



# SURFACE VEHICLE STANDARD

J1979™

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(R) E/E Diagnostic Test Modes

## RATIONALE

Changes have been made to keep pace Californian Air Resources Board legislation: Title 13, CCR Section 1968.2. Malfunction and Diagnostic System Requirements--2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines and Section 1971.1. On-Board Diagnostic System Requirements--2010 and Subsequent Model-Year Heavy-Duty Engines. The majority of the changes are captured in the J1979DA document.

SAE J1979 has been reaffirmed to comply with the SAE Five-Year Review policy.

## FOREWORD

On-Board Diagnostic (OBD) regulations require passenger cars, and light and medium duty trucks, to support communication of a minimum set of diagnostic information to off-board "generic" test equipment. This document 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. These messages are intended to be used by any external test equipment meeting the requirements of SAE J1978 for retrieval of OBD information from a vehicle.

SAE J1979 was originally developed to meet U.S. OBD requirements for 1996 and later model year vehicles. ISO 15031-5 was based on SAE J1979 and was intended to combine the U.S. requirements with European OBD requirements for 2000 and later model year vehicles. In addition, this document and later versions of the ISO document include new data reporting requirements included in proposed U.S. regulations, and also include specific requirements for retrieval of the same diagnostic information from vehicles equipped with ISO 15765-4 as a diagnostic data link.

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## 1. SCOPE

### 1.1 Introduction

SAE J1979/ISO 15031-5 set includes the communication between the vehicle's 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 are broken into:

- Diagnostic services (layer 7), specified in:
  - ISO 15031-5/SAE J1979 (emissions-related OBD),
  - ISO 27145-3 (WWH-OBD),
- Presentation layer (layer 6), specified in:
  - ISO 15031-2, SAE J1930-DA,
  - ISO 15031-5, SAE J1979-DA,
  - ISO 15031-6, SAE J2012-DA,
  - ISO 27145-2, SAE J2012-DA,
- Session layer services (layer 5), specified in:
  - 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:
  - DoCAN: ISO 15765-2 Transport protocol and network layer services,
  - SAE J1850: ISO 15031-5/SAE J1979 Emissions-related diagnostic services,
  - ISO 9141-2: ISO 15031-5/SAE J1979 Emissions-related diagnostic services,
  - DoK-Line: ISO 14230-4, ISO 15031-5/SAE J1979 Emissions-related diagnostic services,
- Network layer services (layer 3), specified in:
  - DoCAN: ISO 15765-2 Transport protocol and network layer services,
  - SAE J1850: ISO 15031-5/SAE J1979 Emissions-related diagnostic services,
  - ISO 9141-2: ISO 15031-5/SAE J1979 Emissions-related diagnostic services,
  - DoK-Line: ISO 14230-4, ISO 15031-5/SAE J1979 Emissions-related diagnostic services,
- Data link layer (layer 2), specified in:
  - DoCAN: ISO 15765-4, ISO 11898-1, -2,
  - SAE J1850,
  - ISO 9141-2,
  - DoK-Line: ISO 14230-2,
- Physical layer (layer 1), specified in:
  - DoCAN: ISO 15765-4, ISO 11898-1, -2,
  - SAE J1850,
  - ISO 9141-2,
  - DoK-Line: ISO 14230-1,

in accordance with Table 1.

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

| Applicability                                             | OSI 7 layers           | Emissions-related OBD communication requirements |            |             |                 |             | Emissions-related WWH-OBD communication requirements |             |             |
|-----------------------------------------------------------|------------------------|--------------------------------------------------|------------|-------------|-----------------|-------------|------------------------------------------------------|-------------|-------------|
| Seven layer 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)      |                                                  |            | ISO 14230-2 | ISO 11898-1, -2 |             | ISO 11898-1, -2                                      |             | ISO 13400-3 |
|                                                           | Data link (layer 2)    | SAE J1850                                        | ISO 9141-2 | ISO 14230-2 | ISO 11898-1, -2 | ISO 15765-4 | ISO 11898-1, -2                                      | ISO 15765-4 | ISO 13400-3 |
|                                                           | Physical (layer 1)     |                                                  |            | ISO 14230-1 |                 |             |                                                      |             |             |

### SAE document reference concept

ISO 15031 references several SAE documents which contain all terms, data and DTC definitions.

See Figure 1 - SAE Digital Annex document reference with the following definition of content in ISO 15031 parts:

- 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 like PIDs, Test Ids, Monitor IDs and InfoType IDs.
- SAE J2012: The document is concerned with the procedure for defining emissions-related diagnostic trouble codes. It references SAE J2012-DA which contains all standardized data items like DTCs and FTBs.

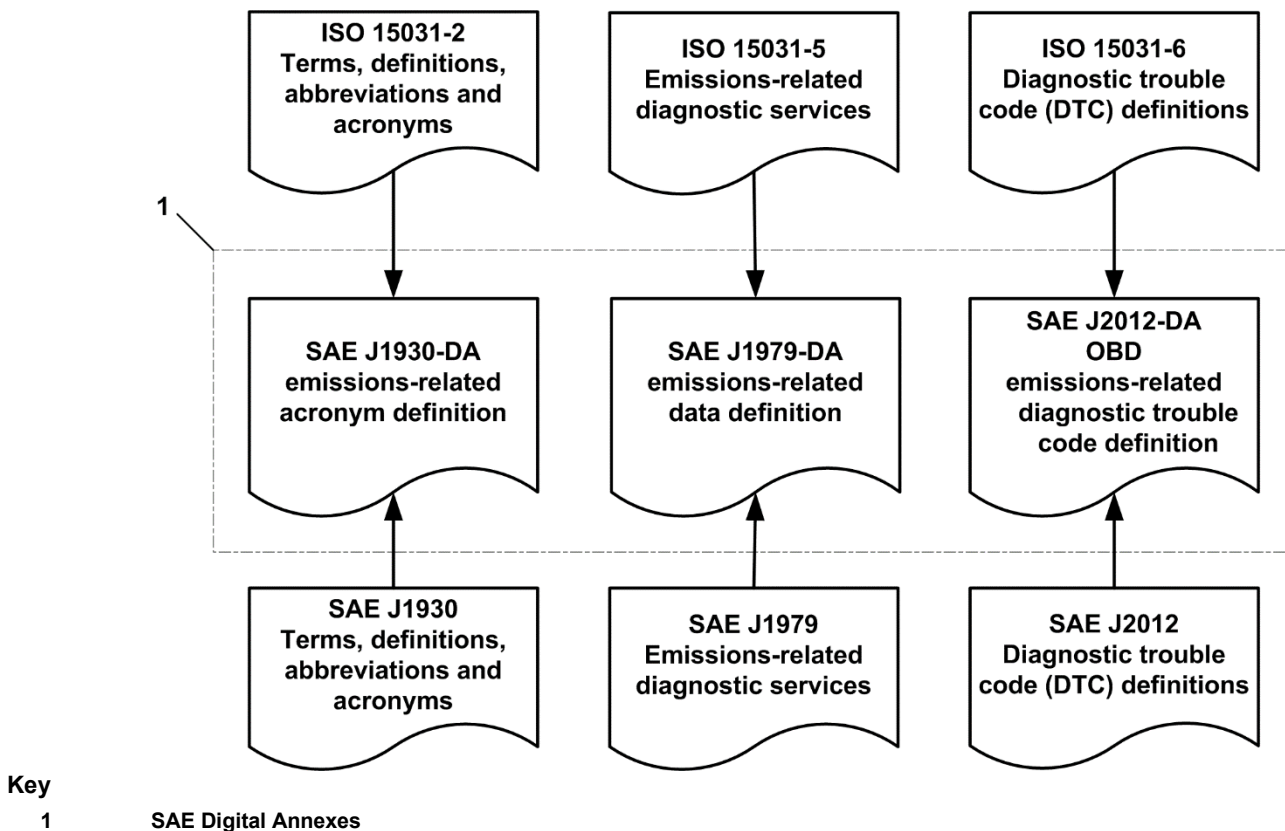


**Figure 1 - SAE Digital Annex document reference**

On-Board Diagnostic (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 (Digital Annex)

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

- Parameter Identifiers (PIDs),
- Test Identifiers (TIDs),
- OBD Monitor Identifiers (OBDMIDs),
- Unit and Scaling Identifiers (UASIDs), and
- Info Types (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 diagnostic trouble codes 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.

ISO 15031-5/SAE J1979 references a "Change Request Form" to be used for new data items to be defined by the SAE task force for standardization. The standardized data items will be defined in the SAE J1979-DA. Once the information has been balloted and approved, the documents will be published on the SAE Store Web Site.

The revision request form and instructions for updating ISO 15031 Part 5/SAE J1979 can be obtained on the Registration Authority's web site 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 filename:

SAE\_J1979-DA\_Revision\_Request\_Form.doc

Fill out the revision request form with your request.

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

SAE Automotive Headquarters  
755 West Big Beaver Road  
Suite 1600  
Troy, MI 48084-4093, USA  
Fax: +1 (248) 273-2494  
Email: [saej1979@sae.org](mailto:saej1979@sae.org)

## 1.2 Document Scope

This document supersedes SAE J1979 May 2007, and is technically equivalent to ISO 15031-5 2010, with the addition of new capabilities required by revised regulations from the California Air Resources Board and revised regulations from the European Commission.

This document 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 document 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. behavior of both the vehicle and external test equipment if data is not available,
- d. a set of diagnostic services, with corresponding content of request and response messages, to satisfy OBD regulations.

This document 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 document 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 document is responsible to verify the applicability of each section of this document for a specific vehicle, engine, model year and region.

SAE J1979/ISO 15031-5 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 SAE J1978 is intended to be able to use these messages to retrieve emissions-related information from the vehicle.

Each section of this part of SAE J1979/ISO 15031-5 which specifies additional detail to existing sections of ISO 9141-2, ISO 14230-4, SAE J1850, and ISO 15765-4 supersede those specifications.

This part of SAE J1979/ISO 15031-5 references the SAE J1979-DA (Digital Annex), which includes all definitions of PIDs, OBDMIDs, TIDs and INFOTYPES.

NOTE: SAE J1979/ISO 15031-5 provides the mechanism to satisfy the requirements included in the country-specific regulations and not all capabilities included in this document are required by the country-specific regulations. SAE J1979 is not considered a final authority for interpretation of the regulations, so readers should determine the applicability of capabilities defined in this document for their specific needs.

## 2. REFERENCES

This specification takes precedence over all conflicts in the documents cited in this section.

### 2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

#### 2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

SAE J1850      Class B Data Communications Network Interface

SAE J1930      Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms - Equivalent to ISO/TR 15031-2

SAE J1930DA    Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms Web Tool Spreadsheet

SAE J1978      OBD II Scan Tool - Equivalent to ISO/DIS 15031-4:December 14, 2001

SAE J1979DA    Digital Annex of E/E Diagnostic Test Modes

SAE J2012      Diagnostic Trouble Code Definitions

SAE J2012DA    Digital Annex of Diagnostic Trouble Code Definitions and Failure Type Byte Definitions

SAE J2284/3    High-Speed CAN (HSC) for Vehicle Applications at 500 KBPS

SAE J2534-1    Recommended Practice for Pass-Thru Vehicle Programming

## 2.1.2 ISO Documents

Copies of these documents are available online at <http://webstore.ansi.org/>

- ISO 9141-2:1994 "Road Vehicles-Diagnostic Systems-CARB Requirements for Interchange of Digital Information", February 1994
- ISO 14230-4:2000 "Road Vehicles-Diagnostic Systems-KWP 2000 Requirements for Emission-related Systems", June 2000
- ISO 15031-1:2010 (Ed. 2) Road vehicles -- Communication between vehicle and external equipment for emissions-related diagnostics -- Part 1: General information and use case definition
- ISO 15031-2:2010 (Ed. 1) Road vehicles -- Communication between vehicle and external equipment for emissions-related diagnostics -- Part 2: Guidance on terms, definitions, abbreviations and acronyms
- ISO 15031-3:2016 (Ed. 2) Road vehicles -- Communication between vehicle and external equipment for emissions-related diagnostics -- Part 3: Diagnostic connector and related electrical circuits: Specification and use
- ISO 15031-4:2014 (Ed. 2) Road vehicles -- Communication between vehicle and external equipment for emissions-related diagnostics -- Part 4: External test equipment
- ISO 15031-5:2015 (Ed. 3) Road vehicles -- Communication between vehicle and external equipment for emissions-related diagnostics -- Part 5: Emissions-related diagnostic services
- ISO 15031-6:2015 (Ed. 3) Road vehicles -- Communication between vehicle and external equipment for emissions-related diagnostics -- Part 6: Diagnostic trouble code definitions
- ISO 15031-7:2013 (Ed. 2) Road vehicles -- Communication between vehicle and external equipment for emissions-related diagnostics -- Part 7: Data link security
- 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 – Amendment 1, February 2013

### 3. TERMS, DEFINITIONS, SYMBOLS, AND ABBREVIATED TERMS

#### 3.1 Terms and Definitions

For the purposes of this document, the terms and definitions given in SAE J1930, ISO 14229-2, ISO 14230-2, and ISO 15765-2 and the following apply.

##### 3.1.1 ABSOLUTE THROTTLE POSITION SENSOR

Value intended to represent the throttle opening

NOTE: 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, bank 1 always containing cylinder number 1, bank 2 the opposite bank.

NOTE: If there is only one bank, 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 identifying the sensors as #1, #2, and #3 in order as they move further away from the cylinder.

##### 3.1.3 BASE FUEL SCHEDULE

The fuel calibration schedule programmed into the Powertrain Control Module or PROM when manufactured or when updated by some off-board source, prior to any learned on-board correction.

##### 3.1.4 CALCULATED LOAD VALUE

For 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. Both spark ignition and compression ignition vehicles can use an alternate definition that substitutes engine torque in place of airflow in the calculation.

NOTE: This definition provides a unit-less number, 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: A tester normally makes use of other functions such as data base management, specific interpretation, man-machine interface.

##### 3.1.6 CONTINUOUS MONITORING

Sampling at a rate no less than two samples per second. 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: 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 or is not 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 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

A 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). Normally, the 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: 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: 2s complement: negative numbers are represented by complementing the binary number and then adding 1.

EXAMPLE     $-0.99 = 8001 \text{ hex} = 1000\ 0000\ 0000\ 0001 \text{ binary}$   
               $0 = 0000 \text{ hex} = 0000\ 0000\ 0000\ 0000 \text{ binary}$   
               $+0.99 = 7FFF \text{ hex} = 0111\ 1111\ 1111\ 1111 \text{ binary}$

NOTE 2:  $(-0.99) + (+0.99) = 0$ .

### 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<sub>CAN\_min</sub> 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<sub>CAN\_max</sub> 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<sub>reload</sub> TIMING PARAMETER

CAN application timing parameter with the maximum value (P2<sub>CAN\_max</sub>) for external test equipment only.

### 3.1.17 SERVER

Function that is part of an electronic control unit that provides the diagnostic services.

NOTE: This document differentiates between the server (i.e., the function) and the electronic control unit so that this document 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 purpose.

NOTE: This is also the equivalent of test mode or mode.

## 3.2 Abbreviated Terms

|            |                                                       |
|------------|-------------------------------------------------------|
| .con       | Confirmation                                          |
| .ind       | Indication                                            |
| .req       | Request                                               |
| CVN        | Calibration Verification Number                       |
| ECM        | Engine Control Module                                 |
| EI-AECD    | Emission Increasing Auxiliary Emission Control Device |
| ERR        | Error Detection Byte                                  |
| 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                                |
| NTE        | Not To Exceed                                         |
| PCM        | Powertrain Control Module                             |
| SI         | International System of Units                         |
| 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                           |

#### 4. CONVENTIONS

SAE J1979/ISO 15031 is based on the conventions specified in the OSI Service Conventions (ISO/IEC 10731) as they apply for diagnostic services.

Figure 2 - Emissions-related OBD on ISO 15765-4, SAE J1850, ISO 9141-2, ISO 14230-4 document reference according to OSI model illustrates the document references.

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. ISO 15031/SAE J1979 references the standards as an applicable data link for emissions-related OBD.

ISO 15031-5/SAE J1979 specifies the applicable emissions-related diagnostic services. This part of SAE J1979 specifies the data record structures and references the SAE J1930-DA, SAE J1979-DA, and SAE J2012-DA which include all emissions-related OBD data definitions.

## 5. DOCUMENT OVERVIEW

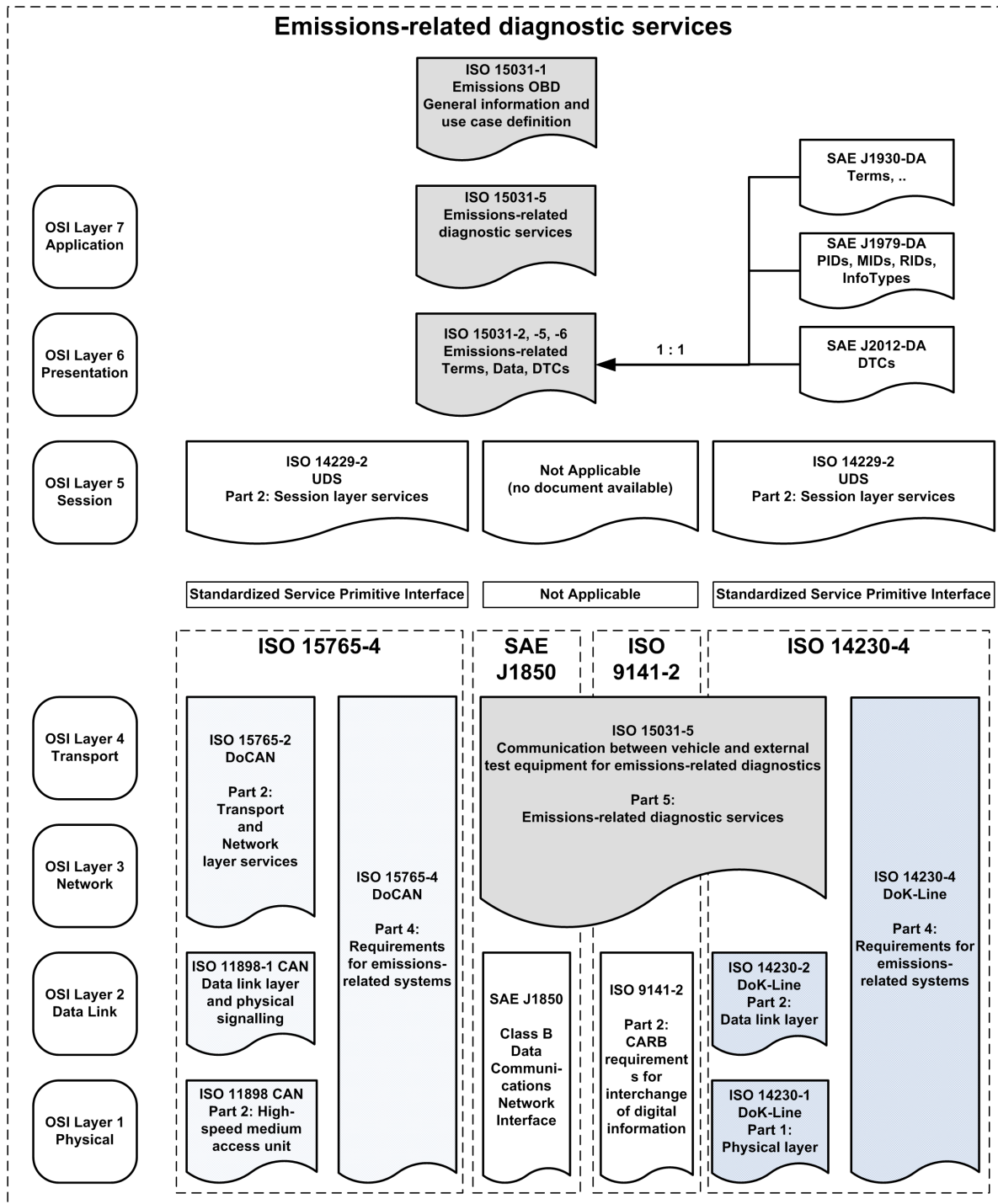


**Figure 2 - Emissions-related OBD on ISO 15765-4, SAE J1850, ISO 9141-2, ISO 14230-4 document reference according to OSI model**

## 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 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 message length limit of the 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 mean the external test equipment will request data without knowledge of which ECU(s) on the vehicle will respond. In some vehicles, multiple ECUs may 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 document shall support service \$01 and PID \$00. Service \$01 with PID \$00 is defined as the universal "initialization/keep alive/ping" message for all emissions-related OBD ECUs.

#### 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 protocol:

- P2<sub>K-line</sub>, P3<sub>K-line</sub>: P2, P3 for ISO 9141-2 and ISO 14230-4 protocols
- P2<sub>J1850</sub>: P2 for SAE J1850 protocol
- P2<sub>CAN</sub>: P2 for ISO 15765-4 protocol

**IMPORTANT** - The vehicle manufacturer is responsible to specify a shorter P2 timing window than specified in this document for each emission-related server/ECU in the vehicle 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 ISO 9141-2 application timing parameter values**

| Parameter                                       | Min Value<br>ms | Max Value<br>ms | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------|-----------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P2 <sub>K-line</sub><br>Key Bytes:<br>\$08 \$08 | 25              | 50              | Time between external test equipment request message and the successful transmission of the ECU(s) response message(s). Each OBD ECU shall start sending its response message within P2 <sub>K-line</sub> after the request message has been correctly received. Subsequent response messages shall also be transmitted within P2 <sub>K-line</sub> of the previous response message for multiple message responses.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| P2 <sub>K-line</sub><br>Key Bytes:<br>\$94 \$94 | 0               | 50              | Time between external test equipment request message and the successful transmission of the ECU response message(s). The OBD ECU shall start sending its response message within P2 <sub>K-line</sub> after the request message has been correctly received. Subsequent response messages shall also be transmitted within P2 <sub>K-line</sub> of the previous response message for multiple message responses.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| P3 <sub>K-line</sub>                            | 55              | 5000            | <p>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<sub>K-line</sub> minimum time expired.</p> <p>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.</p> |

### 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            | Min Value<br>ms | Max Value<br>ms | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------|-----------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P2 <sub>K-line</sub> | 25              | 50              | Time between external test equipment request message and the successful transmission of the ECU(s) response message(s). Each OBD ECU shall start sending its response message within P2 <sub>K-line</sub> after the request message has been correctly received. Subsequent response messages shall also be transmitted within P2 <sub>K-line</sub> of the previous response message for multiple message responses.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| P3 <sub>K-line</sub> | 55              | 5000            | <p>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<sub>K-line</sub> minimum time expired.</p> <p>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.</p> |

### 6.2.2.4 Data Link Layer Interface Adaptation

#### 6.2.2.4.1 General Information

This part of ISO 15031/SAE J1979 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: Session layer services.

**Table 4 - Mapping of T\_PDU service primitives onto DL\_PDU service primitives**

| <b>transport/network layer service primitives</b><br>(data link independent according to ISO 14229-2) | <b>DoK-Line data link layer service primitives</b><br>(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 - Mapping of T\_PDU parameter onto DL\_PDU parameter 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**

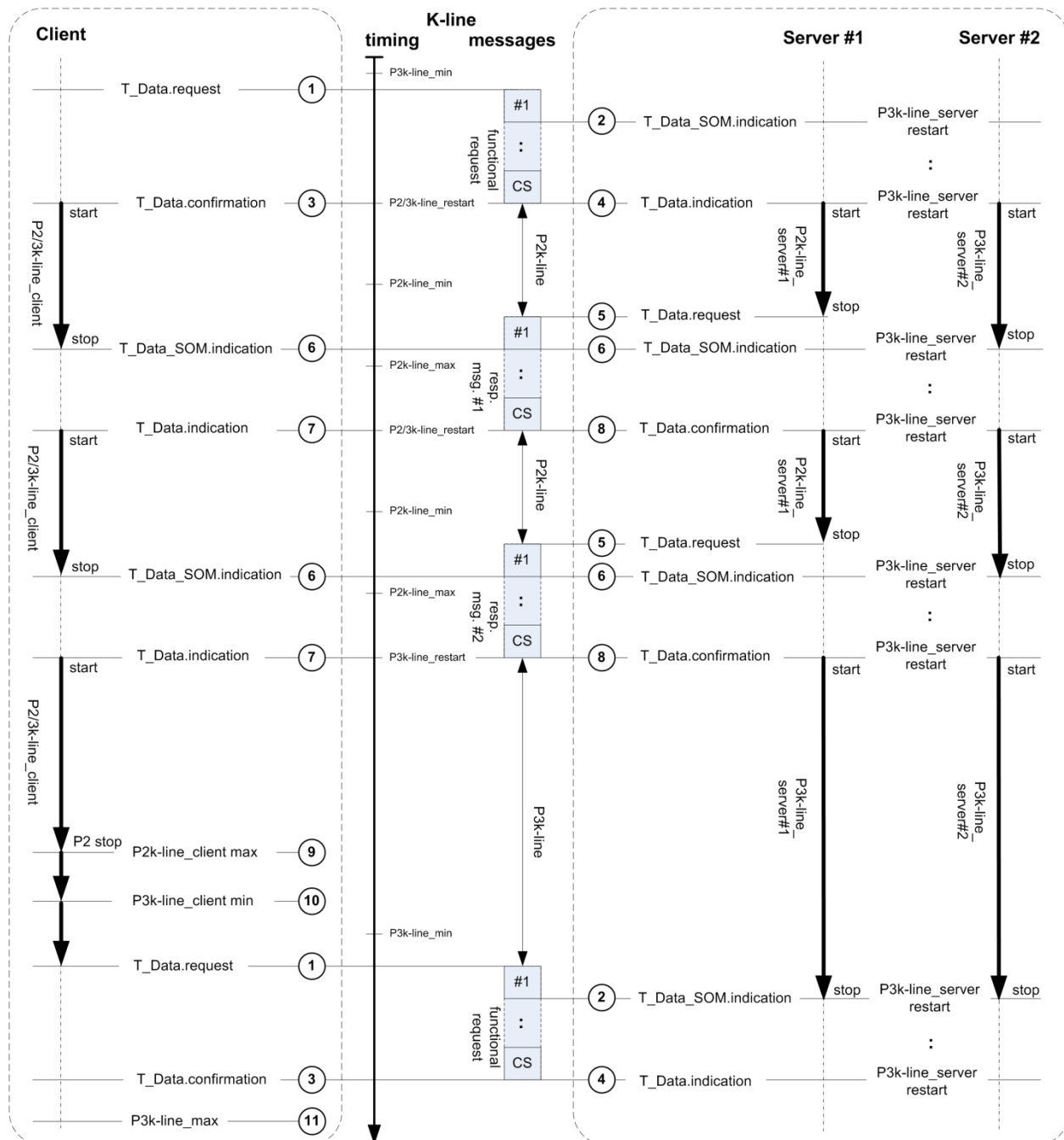
| <b>T_PDU parameter</b><br>(data link independent according to ISO 14229-2) | <b>DL_PDU parameter</b><br>(DoK-Line data link dependent according to ISO 14230-2) |
|----------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 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 sub clause 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 follows the figure that references the points marked in Figure 3.

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<sub>K-line</sub> timer value on each received byte regardless of whether the byte is part of a request message or a response message from any another server or an echo from its transmit line. There are several methods of how a server could implement the timing handling. The implementation of timing parameters is not part of this International Standard but an important system supplier responsibility. Some general server timing parameter implementation guidelines are described in this sub clause. The server time stamps each receiver interrupt event and restarts/resets the P3<sub>K-line\_server</sub> 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, the Figure 3 only shows a P3<sub>K-line\_server</sub> restart after the reception of the first byte and last byte (checksum) of a received message. The P3<sub>K-line\_server</sub> 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 0x33 address. If the server has received a complete message, it compares the target address with the 0x33 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.



- 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<sub>K-line</sub>**/**P3<sub>K-line</sub>** 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<sub>K-line</sub>** and **P3<sub>K-line</sub>** timer, using the default reload values **P2<sub>K-line\_max</sub>** and **P3<sub>K-line\_max</sub>**.
- 4 If the last message byte is received, each server checks whether the received message includes a target address which matches the 0x33 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 0x33, or if the address is a match but no response needs to be sent (server #2), the **P2** timer is stopped. Since the **P3<sub>K-line</sub>** 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<sub>K-line\_min</sub>** 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<sub>K-line</sub>** timer.

**Figure 3 - ISO 9141-2 and ISO 14230-4 protocol client and server timing behavior**

- 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<sub>K-line</sub>/P3<sub>K-line</sub> 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<sub>K-line</sub> and P3<sub>K-line</sub> timer, using the default reload values P2<sub>K-line\_max</sub> and P3<sub>K-line\_max</sub>.
- 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<sub>K-line</sub>/P3<sub>K-line</sub> 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<sub>K-line</sub> timer is restarted, but no T\_Data.indication is forwarded to the application because the target address does not match the 0x33 (target address of this message is the tester address 0xF1).
- 9 The client application detects a P2<sub>K-line\_max</sub> timeout, which indicates that all response messages from all servers are received.
- 10 The client application indicates that P3<sub>K-line\_min</sub> is reached and that the P3<sub>K-line</sub> timing window is now open to send a new request message [see 1)].
- 11 P3<sub>K-line\_max</sub> 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 behavior (continued)**

#### 6.2.2.6 Definition for SAE J1850

For SAE J1850 network interfaces, the on-board systems shall respond to a request within P2<sub>J1850</sub> 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<sub>J1850</sub> is specified in Table 6 - Definition of SAE J1850 application timing parameter values.

**Table 6 - Definition of SAE J1850 application timing parameter values**

| Parameter           | Min Value<br>ms | Max Value<br>ms | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------|-----------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P2 <sub>J1850</sub> | 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 <sub>J1850</sub> after the request message has been correctly received. Subsequent response messages shall also be transmitted within P2 <sub>J1850</sub> 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    | Min Value<br>ms | Max Value<br>ms | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------|-----------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $P2_{CAN}$   | 0               | 50              | <p>This is a system-wide parameter related to diagnostic response times. Each server (ECU) is required to respond to a request between <math>P2_{CAN\_min}</math> and <math>P2_{CAN\_max}</math>.</p> <p>A client (tester) shall wait for at least <math>P2_{CAN\_max}</math> for the single-frame (SF) or first-frame (FF) of a response.</p> <p><math>P2_{CAN}</math> 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.</p> <p>For clients (testers) which also support UDSONCAN for enhanced diagnostics, a <math>P2_{reload}</math> mechanism is required. Upon receiving the SF or FF the client (tester) shall reload its <math>P2_{CAN}</math> timer with a value of at least <math>P2_{CAN\_max}</math> and restart the timer. Once the client's (tester's) <math>P2_{CAN}</math> timer expires without receiving a SF or FF the client (tester) may assume no more responses are forthcoming.</p> |
| $P2^*_{CAN}$ | 0               | 5000            | <p>Time between the successful reception of a negative response message with NRC 0x78 and the next response message (positive or negative message).</p> <p>See Table 11 for a list of which services support the use of NRC 0x78.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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/SAE J1979 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 - Mapping of  $T\_PDU$  service primitives onto  $N\_PDU$  service primitives specifies the mapping interface between the ISO 15765-2 DoCAN Part 2: Transport protocol and network layer services and the ISO 14229-2 UDS Part 2: Session layer services.

**Table 8 - Mapping of T\_PDU service primitives onto N\_PDU service primitives**

| <b>transport/network layer service primitives</b><br>(data link independent according to ISO 14229-2) | <b>DoCAN network layer service primitives</b><br>(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 - Mapping of T\_PDU parameter onto N\_PDU parameter 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.).

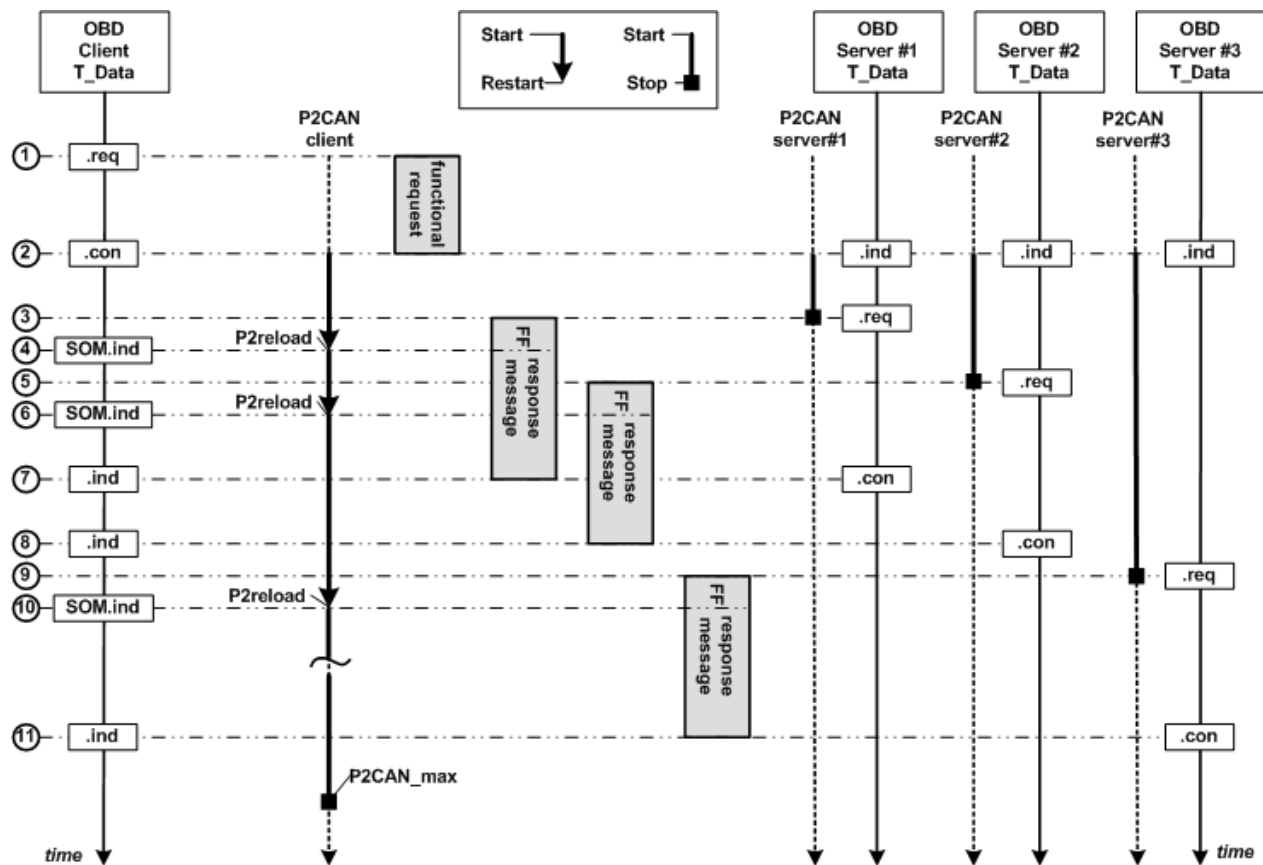
**Table 9 - Mapping of T\_PDU parameter onto N\_PDU parameter**

| <b>T_PDU parameter</b><br>(data link independent according to ISO 14229-2) | <b>N_PDU parameter</b><br>(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

Figure 4 graphically depicts the timing handling in the client and three (3) servers for a functionally addressed request message during the default session. A description follows the figure that references the points marked in Figure 4.

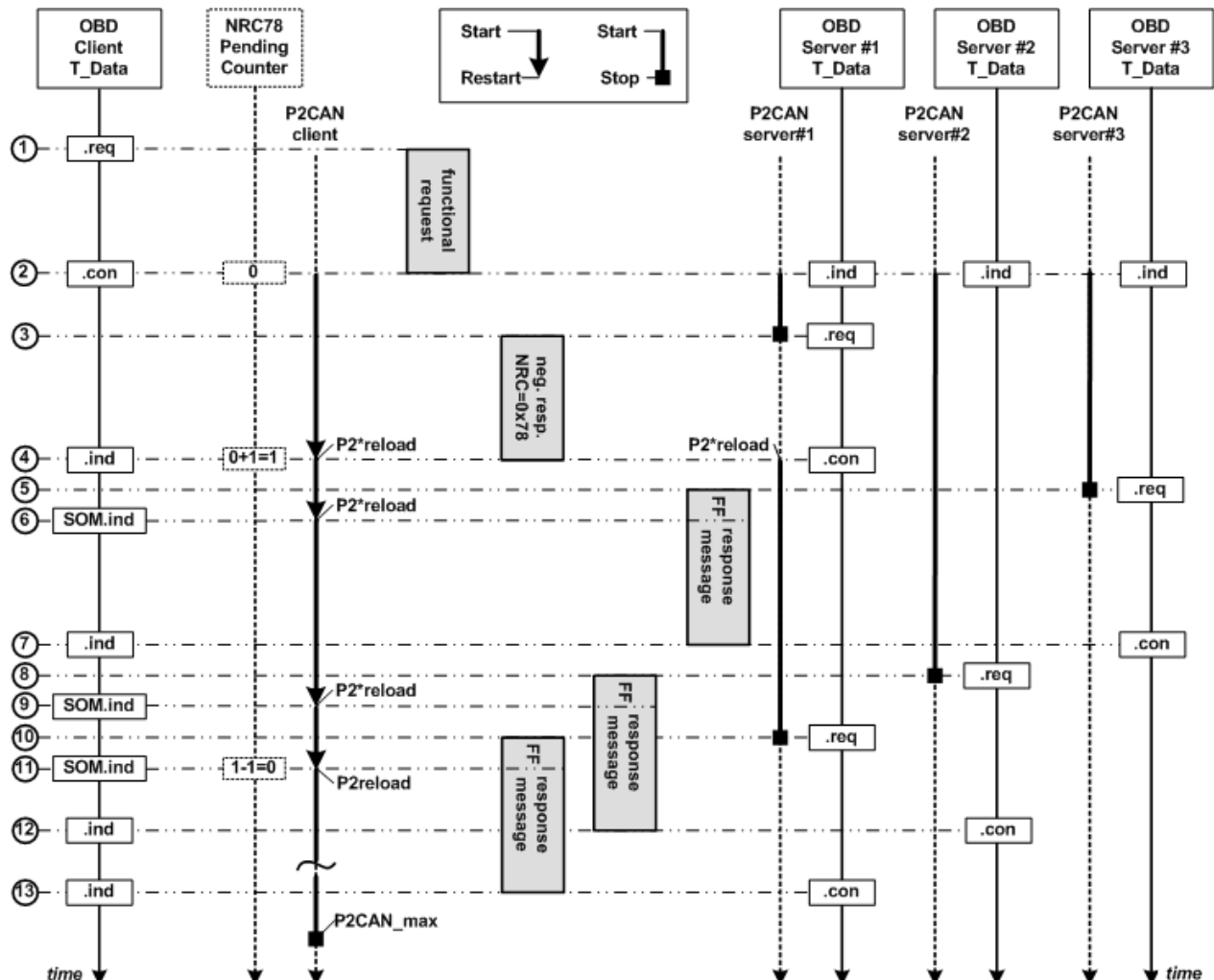


- 1 **Client T\_Data.req:** diagnostic application issues functionally addressed request message to network layer.
- 2 **All server T\_Data.ind:** network layer issues to diagnostic application the reception of a request message. All servers start the  $P2_{CAN\_Server}$  timer using the value of  $P2_{CAN} = P2_{CAN\_max}$ .  
**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 graphically depicts 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 a NRC \$78. A description follows the figure that references the points marked in Figure 5.



- 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 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. 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 = 0x78 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 = 0x78 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\_Data.SOM.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\_Server.

Figure 5 - Functional OBD communication - enhanced response timing

- 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  $P2_{CAN}$  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 (continued)**

### 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.

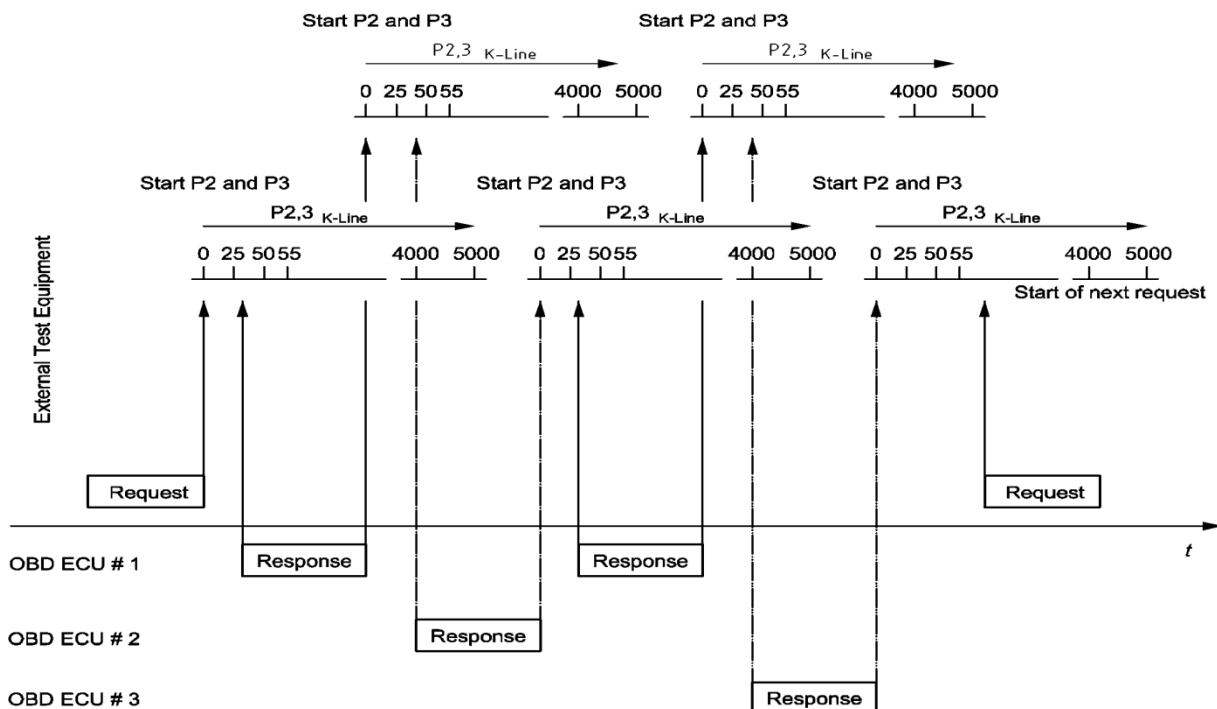


**Figure 6 - ISO 9141-2 (Key Bytes: 0x08 0x08) and ISO 14230-4 application timing parameter overview**

### 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 shows an example of a request message followed by four (4) response messages and another request message.

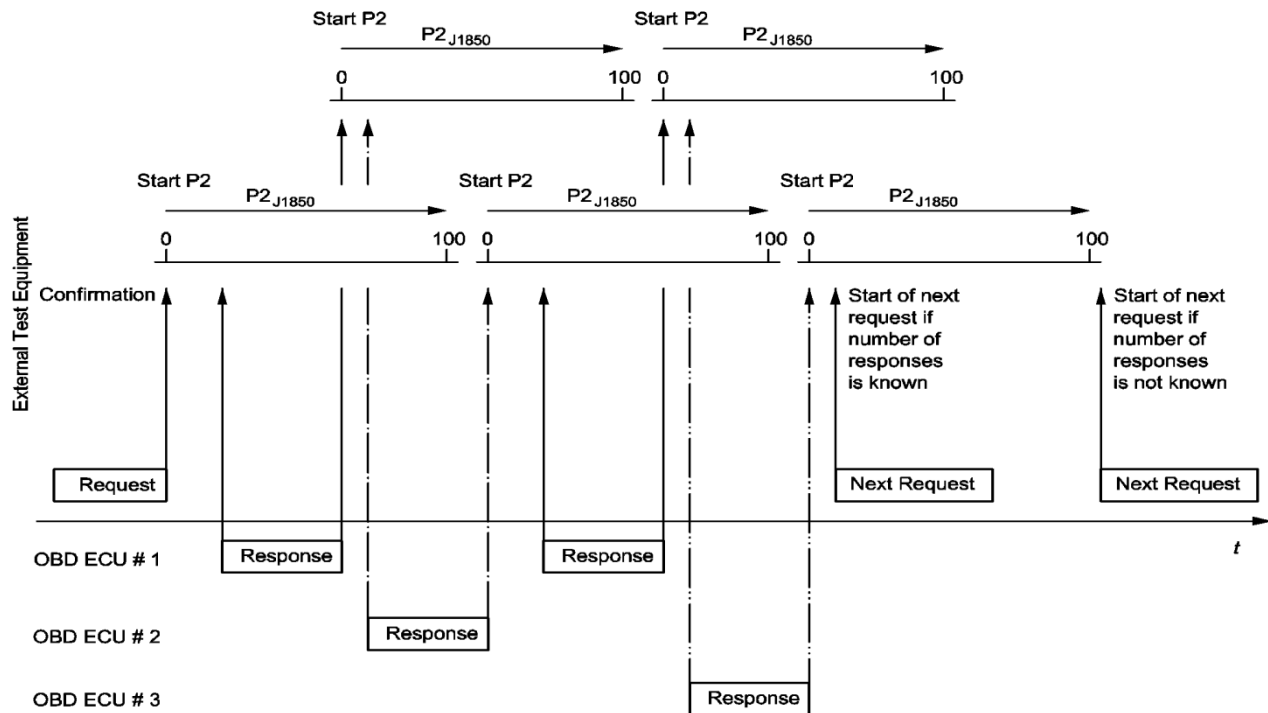


**Figure 7 - SAE J1850 application timing parameter overview**

### 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 \$01, PID \$00), 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 shows 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.

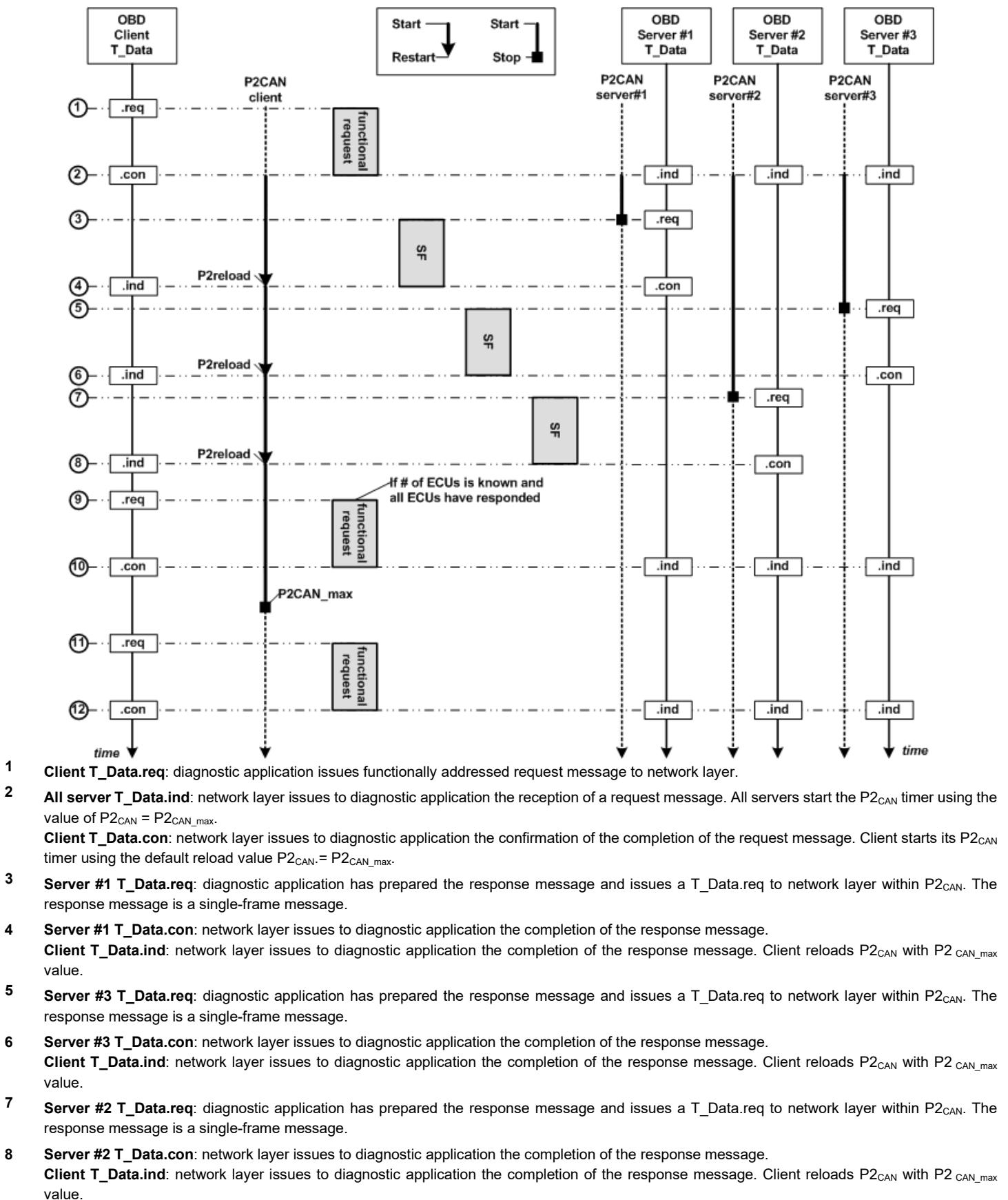


**Figure 8 - ISO 15765-4 application timing parameter (single frame response messages) overview**



- 9 **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  $P2_{CAN\_Server}$  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 (continued)**

Figure 9 shows 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.

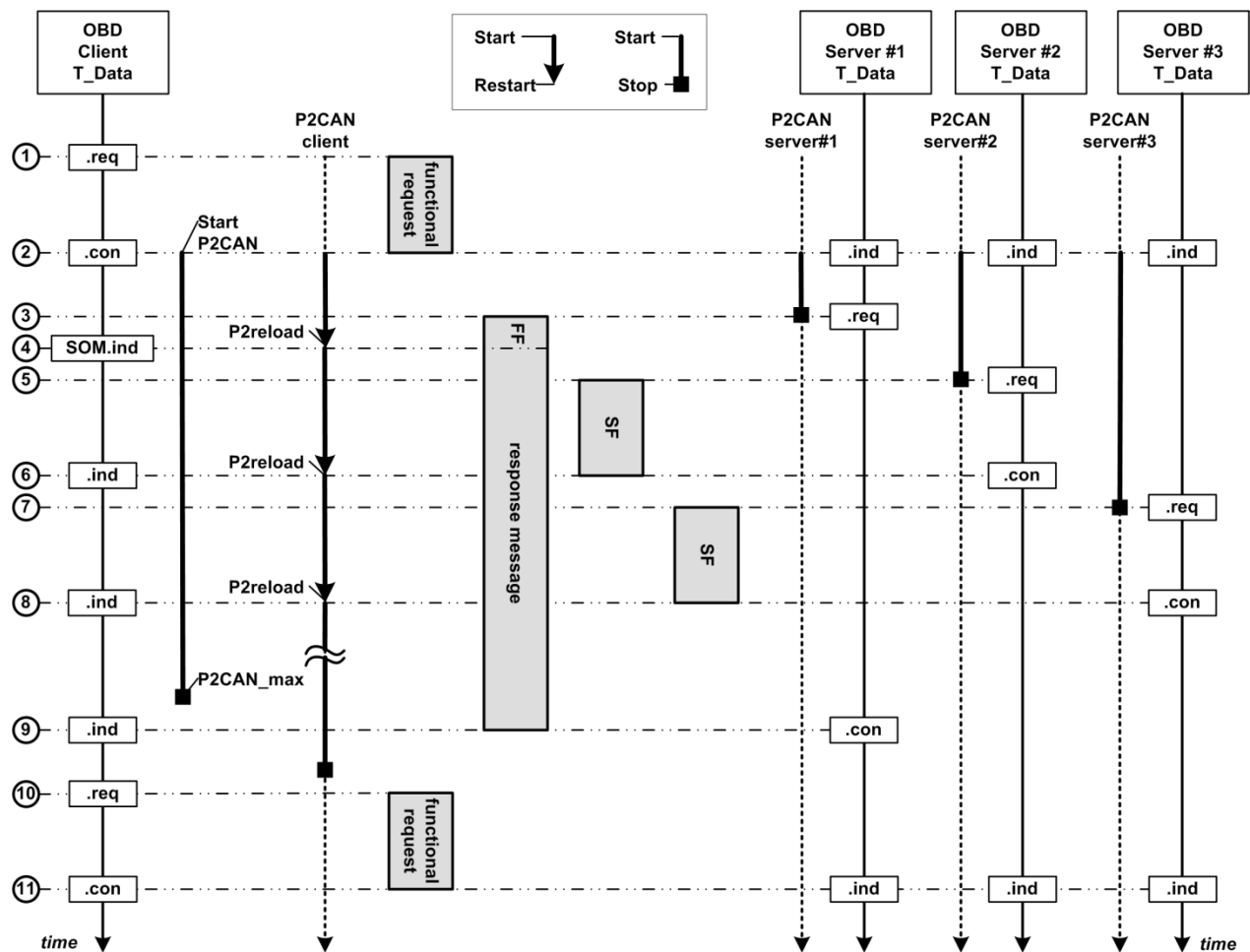
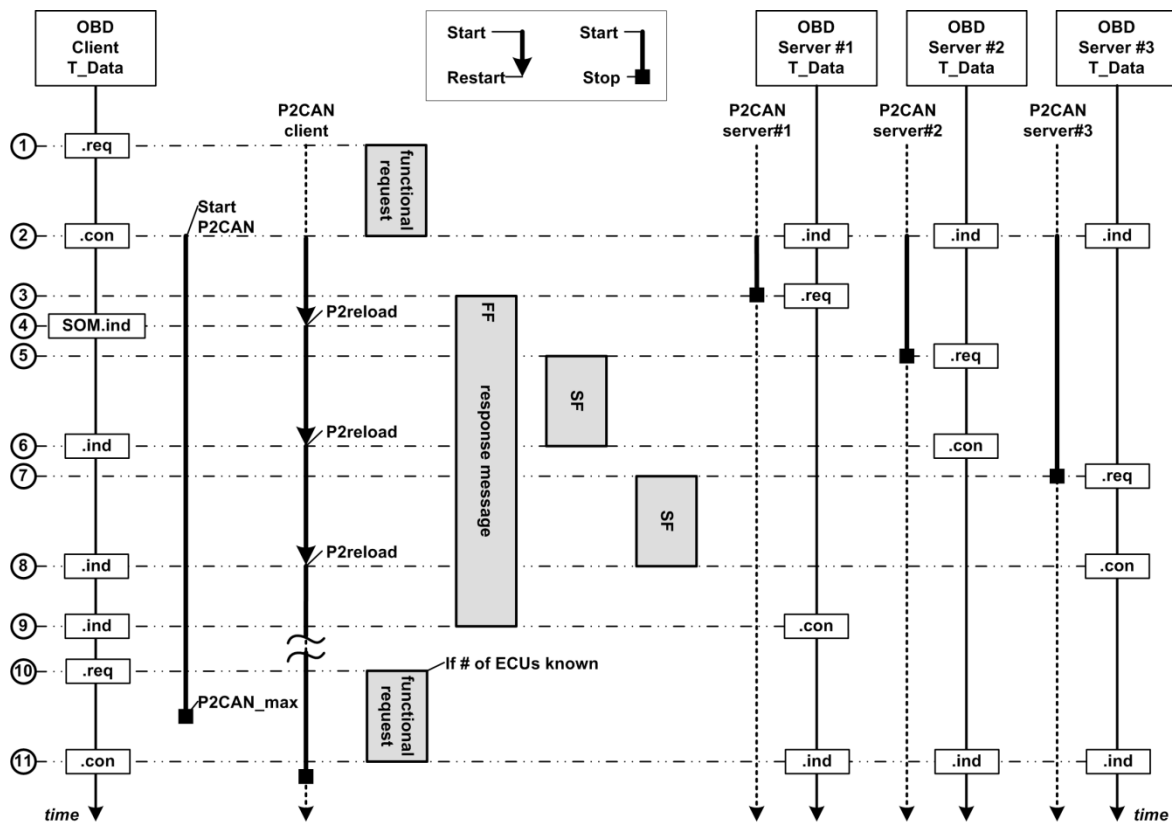


**Figure 9 - ISO 15765-4 functional OBD on CAN communication -  
Multiple frame response messages not finished within  $P2_{CAN}$**

- 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  $P2_{CAN\_Server}$  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 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  $P2_{CAN\_Server}$  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 OBD on CAN communication -  
Multiple frame response messages not finished within  $P2_{CAN}$  (continued)**

Figure 10 shows an example of a request message followed by one (1) multiple frame response message and two (2) single frames, (completion within  $P2_{CANmax}$ ) 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.



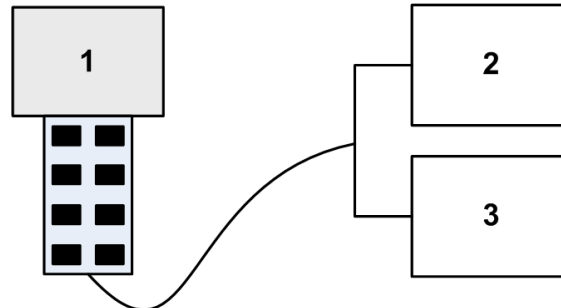
- 1 **Client T\_Data.req:** diagnostic application issues functionally addressed request message to network layer.
- 2 **All server T\_Data.ind:** network layer issues to diagnostic application the reception of a request message. All servers start the  $P2_{CAN}$  timer using the value of  $P2_{CAN} = P2_{CAN\_max}$ .  
**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  $P2_{CAN\_max}$ .
- 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\_Data.SOM.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  $P2_{CAN\_Server}$  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  $P2_{CAN\_max}$ .

**Figure 10 - ISO 15765-4 functional OBD on CAN 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 Behavior to a Request for Supported/non-supported OBD Information

Figure 11 shows 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 \$01 and PID \$00 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 5.2.3.3).

#### 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 is not available. One condition is that the service is not supported, and the other is that the service is supported but data is 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 to not 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 may not always be available when requested. For Services \$05 and \$06, if the test has not been run since test results were cleared, or for Service \$02 if freeze frame data has not been stored, or for Service \$09 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 is invalid (ISO 9141-2 and SAE J1850 only). The functional description for these services discusses the method to determine if the data is valid.

#### 6.2.4.2 ISO 15765-4 - Data Not Available

There are five (5) conditions for which data is 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 is 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 is 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 response code \$22 - ConditionsNotCorrect (negative response message format is specified in 6.3.3.4). For Services \$01, \$02, \$03, \$06, \$07 and \$0A the use of a negative response message including response code \$22 is not permitted. For Services \$04, \$08 and \$09 the use of a NRC \$22 is allowed. Use of \$22 for Service \$09 CVN request may be restricted by OBD regulations.
- d. **Request message is supported but data is not available within P2 timing:** The behavior 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 behavior of the ECU(s) and the external test equipment is specified in 6.2.4.3. For Services \$04 and \$09 the use of a NRC \$78 is allowed.

#### 6.2.4.3 Data Not Available Within P2 Timing

##### 6.2.4.3.1 Overview

The following sub clauses specify the request/response message handling for each protocol if the data is not available within the P2 timing in the ECU(s). The description in the sub section only applies to Service \$09, InfoType \$06 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:

- a. If the response message is not received within P2<sub>K-Line</sub>, the external test equipment shall stop retrying the request message after 1 minute from the original request.
- b. The retry message shall be sent at least every 4 seconds (between 55 and 4000 ms). The retry message keeps the bus alive and prevents the external test equipment from having to re-initialize the bus (P3<sub>K-Line</sub> time out).
- c. 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.
- d. The external test equipment shall record if all ECUs have sent the expected number of response messages.
- e. 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.

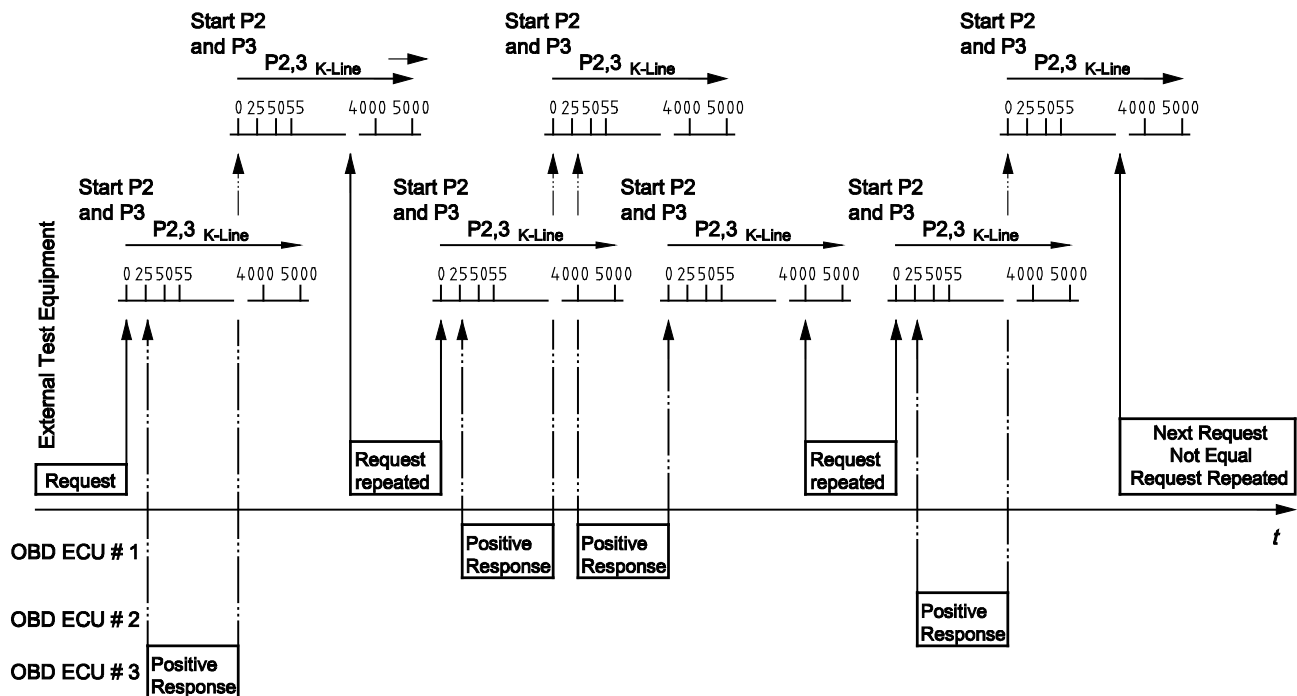


**Figure 12 - ISO 9141-2 (Key Bytes: 0x08 0x08)**  
**Data not available within P2 timing handling overview**

For the ISO 9141-2 protocol the response message timing  $P2_{K-Line}$  shall be according to Table 2 – Definition of ISO 9141 application of timing parameter values. The  $P2_{K-line\_min}$  application timing parameter value depends on the Key Bytes as listed:

- Key Bytes: 0x08 0x08:  $P2_{K-line\_min} = 25 \text{ ms}$
- Key Bytes: 0x94 0x94:  $P2_{K-line\_min} = 0 \text{ ms}$

#### 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 response code \$78 - 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 response code \$78 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.

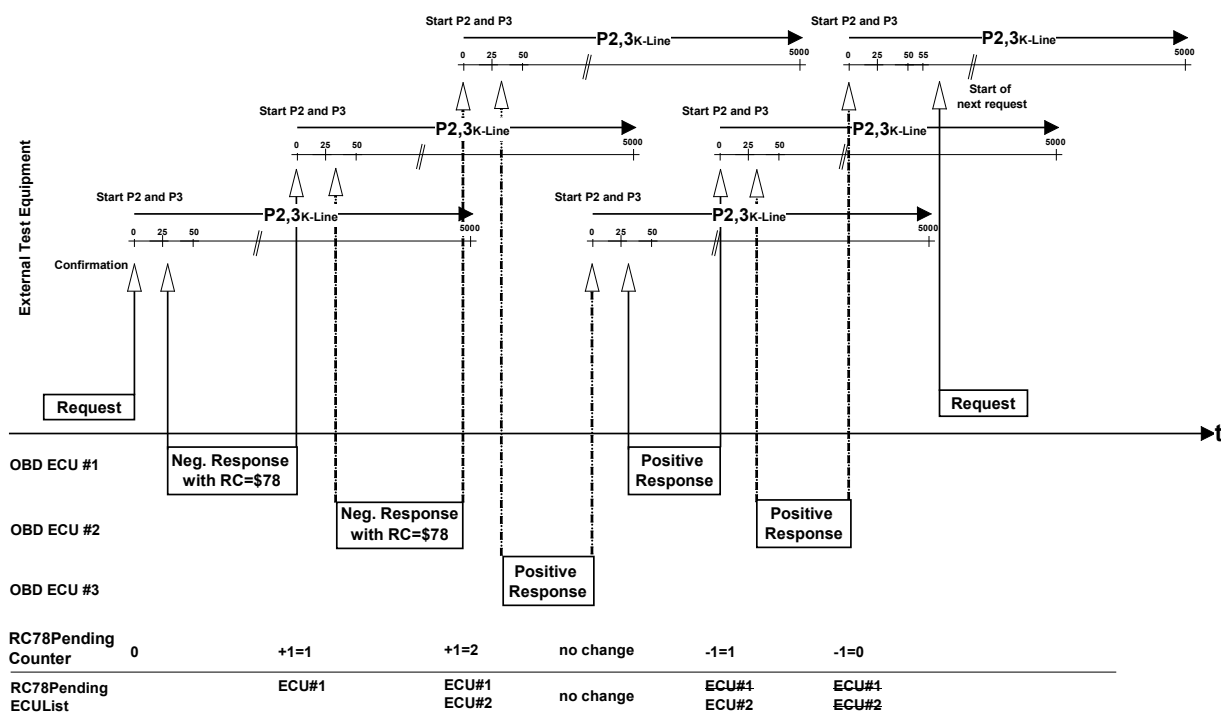


Figure 13 - ISO 14230-4 - NRC \$78 handling overview

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<sub>J1850</sub>, the external test equipment shall wait 30 seconds ± 1 second and then retry the request message.
- b. The retry message shall be stopped after 1 minute from the original request.
- c. The external test equipment shall record if all ECUs have sent the expected number of response messages.

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

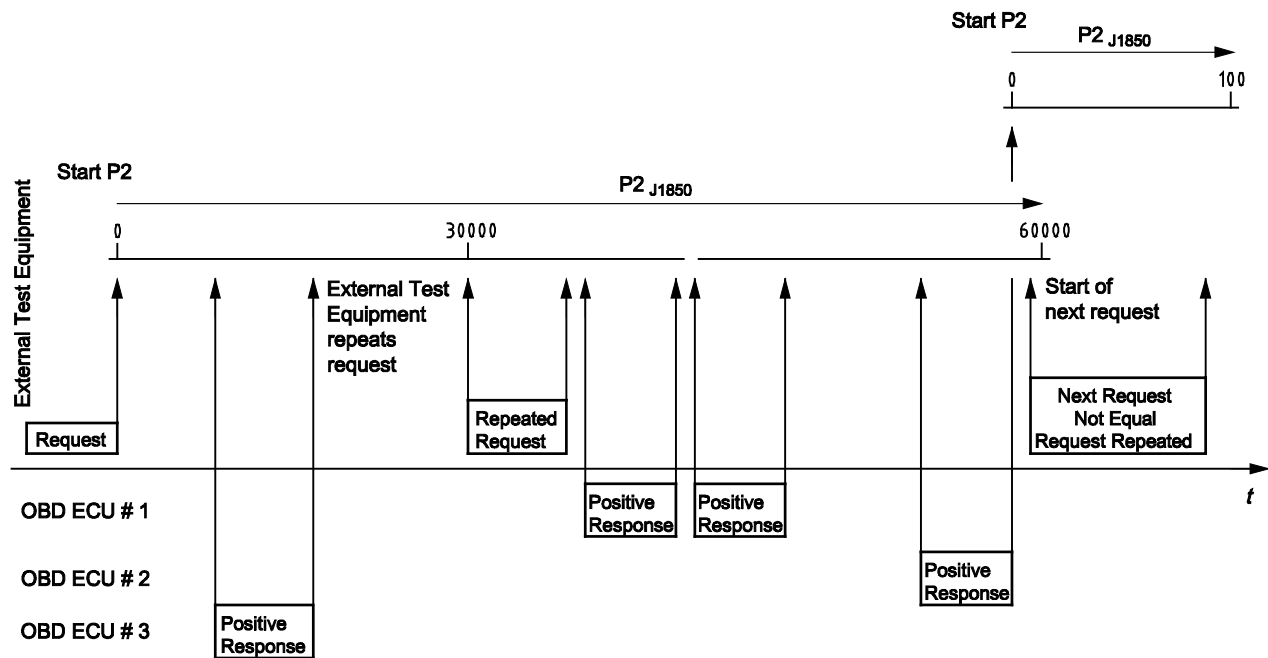


**Figure 14 - SAE J1850 - Data not available within P2 timing handling overview**

#### 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 is not available:

- Service is not supported.
- Service is supported but data is 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 or \$0A-\$0F | Unsupported                                       | The ECU shall not respond                                                                                                                                                                                                                       | The ECU shall not respond                                                                                                                                                                                                                       | ECU can either not respond<br><b>or</b><br>send a negative response                                                                                                                                                                                                 | \$11 |
| \$01              | Not supported                                     | All ECUs must respond to Service \$01 PID \$00 if Service \$01 is supported. If Service \$01 is not supported, no response is allowed.                                                                                                          | All ECUs must respond to Service \$01 PID \$00 if Service \$01 is supported. If Service \$01 is not supported, no response is allowed.                                                                                                          | All ECUs must respond to Service \$01 PID \$00 if Service \$01 is supported. If Service \$01 is not supported, ECU can either not respond<br><b>or</b><br>send a negative response                                                                                  | \$11 |
|                   | Unsupported PID requested                         | No response preferred, positive response is allowed                                                                                                                                                                                             | No response preferred, positive response is allowed                                                                                                                                                                                             | ECU can either not respond<br><b>or</b><br>send a negative response                                                                                                                                                                                                 | \$12 |
|                   | Supported PID requested                           | Positive response is required                                                                                                                                                                                                                   | Positive response is required                                                                                                                                                                                                                   | Positive response is required                                                                                                                                                                                                                                       | N/A  |
| \$02              | Not supported                                     | The ECU shall not respond                                                                                                                                                                                                                       | The ECU shall not respond                                                                                                                                                                                                                       | ECU can either not respond<br><b>or</b><br>send a negative response                                                                                                                                                                                                 | \$11 |
|                   | Supported PID requested, no Freeze Frame stored   | PID \$02 indicates \$0000, but if PIDs are requested, ECU can either not respond or send invalid data, except if supported PIDs (\$00, \$20, ...) have been requested, then the ECU shall send a response with the supported PID and data bytes | PID \$02 indicates \$0000, but if PIDs are requested, ECU can either not respond or send invalid data, except if supported PIDs (\$00, \$20, ...) have been requested, then the ECU shall send a response with the supported PID and data bytes | PID \$02 indicates \$0000, but if PIDs are requested, ECU can either not respond<br><b>or</b><br>send a negative response, except if supported PIDs (\$00, \$20, ...) have been requested, then the ECU shall send a response with the supported PID and data bytes | \$12 |
|                   | 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<br><b>or</b><br>send a negative response                                                                                                                                                                                                 | \$12 |
|                   | 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<br><b>or</b><br>send a negative response                                                                                                                                                                                                 | \$12 |
| \$03 /\$07        | Not supported                                     | The ECU shall not respond                                                                                                                                                                                                                       | The ECU shall not respond                                                                                                                                                                                                                       | ECU can either not respond<br><b>or</b><br>send a negative response                                                                                                                                                                                                 | \$11 |
|                   | 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              | Not supported                                     | The ECU shall not respond                                                                                                                                                                                                                       | The ECU shall not respond                                                                                                                                                                                                                       | ECU can either not respond<br><b>or</b><br>send a negative response                                                                                                                                                                                                 | \$11 |
|                   | Supported, conditions not correct                 | The ECU shall not respond                                                                                                                                                                                                                       | The ECU shall not respond                                                                                                                                                                                                                       | Negative response is required                                                                                                                                                                                                                                       | \$22 |
|                   | Supported, conditions correct                     | Positive response is required                                                                                                                                                                                                                   | Positive response is required                                                                                                                                                                                                                   | Positive response is required                                                                                                                                                                                                                                       | N/A  |

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

|            |                                                                                                       |                                                                                                                                                 |                                                                                                                                                 |                                                                                                                                                                |
|------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| \$05 /\$06 | Not supported                                                                                         | The ECU shall not respond                                                                                                                       | The ECU shall not respond                                                                                                                       | ECU can either not respond <b>or</b> send a negative response \$11                                                                                             |
| \$05 /\$06 | 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 <b>or</b> send invalid data or send negative response \$12                                                   |
|            | 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 <b>or</b> send a negative response \$12                                                                                             |
|            | 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 <b>or</b> send a negative response \$12                                                                                             |
| \$08       | Not supported                                                                                         | The ECU shall not respond                                                                                                                       | The ECU shall not respond                                                                                                                       | ECU can either not respond <b>or</b> send a negative response \$11                                                                                             |
|            | 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 <b>or</b> may respond with a manufacturer-specified value as DATA A which corresponds to the reason the test cannot be run. \$22 |
|            | Unsupported TID requested                                                                             | No response preferred, positive response is allowed                                                                                             | No response preferred, positive response is allowed                                                                                             | ECU can either not respond <b>or</b> send a negative response \$12                                                                                             |
| \$09       | Not supported                                                                                         | The ECU shall not respond                                                                                                                       | The ECU shall not respond                                                                                                                       | ECU can either not respond <b>or</b> send a negative response \$11                                                                                             |
|            | Supported INFOTYPE requested, data available (VIN, CVN, CALID)                                        | Positive response is required                                                                                                                   | Positive response is required                                                                                                                   | Positive response is required N/A                                                                                                                              |
|            | Supported INFOTYPE requested, data not available, conditions correct (CVN)                            | Respond within 1 minute; do not restart CVN calculation. Test tool sends retry message every 0.055 to 4.0 seconds                               | Respond within 1 minute; do not restart CVN calculation. Test tool sends retry message after 30 seconds                                         | One or multiple negative response message(s) required within P2max (25 – 50 ms) until positive response is sent \$78                                           |
|            | 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                                                                                                                             |
|            | Unsupported INFOTYPE requested                                                                        | No response preferred, positive response is allowed                                                                                             | No response preferred, positive response is allowed                                                                                             | ECU can either not respond <b>or</b> send a negative response \$12                                                                                             |

Note – ISO9141-2 and SAE J1850 do not support NRCs.

Note – Negative response structure follows the scheme: \$7F, ServiceID, NRC (e.g., \$7F, \$01, \$11)

**Documents**

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