Supported TID requested, conditions correct	Positive response is required.	N/A
	Supported TID requested, conditions not correct	Negative response required.	22 ₁₆
	Unsupported TID requested	The ECU shall not respond.	N/A