SURFACE VEHICLE STANDARD

J1979™-3 DEC2022

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E/E Diagnostic Test Modes: Zero Emission Vehicle Propulsion Systems on UDS (ZEVonUDS)

RATIONALE

Due to regulatory adoption of OBDonUDS, SAE J1979 now becomes a multiple part document series:

1. SAE J1979, which defines diagnostic test modes for OBDonEDS used for emissions OBD.
2. SAE J1979-2, which defines the diagnostic services for OBDonUDS used for emissions OBD.
3. SAE J1979-3 (ZEVonUDS), which defines the diagnostic services for electric, fuel cell, and other zero emissions propulsion systems.

Market regulations specify which data links are allowed for sale in a given market.

FOREWORD

SAE J1979-3 specifies diagnostic services required to be supported by motor vehicles and external test equipment for diagnostic purposes which pertain to Zero Emission Vehicle (ZEV) propulsion 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.

ZEVonUDS provides an implementation guidance based on the principles of ISO 14229, focusing on standardization of data to ensure access to important repair information by independent repair facilities. Other requirements such as SAE J1979-2 include many functions that are unnecessary for ZEVs. The purpose of this standard is to focus on providing the necessary content and performance requirements for ZEV powertrain communications. ZEVonUDS diagnostic requirements can be satisfied over either CAN or Ethernet datalinks. SAE J1979-3 provides references to ISO 14229-1 and SAE J1979-2 services. Unreferenced UDS features are optional provided they do not interfere with required services specified in this document.

This requirement applies to all ECUs that provide operational data and diagnoses those components that are integral to provide propulsion on a ZEV. In general, if an ECU monitors a component whose failure directly affects the ZEV propulsion system, it shall be reported using SAE J1979-3 standardization.

Examples of SAE J1979-3 covered subsystems are:

- Traction drive motors and their inverters.
- Energy storage systems.
- High voltage charging systems (including components whose failures impact regenerative braking).
- Thermal control systems supporting propulsion (i.e., battery cooling pumps and sensors).

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A government agency may have policy reasons for specifically tracking ZEV componentry (i.e., unique warranty requirements). In order to track the linkage between a diagnostic trouble code and a covered repair under a ZEV component warranty, provisions are made in this document to highlight those failures that are ZEV propulsion related. These linkages can be thought of analogously to emissions related failures requiring emissions related warranty repair. The service used to highlight failures that are propulsion related is UDS Service 0x19 Subfunction 0x42.

When referencing other documents to fulfil this set of requirements, the reader should substitute “emissions related” for “ZEV propulsion related.” Global regulations may vary in the definition of ZEV propulsion componentry; therefore, the applicability of this document to various components may vary from region to region.

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1. SCOPE

1.1 Introduction

SAE J1979-3 describes the communication between the zero emissions propulsion systems and test equipment required by government regulations. Standardization 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.

To achieve this, SAE J1979-3 is based on the Open Systems Interconnection (OSI) Basic Refer to 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:

- Application (layer 7), specified in:
  - ISO 14229-1, ISO 14229-3 UDSonCAN, or ISO 14229-5 UDSonIP
  - SAE J1979-3 ZEVonUDS
- Presentation layer (layer 6), specified in:
  - SAE J1930, SAE J1930DA
  - SAE J1979DA
  - SAE J2012, SAE J2012DA
  - SAE J1939DA, SAE J1939-73
- Session layer services (layer 5), specified in:
  - ISO 14229-2
- Transport layer services (layer 4), specified in:
  - DoCAN: ISO 15765-2 Transport protocol and network layer services
  - ISO 15765-4 Requirements for emissions related systems
  - DoIP: ISO 13400-2 Road vehicles - Diagnostic communication over Internet Protocol (DoIP) - Part 2: Transport protocol and network layer services
- Network layer services (layer 3), specified in:
  - DoCAN: ISO 15765-2 Transport protocol and network layer services
  - ISO 15765-4 Requirements for emissions related systems
  - DoIP: ISO 13400-2 Road vehicles - Diagnostic communication over Internet Protocol (DoIP) - Part 2: Transport protocol and network layer services
- Data link layer (layer 2), specified in:
  - DoCAN: ISO 15765-4, ISO 11898-1, -2
  - DoIP: ISO 13400-3 Road vehicles - Diagnostic communication over Internet Protocol (DoIP) - Part 3: Wired vehicle interface based on IEEE 802.3

- Physical layer (layer 1), specified in:
  - DoCAN: ISO 15765-4, ISO 11898-1, -2, in accordance with Table 1
  - DoIP: ISO 13400-3 Road vehicles - Diagnostic communication over Internet Protocol (DoIP) - Part 3: Wired vehicle interface based on IEEE 802.3
  - ISO 13400-4 Road vehicles - Diagnostic communication over Internet Protocol (DoIP) - Part 4: Ethernet-based high-speed data link connector
  - SAE J1962 Diagnostic Connector

NOTE: SAE J1979-3 provides a standard to satisfy known country-specific certification regulations. SAE J1979-3 is not considered a final authority for interpretation of the certification regulations, so users of this document should determine the applicability of capabilities defined in this document for their specific OBD regulatory requirements

Table 1 - Regulated diagnostic specifications applicable to the OSI layers

<table>
<tr><th>Applicability</th><th>OSI 7 Layers</th><th colspan="3">Regulated ZEV Communication Requirements Based on UDS</th></tr>
<tr><td rowspan="7">Seven layer according to ISO/IEC 7498-1 and ISO/IEC 10731</td><td>Application (layer 7)</td><td colspan="3">ISO 14229-1, ISO 14229-3, ISO 14229-5, SAE J1979-3</td></tr>
<tr><td>Presentation (layer 6)</td><td colspan="3">SAE J1930DA, SAE J1979DA, SAE J2012DA, SAE J1939DA</td></tr>
<tr><td>Session (layer 5)</td><td colspan="3">ISO 14229-2</td></tr>
<tr><td>Transport (layer 4)</td><td rowspan="2">ISO 15765-2</td><td rowspan="3">ISO 15765-4</td><td rowspan="2">ISO 13400-2</td></tr>
<tr><td>Network (layer 3)</td></tr>
<tr><td>Data link (layer 2)</td><td rowspan="2">ISO 11898-1, -2</td><td rowspan="2">ISO 13400-3</td></tr>
<tr><td>Physical (layer 1)</td></tr>
</table>

1.1.1 SAE Document Reference Concept

SAE J1979-3 references several SAE documents which contain all terms, data, and DTC definitions.

See Figure 1, with the following definitions:

- SAE J1930 defines a procedure for naming objects and systems and with the set of words from which names are built. It references SAE J1930DA, which contains all standardized naming objects, terms, and abbreviations.
- SAE J1979DA contains all standardized data items for OBD diagnostics communications including PIDs, Test IDs, Monitor IDs, and InfoType IDs. Many data items are augmented with user notes for calculation and display. Usage notes for clearing fault codes and combining diagnostic events are also provided for diagnostic executive design.
- SAE J2012 defines the procedure for defining emissions-related diagnostic trouble codes. It references SAE J2012DA, which contains all standardized data items like DTCs and FTBs.
- SAE J1939DA contains all standardized SPNs, which can be used as DTCs for HDV/MDV applications.
- SAE J1939-73 Appendix A defines Failure Mode Indicators (FMIs).

Key:

1. SAE digital annexes.

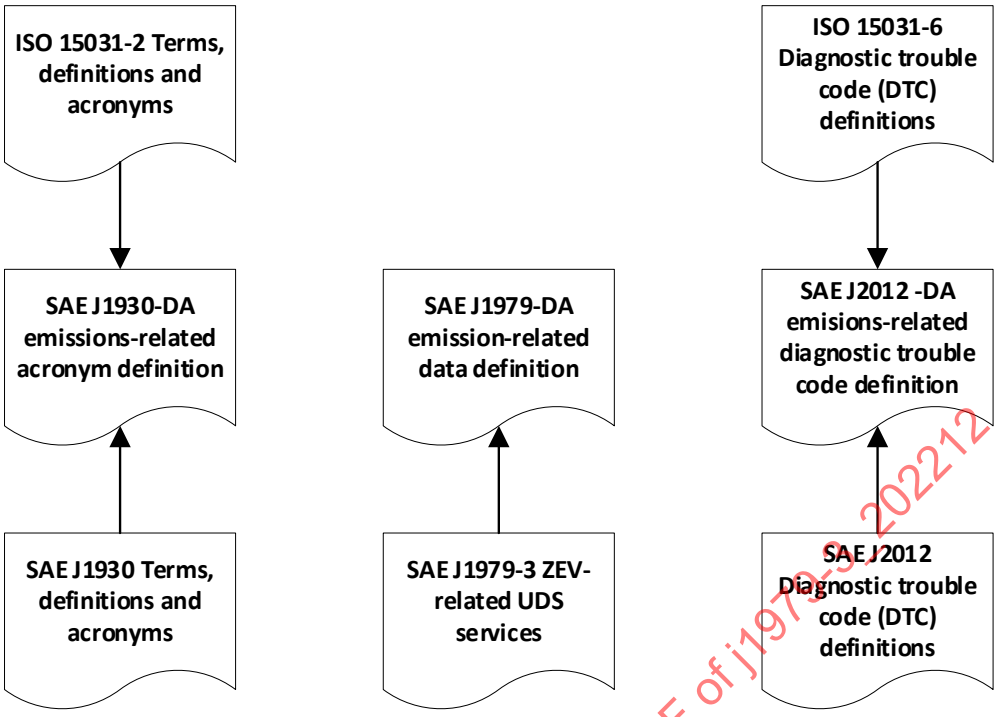

Figure 1 - SAE digital annex document reference

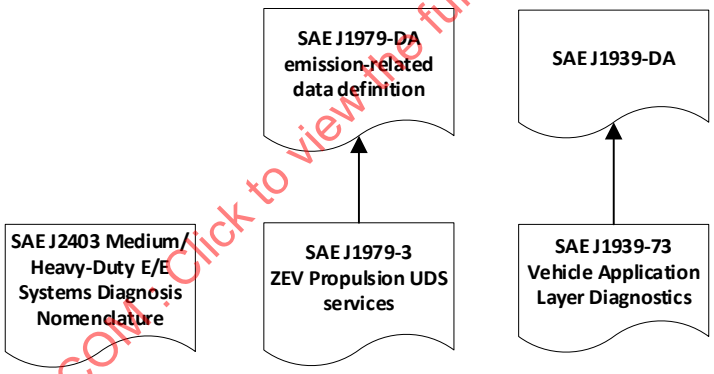

Figure 2 - SAE J1979-3 SAE document reference for MDV/HDV utilizing SAE J1939

1.1.2 SAE J1979DA (Digital Annex)

This document references SAE J1979DA. SAE J1979DA is concerned with the definition of:

- Data Identifiers (DIDs)
  - Parameter Identifiers (PIDs)
  - Info Types (ITIDs)
- Routine Identifiers (RIDs)

1.1.3 SAE Digital Annex Revision Procedure

New ZEV regulatory requirements require monitoring of the componentry that facilitates zero emission transportation. New ZEV technology parameters 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 who are represented by members of the appropriate SAE task force.

SAE J1979-3 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 J1979DA. 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 SAE J1979-3 can be obtained on the Registration Authority's website at: https://standardsworks.sae.org/standards-committees/j1979-review-task-force.

Located within the overview tab in the public resources section, a document with the title: *J1979DA Revision Request Form* is available for change requests. Click on the name to download the document.

Fill out the revision request form with your request.

Please send an email with the completed revision request form as an attachment to: saej1979@sae.org.

Those users who use SAE_J1939-73_DTCFormat to communicate DTCs may also request new Suspect Parameter Number (SPN) values from the SAE Truck and Bus Control and Communications Network Committee. Request forms are available to the public at the committee's SAE Standards Works webpage. The webpage, which can be found at https://standardsworks.sae.org/standards-committees/truck-bus-control-communications-network-committee, provides the following forms:

- Request Processing Guidelines
- General Request Form
- Bulk Request Form

The index of SPN assignments is published quarterly in SAE J1939DA. SAE J1939DA includes all the SPN labels defined in SAE J2403 and SAE J2403DA. SAE J1939DA also defines a range of manufacturer proprietary SPNs that are occasionally used for diagnostic conditions that do not map unambiguously into the standardized list of SPNs.

1.2 Document Scope

This document is intended to satisfy the data reporting requirements of standardization regulations in the United States and Europe, and any other market 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.

e. Standardized source and target addresses for clients and vehicle.

This document includes capabilities required to satisfy OBD requirements for multiple regions, model years, engine types, and vehicle types. At the time of publication many regional regulations are not yet final 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 J1979-3 specifies diagnostic services, and both functionally addressed and physically 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 ZEV propulsion-related information from the vehicle.

The structure of this document is based on the structure of SAE J1979 for the convenience of users familiar with SAE J1979. Each section of this part of SAE J1979-3 which specifies additional detail to existing sections of ISO 15765-4 and SAE J1979 supersedes those specifications for their use under the scope of SAE J1979-2. When applicable, a reference to respective sections in SAE J1979-2 is made in this document.

SAE J1979-3 references SAE J1979DA, which includes all Data Identifiers and Routine Identifiers.

2. REFERENCES

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.

SAE J1930DA	Digital Annex of Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms
SAE J1939	Serial Control and Communications Heavy Duty Vehicle Network - Top Level Document
SAE J1939DA	Digital Annex of Serial Control and Communications Heavy Duty Vehicle Network
SAE J1939-71	Vehicle Application Layer
SAE J1939-73	Application Layer - Diagnostics
SAE J1962	Diagnostic Connector
SAE J1978	OBD-II Scan Tool
SAE J1979DA	Digital Annex of E/E Diagnostic Test Modes
SAE J2012DA	Digital Annex of Diagnostic Trouble Code Definitions
SAE J2403	Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature

2.1.2 ISO Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ISO 7498-1	Information processing systems - Open systems interconnection - Basic reference model
ISO/IEC 10731	Information technology - Open Systems Interconnection - Basic Refer to Model - Conventions for the definition of OSI services
ISO 14229-1	Road vehicles - Unified diagnostic services (UDS) - Part 1: Application layer
ISO 14229-2	Road vehicles - Unified diagnostic services (UDS) - Part 2: Session layer services

ISO 14229-3 Road vehicles - Unified diagnostic services (UDS) - Part 3: Unified diagnostic services on CAN implementation (UDSonCAN)

ISO 14229-5 Road vehicles - Unified diagnostic services (UDS) - Part 5: Unified diagnostic services on Internet Protocol implementation (UDSonIP)

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

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

ISO 13400-2 Road vehicles - Diagnostic communication over Internet Protocol (DoIP) - Part 2: Transport protocol and network layer services

ISO 13400-3 Road vehicles - Diagnostic communication over Internet Protocol (DoIP) - Part 3: Wired vehicle interface based on IEEE 802.3

ISO 13400-4 Road vehicles - Diagnostic communication over Internet Protocol (DoIP) — Part 4: Ethernet-based high-speed data link connector

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

3. TERMS, DEFINITIONS, SYMBOLS, AND ABBREVIATED TERMS

For the purposes of this document, the terms and definitions given in SAE J1979-2, SAE J1930, SAE J2403, ISO 14229-2, ISO 14229-1, ISO 15765-2, and the following apply.

3.1 Terms and Definitions

CLIENT: Defines the node performing an initial request to a server. Usually a diagnostic application within semi-permanent attached device to the vehicle SAE J1962 data link connector and responsible for requesting diagnostic information. Client could also be internal to the vehicle. May also be referred to as a tester client.

DoIP SERVER: A DoIP Server is an IP node that can be publicly addressable and do support the DoIP protocol.

ECU SERVER: Diagnostic application responsible for serving diagnostic information.

OBDonUDS ECU: An ECU that meets the functionality defined in SAE J1979-2 recommended practice.

SERVER: Defines the node responding to a client request. Usually a diagnostic application within a vehicle mounted ECU and responsible for handling a client's request for diagnostic information. May also be referred to as an ECU server.

ZEVonUDS ECU: An ECU that meets the functionality defined in SAE J1979-3 recommended practice.

3.2 Abbreviated Terms

BECM	Battery Energy Control Module
CALID	Calibration Identifier
CAN	Controller Area Network
DID	Data Identifier
DoCAN	Diagnostic Communication Over Controller Area Network
DoIP	Diagnostic Communication Over Internet Protocol
DTC	Diagnostic Trouble Code
DTCSM	DTC Status Mask
DTCSVM	DTC Severity Mask
EBCM	Electronic Brake Control Module
ECM	Engine Control Module
ECU	Electronic Control Unit
FTB	Failure Type Byte
FGID	Functional Group Identifier
GHG	Green House Gas
GODTC	Group of DTC
HB	High Byte
HEX	Hexadecimal Numbering System
ITID	Infotype Identifier
ISO	International Organization for Standardization
LB	Low Byte
MIL	Malfunction Indicator Light
NRC	Negative Response Code
OBD	On-Board Diagnostics
PID	Parameter Identifier
PWM	Pulse Width Modulated
RDCM	Rear Diagnostic Control Module
RID	Routine Identifier

SID	Service Identifier
SPN	Suspect Parameter Number
TCM	Transmission Control Module
UDS	Unified Diagnostic Services
VIN	Vehicle Identification Number
VPW	Variable Pulse Width
ZEV	Zero Emission Vehicle

For additional abbreviated terms, also refer to SAE J1930 and SAE J1979-2.

3.3 Symbols

$	Hexadecimal Numbering System
%	Percentage
ms	Milliseconds

For additional symbols, also refer to SAE J1930.

4. CONVENTIONS

SAE J1979-3 is based on the conventions specified in the OSI Service Conventions (ISO/IEC 10731) as they apply for diagnostic services.

Figures 1, 2, and 3 illustrate the document references.

The protocol initialization identifies the data link layers supported by the vehicle. SAE J1979-3 references the standards as an applicable data link for ZEV standardized communications.

5. DOCUMENT OVERVIEW

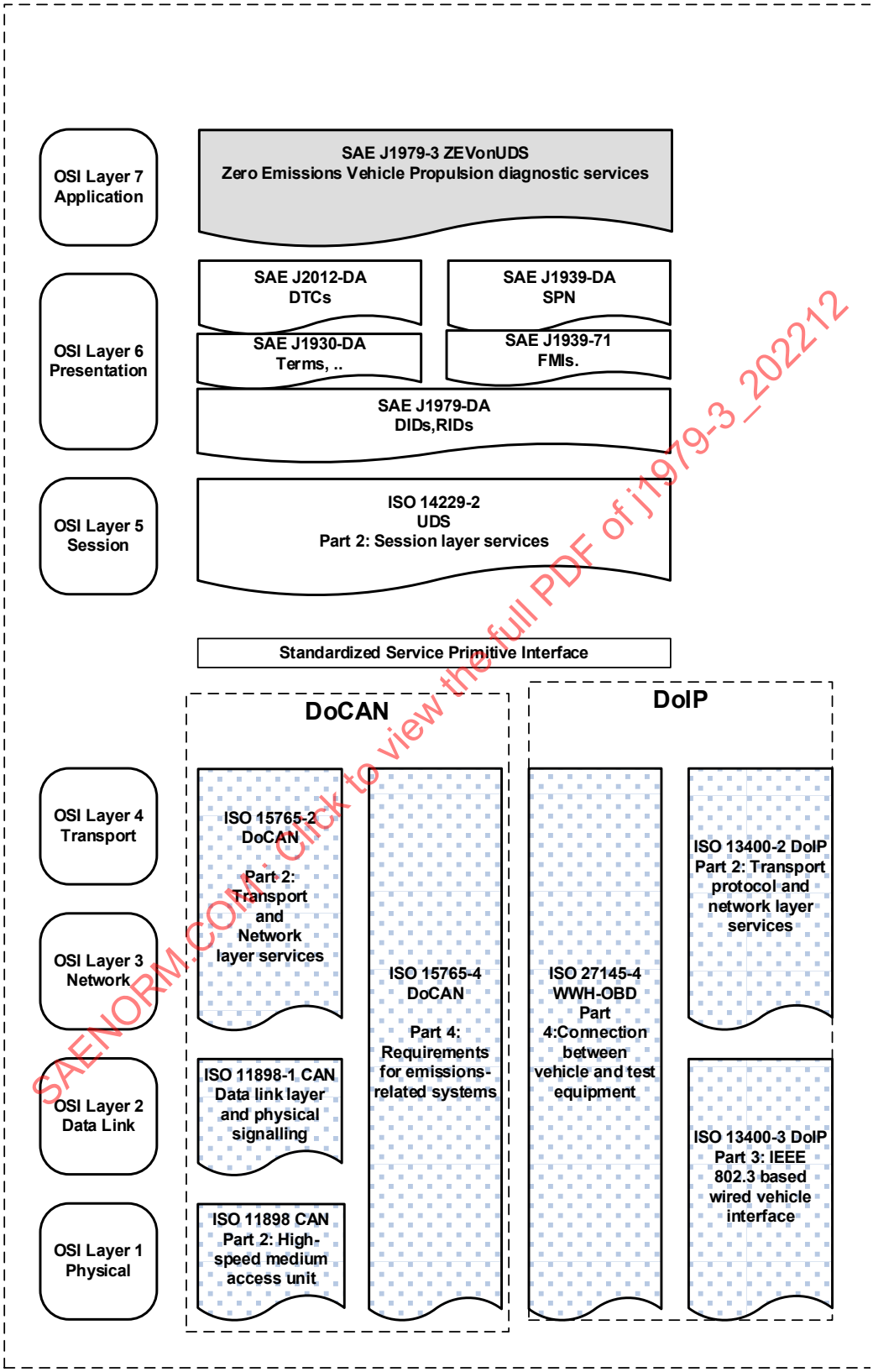

Figure 3 - Regulated ZEV propulsion system communication standards

6. TECHNICAL REQUIREMENTS

6.1 DTCStatusMask/DTC Status Byte and DTCStatusAvailabilityMask

The DTC status byte (statusOfDTC) is part of the data from the UDS Service $19 and offers status information about each DTC.

Each of the 8 bits in the statusOfDTC has a meaning that is defined in ISO 14229-1 but for ZEV Propulsion related DTCs only Bit 0, 1, 2, 3, 4, and 6 are evaluated. For compliance to this standard, user optional bits (U) shall not be evaluated for conformance.

Bits in the StatusAvailabilityMask that are not supported by the server shall be set to “0.” Each supported bit (indicated by a value of “1’) shall be implemented for every DTC supported by the server.

Table 2 - DTC status bit definition

Bit	Description	Cvt	Mnemonic
#0	TestFailed	M	TF
#1	TestFailedThisOperationCycle	M	TFTOC
#2	pendingDTC	M	PDTC
#3	confirmedDTC	M	CDTC
#4	testNotCompletedSinceLastClear	M	TNCSLC
#5	TestFailedSinceLastClear This bit is optional for the vehicle manufacturer to support for ZEVonUDS.	U	TFSLC
#6	testNotCompletedThisOperationCycle	M	TNCTOC
#7	warningIndicatorRequested This bit is optional for the vehicle manufacturer to support and is not used for ZEVonUDS.	U	WIR

M = Mandatory, shall be evaluated for conformance.
U = User Optional, shall not be evaluated for conformance.

The DTC Status Bits #0, #1, #2, and #3 are related as indicators for failed diagnostic monitors (DTCs).

The combination of DTC Status Bits #4 and #6 may comprise the complete set of DTCs. The act of combining these bits could result in a long response message.

Refer to ISO 14229-1 for status bit definitions.

6.2 DTCSeverityMask and DTCSeverityAvailabilityMask

Each of the 8 bits in the DTC Severity Mask has a precise meaning that is defined in ISO 14229-1. The following definitions in Tables 6 and 4 show an overview. Bits in the DTCSeverityAvailabilityMask that are not supported by the server are set to “0.”

Table 3 - DTC severity byte definition

DTCSeverity byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
DTC severity information			DTC class information				

Table 4 - DTC severity and DTC class bit definition

Bit	Description	Cvt	Mnemonic
	DTC class bit definition		
#0	DTCClass_0	N/A	DTCClass_0
#1	DTCClass_1	M	DTCClass_1
#2	DTCClass_2	N/A	DTCClass_2
#3	DTCClass_3	N/A	DTCClass_3
#4	DTCClass_4	N/A	DTCClass_4
#5-7	Reserved by ISO 14229-1		

M = Mandatory, shall be evaluated for conformance.
N/A = Not Applicable, shall not be evaluated for conformance.

ZEVs shall support DTCClass_1 to allow re-use of existing PHEV modules and generic scan tools.

Refer to ISO 14229-1 for more information of the DTCClass/SeverityMask.

6.3 FunctionalGroupIdentifier

ZEVs shall support FunctionalGroupIdentifier $33.

6.4 GroupOfDTCIdentifier

ZEVs shall support GroupOfDTCIdentifier $FFFF33 and $FFFFFF.

Refer to ISO 14229-1 for the definition of all GroupOfDTCIdentifier. The following definition in Table 5 shows an excerpt.

Table 5 - GroupOfDTCIdentifier definition

Byte Value (Hex)	Description	Cvt	mnemonic
FFFF33	ZEV propulsion systems Group	M	ZPSYSGRP
FFFFFF	All Groups (all DTCs)	M	AG

6.5 DTCFormatIdentifierDTCFormatIdentifier

The main purpose of the DTCFormatIdentifier is to indicate to the Client which DTC list to use when presenting the DTC number and name. There are two DTCFormatIdentifiers allowed in SAE J1979-3:

1. SAE_J2012_DTCFormat_04 (value 4).

2. SAE_J1939-73_DTCFormat (value 2).

An ECU shall only support one DTCFormat, i.e., all DTCs in an ECU shall utilize the same DTCFormat.

A vehicle may utilize more than one DTCFormat in disparate ECUs, e.g., a truck may utilize one DTCFormat in the ECM and another in the RDCM.

Refer to ISO 14229-1.

6.5.1 SPN Interpretation for SAE J1939-73_DTCFormat

Refer to SAE J1939-73 and SAE J1939DA.

6.6 SAE J1979-3 Diagnostic Service Requirements

6.6.1 Protocol Detection

The following ZEV propulsion systems protocol check (SAE J1979-3) is performed in conjunction with existing ISO 15765-4 (SAE J1979-1) and ISO 14229-1 (SAE J1979-2) protocol checks.

The ZEV propulsion systems protocol check confirmation is done by:

1. First, perform a functional request of DID 0xF810 on DoCAN using the ISO 14229-1 protocol. If one or more positive responses are made, then the vehicle is confirmed to be regulated DoCAN (ISO 14229-2) protocol compliant.

    a. After a positive response to DID 0xF810, perform a physical request of DID 0xF41C to determine the regulated ZEV market (for example (Heavy Duty ZEV = 0x1B).

2. Then, if no positive responses from step one are received, then further confirmation is accomplished by:

    a. Perform the DoIP activation line process to determine which DoIP option the vehicle Ethernet line supports.

    b. Once determined, perform functional request of DID 0xF810 on DoIP using the ISO 13400-2 protocol. If one or more positive responses are made, then the vehicle is confirmed to be regulated DoIP (ISO 13400-2) protocol compliant.

    c. After a positive response to DID 0xF810, perform a physical request of DID 0xF41C to determine the regulated ZEV market (for example, Heavy Duty ZEV = 0x1B).

Notes:

1. The tool will stop further protocol determination checks when it gets a first positive response from the vehicle's ZEV propulsion system.

2. This specification requires that all ZEV ECU Servers must support the same datalink, which is specified as either DoCAN (ISO 14229-1) or DoIP (ISO 13400-1).

3. A ZEV propulsion system compliant vehicle shall not acknowledge support of ZEVonUDS using a mix of communications using both DoCAN and DoIP protocols. The vehicle shall only respond to DID 0xF810 on the DoCAN (ISO 14229-2) protocol or the DoIP (ISO 13400-2) protocol. After vehicle identification, the tool will only seek information from a vehicle either on the DoCAN or the DoIP protocols. Furthermore, once the tool establishes communication to the vehicle using ZEVonUDS, the supported services on other protocols becomes outside the scope of this document.

4. If multiple vehicles are available on a subnet, the tool shall ensure each server is paired to the appropriate vehicle on the network. Each DoIP server shall have a VIN in the Vehicle Identification response that accurately represents the responding vehicle. Refer to ISO 13400-2 for guidance.

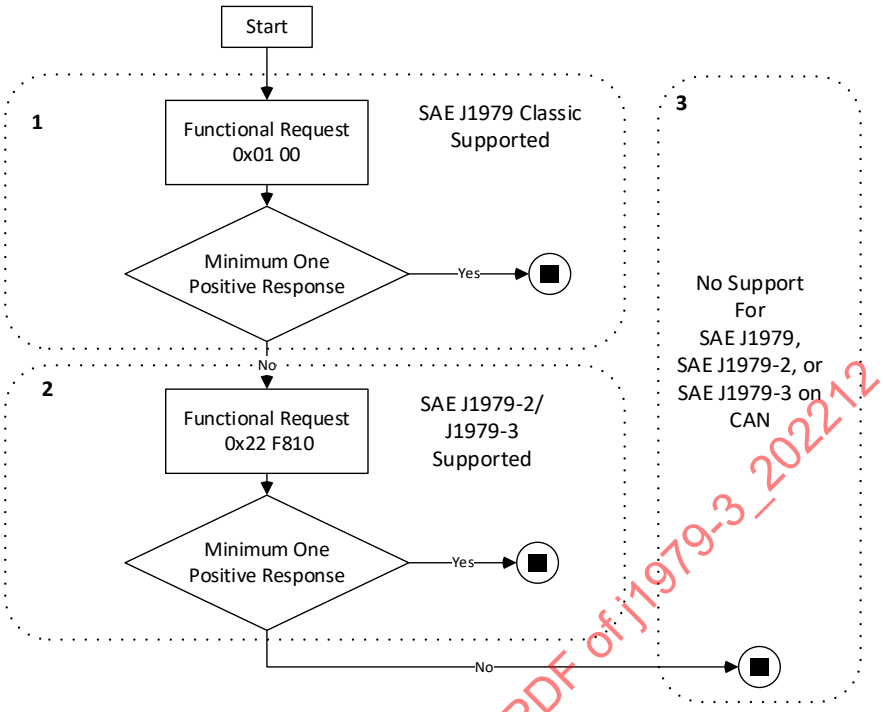

Figure 4 - Protocol detection over CAN

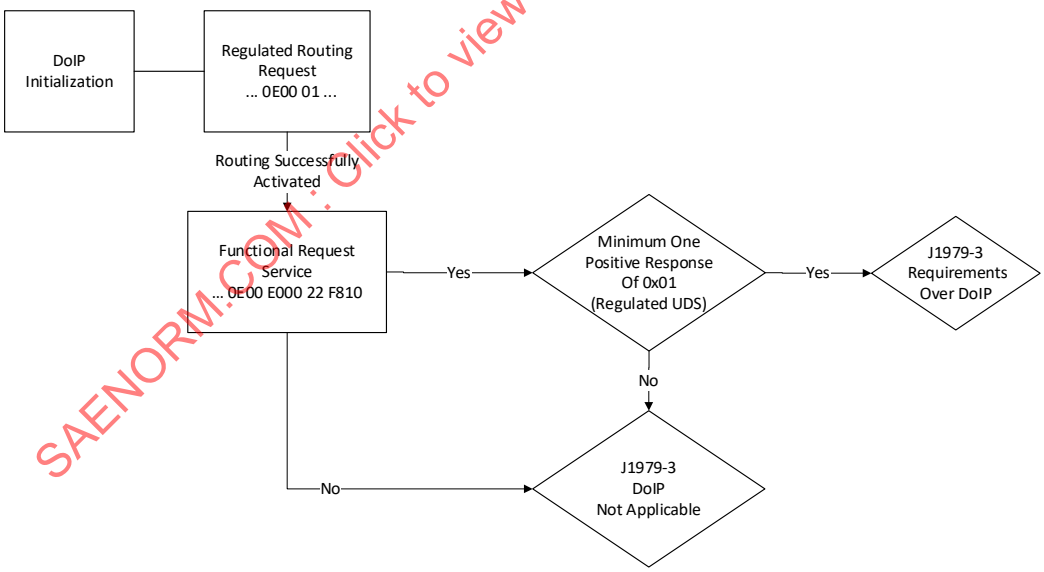

Figure 5 - Protocol detection over DoIP

6.6.2 Multiple Responses to a Single Data Request

For the DoCAN protocol, refer to SAE J1979-2.

For the DoIP protocol, the only functional request required is during the protocol identification and shall be handled with reference to ISO 13400-2.

6.6.3 Application Timing Parameter Definition

6.6.3.1 Overview

SAE J1979-3 references the timing requirements that are framed in ISO standards for DoCAN and DoIP.

6.6.3.2 Definition for ISO 15765-4

For DoCAN, refer to SAE J1979-2.

6.6.3.3 Definition for ISO 14229-5

Services 0x10, 0x11, 0x2A and 0x86 are not supported by ZEVonUDS so no ISO 14229-5 (UDSonIP) considerations apply.

6.6.4 Request Timing Parameters

6.6.4.1 Minimum Time between Requests from External Test Equipment

For DoCAN, refer to SAE J1979-2 recommended practice and Appendix A of this document.

For DoIP, upon completion of the routing activation and commencement of the diagnostic session: all ZEV related ECUs shall respond per the parameters shown in Table 6. For all other timing requirements, refer to ISO-13400-2 and Appendix B of this document.

6.6.4.2 ECU Behavior to a Request for Supported/Non-Supported OBD Information

Table 6 indicates the proper server ECU response on DoCAN and DoIP.

Table 6 - Proper response from server/ECU on functional or physical requests for CAN and ethernet connection to ZEVonUDS ECUs

UDS Service	Sub-Function	Data-Identifier	Condition	ISO 14229-1	Functional NRC	Physical NRC	DoCAN Client Timeout	DoIP Client Response Timing
all	all	all	Service not supported	On physical request a negative response is required. On functional request no response is allowed.	N/A	$11	$P2_{CAN\_max}$	$P6_{Client\_min}$
all	all	all	Subfunction not supported	On physical request a negative response is required. On functional request no response is allowed.	N/A	$12	$P2_{CAN\_max}$	$P6_{Client\_min}$
all	all	all	Incorrect Message length Or Invalid Format	On physical or functional request a negative response is required.	$13	$13	$P2_{CAN\_max}$	$P6_{Client\_min}$
all	all	all	Unsupported DID/ /ITID/RID requested	On physical request a negative response is required. On functional request no response is allowed.	N/A	$31	$P2_{CAN\_max}$	$P6_{Client\_min}$
$14	N/A	N/A	Conditions not correct	Negative response is required.	$22	$22	$P2_{CAN\_max}$	$P6_{Client\_min}$
			Unsupported GODTC, unsupported addressing method	Negative response is required. for an incorrect FGID or if physical code clear is prohibited	N/A	$31	$P2_{CAN\_max}$	$P6_{Client\_min}$
			Supported GODTC, conditions correct	Positive response message required. Multiple negative response messages allowed within a maximum window of time until a positive response is required.	$78[abc]	$78[abc]	5000ms	$P6^{*}_{Client\_min}$
			ClearDTC not possible due to corrupt NV memory	Negative response is required.	$72	$72	$P2_{CAN\_max}$	$P6_{Client\_min}$
$19	$42	N/A	Unsupported DTCSM, DTCSVM	Positive response indicating no DTCs is required.	N/A	N/A	$P2_{CAN\_max}$	$P6_{Client\_min}$
			Supported FGID/DTCSVM, no DTCs stored	Positive response indicating no DTCs is required.	N/A	N/A	$P2_{CAN\_max}$	$P6_{Client\_min}$
			Supported FGID/DTCSVM, DTCs stored	Positive response including the stored DTCs is required.	N/A	N/A	$P2_{CAN\_max}$	$P6_{Client\_min}$
		N/A	Supported DTCSSRN / FGID/DTCSVM requested, data not available, conditions correct	Positive response message required. Multiple negative response messages allowed within a maximum window of time until a positive response is required.	$78[abc]	$78[abc]	5000ms	$P6^{*}_{Client\_min}$
		All	Unsupported FGID	For functional request: No response For physical request: Negative response with response code $31.	N/A	$31	$P2_{CAN\_max}$	$P6_{Client\_min}$

UDS Service	Sub-Function	Data-Identifier	Condition	ISO 14229-1	Functional NRC	Physical NRC	DoCAN Client Timeout	DoIP Client Response Timing
$22	N/A	$F400 - $F5FF and $F700 - $F7FF	Supported DID requested	Positive response is required (no negative response message with response code $78 allowed).	N/A	N/A	$P2_{CAN\_max}$	$P6_{Client\_min}$
		$F800 - $F8FF	Supported ITID requested, data available (VIN, CALID)	Positive response is required.	N/A	N/A	$P2_{CAN\_max}$	$P6_{Client\_min}$
			Supported ITID requested, data not available, conditions correct (GHG Tracking)	Positive response message required. Multiple negative response messages allowed within a maximum window of time until a positive response is required.	$78[abc]	$78[abc]	5000ms	$P6^*_{Client\_min}$
		$F810	DID $F810 requested during initialization	Positive response is required **or** Negative response for maximum of 5 times	$21	$21	$P2_{CAN\_max}$	2000ms
$31	$01	$E000 - $E1FF	Supported RID requested, conditions correct	Positive response is required.	N/A	N/A	$P2_{CAN\_max}$	$P6_{Client\_min}$
			Supported RID requested, conditions not correct	Negative response required.	$22	$22	$P2_{CAN\_max}$	$P6_{Client\_min}$
			Routine is currently active and cannot be restarted	On physical or functional request, a negative response is required.	$24	$24	$P2_{CAN\_max}$	$P6_{Client\_min}$

[a] After an NRC $78, every NRC is possible, also with functional addressing.
[b] For DoCAN, if NRC $78 is allowed, then $P4_{Server}$ is either 5000ms or $P4_{Server\_max}$ (CVN calculation only). In all other cases $P4_{Server}$ is $P2_{CAN\_max}$. $P4_{Server\_max}$ is defined by ISO 14229-2.
[c] For DoIP, if NRC $78 is allowed, then the client should receive the complete response message within $P6^*_{Client\_min}$ after the successful transmission of the corresponding request message. CVN calculation is allowed to take 600000 ms (10 minutes) before a final response must be received by the client. Note: $P4_{Server}$ does not apply to DoIP as it does not support start of message indications (SOM.ind). For DoCAN protocol, refer to server timer parameters (i.e., $P2_{CAN\_max}$) in SAE J1979-2. For other UDS protocol information, please refer to ISO 14229-1.

NOTES:
1 These and other services or sub-functions may be supported for non-legislated purposes and therefore respond with different responses to a physical and functional request (e.g., NRC $7F to SID $31). This does not lead into a violation of ZEV standardization compliance.
2 Negative response structure follows the scheme: $7F, ServiceID, NRC (e.g., $7F, $01, $11). See 6.7.1 of this document.

6.6.4.3 Negative Response Code Support

ECU servers that comprise the UDS for ZEV propulsion system must support a message response within specified timer parameter requirements when requests are received from external test equipment. This includes the condition where the ECU server has determined that it cannot perform required action within allotted time or the conditions are not correct, and has to report status via a negative response code.

Negative response code (NRC) use requirements are as follows:

1. An NRC is allowed with a physical or functional addressed message. See Table 6, footnote a.

2. For DoCAN, if NRC $78 is allowed, then P4Server is either 5000ms or P4Server_max (CVN calculation only). In all other cases P4Server is P2CAN_max. P4Server_max is defined by ISO 14229-2. See Table 6, footnote b.

3. For DoIP, if NRC $78 is allowed, then the client should receive the complete response message within P6*Client_min after the successful transmission of the corresponding request message. CVN calculation is allowed to take 600000ms (10 minutes) before a final response must be received by the client. In all other Service use cases P4Server is P2CAN_max. Note: P4Server does not apply to DoIP as it does not support start of message indications (SOM.ind). See Table 6, footnote c.

4. For DoCAN protocol, refer to server timer parameters in SAE J1979-2 (i.e., $P2_{CAN\_max}$ presented in Table 6). For other UDS protocol information, please refer to ISO 14229-1.

5. An ECU server may reject a request and issue an NRC (e.g., NRC $7F to a SID $31 request) if the message was not supported by the server, was incorrectly formatted, or was not sent by a known entity. These and other services or sub-functions may be supported for non-legislated purposes and therefore respond with different responses to physical request. This does not lead into a violation of ZEV standardization compliance.

6. Table 7 presents the NRC message format for the ZEV propulsion system.

7. The complete message response structure for negative response codes, plus the list of industry defined negative response codes, is defined in Annex A of ISO 14229-1.

6.6.5 Maximum Values

ECU servers that comprise the ZEV propulsion system must be capable of a message response with a transmitted signal value that represents the “maximum value.” This maximum value provides an indication of current system condition via a data value that exceeds the transform calculated limit.

If the data value exceeds the maximum value that is possible to be sent, the on-board system shall send the maximum value possible ($FF or $FFFF). The external test equipment shall display the maximum value or an indication of data too high.

6.6.6 Invalid Signals

ECU servers that comprise the ZEV propulsion system must be capable of a message response with a data payload value that represents an “invalid signal.” This invalid signal represents two or more ECU servers disagreeing on signal level (or one has not received a signal thus not agreeing), which then provides an indication of current system condition via data value(s) that may describe signal(s) that have not been received.

Refer to SAE J1979-2.

6.7 Diagnostic Message Format

Refer to ISO 14229-1.

6.7.1 Negative Response Message Format per ISO 14229-1 Protocol

Negative response message format is included in the table below.

Table 7 - Negative response format

Data Byte	Parameter Name	Cvt	Byte Value (Hex)	Mnemonic
#1	Negative Response Service Identifier	M	7F	SIDNR
#2	Request Service Identifier	M	xx	SIDRQ
#3	Negative Response Code	M	xx	RC_

For services and data specified in the SAE J1979 series of documents, Table 8 lists the allowed NRCs. Refer to ISO 14229-1 Annex A for definition of NRCs.

Table 8 - Negative response code for ZEVonUDS

Byte Value (Hex)	Definition of Response Code	Mnemonic
11	**serviceNotSupported**	SNS
12	**subfunctionNotSupported**	SFNS
13	**incorrectMessageLengthOrInvalidFormat**	IMLOIF
21	**busyRepeatRequest**	BRR
22	**conditionsNotCorrect**	CNC
24	**requestSequenceError**	RSE
31	**requestOutOfRange**	ROOR
72	**generalProgrammingFailure**	GPF
78	**requestCorrectlyReceived-ResponsePending**	RCRRP

Refer to ISO 14229-1.

6.7.2 Maximum Message Length per ISO 15765-4

The maximum message length is specified in ISO 15765-4. For functional request messages, the message length is limited to 7 data bytes. For physical request messages, see 8.3.2.

6.7.3 Header Byte Definition per ISO 15765-4

Refer to SAE J1979-2.

6.7.4 Data Bytes Definition per ISO 15765-4

Refer to SAE J1979-2.

6.7.5 Maximum Message Length per ISO 13400-2

The maximum message length is specified in ISO 13400-2. For functional request messages, the only permitted message is $22 $F810. For physical request messages, see 8.3.2.

6.7.6 Header Byte Definition per ISO 13400-2

Table 9 - DoIP header format

Data Byte	Description	Cvt	Byte Value (Hex)	Mnemonic
#1	Protocol Version	M	xx	PV
#2	Inverse Protocol Version	M	xx	IPV
#3	Payload Type [HighByte]	M	xx	PT_1
#4	Payload Type [LowByte]	M	xx	PT_2
#5	Payload Length [HighByte]	M	xx	PL_1
#6	Payload Length [HighMidByte]	M	xx	PL_2
#7	Payload Length [LowMidByte]	M	xx	PL_3
#8	Payload Length [LowByte]	M	xx	PL_4

Refer to ISO 13400-2 for definitions on Payload Types and Protocol Versions.

6.7.7 Data Byte Definition per ISO 13400-2

For the ISO 13400-2 protocol, Diagnostic Messages are exchanged via Payload Type $8001. The first two data bytes following the DoIP header is the Source Address (SA), the next two data bytes is the Target Address (TA), then the User Data (UD) which contains the actual UDS request or response which includes the diagnostic service identifier, and the remaining data bytes vary depending on the specific diagnostic service.

Table 10 - DoIP diagnostic message format

Data Byte	Description	Cvt	Byte Value (Hex)	Mnemonic
#1	Source Address [HighByte]	M	xx	SA_1
#2	Source Address [LowByte]	M	xx	SA_2
#3	Target Address [HighByte]	M	xx	TA_1
#4	Target Address [LowByte]	M	xx	TA_2
#5	User Data #1	M	xx	UD_1
#6	User Data #2	C	xx	UD_2
:	:	:	:	:
#(k-1)+4	User Data #(k-1)	C	xx	UD_k-1
#k+4	User Data #k	C	xx	UD_k

C = Conditional - Length depends on the specific UDS request or response.

6.8 Allowance for Expansion and Enhanced Diagnostic Services

This document allows for the addition of diagnostic services both as industry standards and manufacturer-specific services.

6.9 Definition of PIDs for Service $22 ReadDataByIdentifier.

ECU servers that comprise the ZEV propulsion system shall be capable of supporting any PID that has been defined in SAE J1979DA. The ECU server shall be capable of supporting any data type that is defined in a digital annex, ECU description table, or other document or container that can contain parametric data as defined by the system designer.

7. DIAGNOSTIC SERVICE DEFINITION FOR ZEVonUDS

Below is an overview of supported UDS services. Other UDS services are permitted at manufacturer discretion outside of the context of ZEVonUDS.

Refer to SAE J1979-2 about details for implementation.

Table 11 - Overview of ZEVonUDS required ISO 14229-1 UDS services

UDS Name (ISO 14229-1)	SID Value	SFID Value	Sub-Function Name	Comment	DoCAN Functional	DoCAN Physical	DoIP Functional	DoIP Physical
Stored Data Transmission Functional Unit								
ClearDiagnosticInformation	0x14	---	N/A	This service provides the ability to clear diagnostic information from the memory of a server.	Supported[1]	Supported	Not supported	Supported
ReadDTCInformation	0x19	0x42	reportWWHOBDDTCByMaskRecord	This service/subfunction provides DTC information for ZEV Propulsion related failures.	Supported	Supported[2]	Not supported	Supported
Data Transmission Functional Unit								
ReadDataByIdentifier	0x22	---	N/A	This service provides read capabilities for static and dynamic data.	Supported	Supported[3]	Supported, only for DID $F810.	Supported
Routine Functional Unit								
RoutineControl	0x31	0x01	StartRoutine	This service/subfunction provides control capability for routines. This sub-function is mandatory for any device controls required by ZEV regulations.	Supported	Supported[4]	Not supported	Supported

[1] Recommended method to clear DTCs.
[2] Recommended method to read DTCs.
[3] Recommended method for reading data stream and ECU/Vehicle information outside of the following use cases: Protocol Identification (DID $F810) and Vehicle Identification (DID $F802).
[4] Recommended method to execute Routines.

7.1 Request Current Diagnostic Data or Vehicle Information Using Service $22

7.1.1 Functional Description

Refer to ISO 14229-1 for details of how to use service $22 for regulated purposes. The used DIDs and range could be different from SAE J1979-2. Refer to SAE J1979 DA for detailed information about DID assignments.

More details are available in 8.3.2.

NOTE: The server shall always send a positive response with the data it supports even if there is a combination of data identifiers which will be difficult for the Client to translate.

7.1.2 Message Example for Request Current Diagnostic Data

The example below shows how the “Request current diagnostic data” service is implemented.

7.1.2.1 Step #1: Request Supported DIDs from Vehicle

For ZEVonUDS ECUs, the external test equipment requests supported DIDs ($F400, $F420, $F440, $F460, etc.) from each ECU in the vehicle. Refer to Appendix A in SAE J1979DA to interpret the data bytes in the response messages.

ECU(s) responds to all supported ranges if requested. A range is defined as a block of 32 DIDs (e.g., range #1: DID $F401-$F420). The ECU shall not respond to unsupported DID ranges unless subsequent ranges have at least one supported DID.

Next the external test equipment creates an internal list of supported DIDs for each ECU. In this message example, the ECU#1 (ECM) supports the following DIDs: $F401, $F403 - $F409, $F40B - $F411, $F413, $F415, $F419, $F41C, $F420, $F421, $F45B.

7.1.2.2 Step #2: Request DID from Vehicle

For ZEVonUDS ECUs the external test equipment requests a combination of a maximum of six DIDs in one physical request message for each ECU to gain best performance of displaying current data.

- ID $F45B: Hybrid Battery Pack Remaining Charge DID is supported by ECU #1:

Table 12 - ZEVonUDS physical request ECU#1 current powertrain diagnostic data request message

Message Direction:	External test equipment → ECU#1		
Message Type:	Physical Request (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request current powertrain diagnostic data request SID	22	SIDRQ
#2	DID#1 (HB): F45B Hybrid Battery Pack Remaining Charge	F4	DID_HB
#3	DID#1 (LB): F45B Hybrid Battery Pack Remaining Charge	5B	DID_LB

Table 13 - ECU#1 request current diagnostic data response message

Message Direction:	ECU#1 → External test equipment		
Message Type:	Response (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request current powertrain diagnostic data response SID	62	SIDPR
#2	DID#1 (HB): F45B Hybrid Battery Pack Remaining Charge	F4	DID_HB
#3	DID#1 (LB): F45B Hybrid Battery Pack Remaining Charge	5B	DID_LB
#4	Data byte A F45B Hybrid Battery Pack Remaining Charge 25.1%	40	DATA(A)

7.1.2.3 UDS Negative Response Messages on a Physical ZEVonUDS Request

The example below shows a physical ZEVonUDS request current powertrain diagnostic data for ECU#1 that does not support the requested DID $F4FF.

Table 14 - ZEVonUDS physical request ECU#1 current diagnostic data request message

Message Direction:	External test equipment → ECU#1		
Message Type:	Physical Request (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request current diagnostic data request SID	22	SIDRQ
#2	DID#1 (HB): F4	F4	DID_HB
#3	DID#1 (LB): FF	FF	DID_LB

The table below shows a negative response to physical ZEVonUDS request current diagnostic data form ECU#1 that does not support the requested DID $F4FF.

Table 15 - ECU#1 request current diagnostic data negative response message request out of range

Message Direction:	ECU#1 → External test equipment		
Message Type:	Response (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Negative Response Service Identifier	7F	SIDNR
#2	Request current diagnostic data request SID	22	SIDRQ
#3	NRC: RequestOutOfRange	31	NR_ROOR

The example below shows a physical ZEVonUDS request current diagnostic data for ECU#1 with an incorrect request message due to missing DID LB 41 for F441.

Table 16 - ZEVonUDS physical request ECU#1 current diagnostic data request message

Message Direction:	External test equipment → ECU#1		
Message Type:	Physical Request (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request current diagnostic data request SID	22	SIDRQ
#2	DID#1 (HB): F461: Driver's Demand Engine - Percent Torque	F4	DID_HB
#3	DID#1 (LB): F461: Driver's Demand Engine - Percent Torque	61	DID_LB
#4	DID#2 (HB): F441: Monitor status this driving cycle	F4	DID_HB

The table below shows a negative response to physical ZEVonUDS request current diagnostic data form ECU#1 on a request with an incorrect message format.

Table 17 - ECU#1 request current diagnostic data negative response message incorrect message length or invalid format

Message Direction:	ECU#1 → External test equipment		
Message Type:	Response (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Negative Response Service Identifier	7F	SIDNR
#2	Request current diagnostic data request SID	22	SIDRQ
#3	NRC IncorrectMessageLengthOrInvalidFormat	13	NR_IMLOIF

7.1.3 Message Example for Request Vehicle Information Data

A request message with the InfoType for CALIDs (Calibration IDs) may cause the ECU to send a response message that contains multiple CALIDs.

The example below shows how the “Request vehicle information” service is used.

7.1.3.1 Step #1: Request Vehicle Information (Request Supported InfoType) from Vehicle

The external test equipment requests all supported InfoTypes (InfoType#1 = $F800) from the vehicle. The ECU #1 (BECM) and the ECU #2 (TCM) send a response message with InfoTypes supported information for InfoTypes $F801 - $F820.

Now the external test equipment creates an internal list of supported InfoTypes for each ECU.

The ECU #1 (ECM) supports the following InfoTypes: $F802, $F804, and $F80A.

The ECU #2 (TCM) supports InfoTypes $F804 and $F80A.

7.1.3.2 Step #2: Request InfoTypes from Vehicle

Now the external test equipment requests the following InfoTypes:

- InfoType $F802: VIN =[1G1JC5444R7252367] supported by ECU #1.
- InfoType $F804: Cal. ID#1=[JMB*36761500] supported by ECU #1.
- InfoType $F804: Cal. ID#2=[JMB*4787261111] supported by ECU #1.
- InfoType $F804: Cal. ID=[JMA*431299110000] supported by ECU #2.
- InfoType $F80A: ECU Name=[BECM-B+EnergyCtrl] supported by ECU #1.
- InfoType $F80A: ECU Name=[TCM-TransmisCtrl] supported by ECU #2.

In the case of DoCAN, the VIN can be requested via a functionally addressed request. Alternatively, in the case of DoIP, the VIN must be requested via physically addressed request. Both request examples are included below, but only one is sent depending on if the vehicle supports ZEVonUDS via DoCAN or DoIP.

Table 18 - ZEVonUDS functional request (CAN) vehicle information request message

Message Direction:	External test equipment → All ECUs		
Message Type:	Functional Request (DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	22	SIDRQ
#2	DID (HB): F802 - VIN (Vehicle Identification Number)	F8	DID_HB
#3	DID (LB): F802 - VIN (Vehicle Identification Number)	02	DID_LB

Table 19 - ZEVonUDS physical request (DoIP) vehicle information request message

Message Direction:	External test equipment → ECU #1		
Message Type:	Physical Request (DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	22	SIDRQ
#2	DID (HB): F802 - VIN (Vehicle Identification Number)	F8	DID_HB
#3	DID (LB): F802 - VIN (Vehicle Identification Number)	02	DID_LB

Table 20 - ECU#1 request vehicle information response message

Message Direction:	ECU #1 → External test equipment		
Message Type:	Response (DoCAN or DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	62	SIDPR
#2	DID (HB): F802 - VIN (Vehicle Information Number)	F8	DID_HB
#3	DID (LB): F802 - VIN (Vehicle Information Number)	02	DID_LB
#4	1st ASCII character of VIN: “1”	31	VIN
#5	2nd ASCII character of VIN: “G”	47	VIN
#6	3rd ASCII character of VIN: “1”	31	VIN
#7	4th ASCII character of VIN: “J”	4A	VIN
#8	5th ASCII character of VIN: “C”	43	VIN
#9	6th ASCII character of VIN: “5”	35	VIN
#10	7th ASCII character of VIN: “4”	34	VIN
#11	8th ASCII character of VIN: “4”	34	VIN
#12	9th ASCII character of VIN: “4”	34	VIN
#13	10th ASCII character of VIN: “R”	52	VIN
#14	11th ASCII character of VIN: “7”	37	VIN
#15	12th ASCII character of VIN: “2”	32	VIN
#16	13th ASCII character of VIN: “5”	35	VIN
#17	14th ASCII character of VIN: “2”	32	VIN
#18	15th ASCII character of VIN: “3”	33	VIN
#19	16th ASCII character of VIN: “6”	36	VIN
#20	17th ASCII character of VIN: “7”	37	VIN

Now the external test equipment requests the following InfoType:

- InfoType $F804: CALID#1 = [JMB*36761500] and CALID#2 =[JMB*4787261111]; supported by ECU#1.
- InfoType $F804: CALID#1 = [JMA*4312991110000]; supported by ECU#2.

Table 21 - ZEVonUDS physical request vehicle information request message

Message Direction:	External test equipment → ECU #1		
Message Type:	Physical Request (DoCAN or DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	22	SIDRQ
#2	DID (HB): F804 Calibration ID	F8	DID_HB
#3	DID (LB): F804 Calibration ID	04	DID_LB

Table 22 - ECU#1 request vehicle information response message

Message Direction:	ECU #1 → External test equipment		
Message Type:	Response (DoCAN or DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	62	SIDPR
#2	DID (HB): F804 Calibration ID	F8	DID_HB
#3	DID (LB): F804 Calibration ID	04	DID_LB
#4	Data A: “J”	4A	DATA_A
#5	Data B: “M”	4D	DATA_B
#6	Data C: “B”	42	DATA_C
#7	Data D: “*”	2A	DATA_D
#8	Data E: “3”	33	DATA_E
#9	Data F: “6”	36	DATA_F
#10	Data G: “7”	37	DATA_G
#11	Data H: “6”	36	DATA_H
#12	Data I: “1”	31	DATA_I
#13	Data J: “5”	35	DATA_J
#14	Data K: “0”	30	DATA_K
#15	Data L: “0”	30	DATA_L
#16	Data M: Fill byte	00	DATA_M
#17	Data N: Fill byte	00	DATA_N
#18	Data O: Fill byte	00	DATA_O
#19	Data P: Fill byte	00	DATA_P
#20	Data A: “J”	4A	DATA_A
#21	Data B: “M”	4D	DATA_B
#22	Data C: “B”	42	DATA_C
#23	Data D: “*”	2A	DATA_D
#24	Data E: “4”	34	DATA_E
#25	Data F: “7”	37	DATA_F
#26	Data G: “8”	38	DATA_G
#27	Data H: “7”	37	DATA_H
#28	Data I: “2”	32	DATA_I
#29	Data J: “6”	36	DATA_J
#30	Data K: “1”	31	DATA_K
#31	Data L: “1”	31	DATA_L
#32	Data M: “1”	31	DATA_M
#33	Data N: “1”	31	DATA_N
#34	Data O: Fill byte	00	DATA_O
#35	Data P: Fill byte	00	DATA_P

Now the external test equipment requests the following InfoType:

- InfoType $F80A: ECUNAME; supported by ECU#1; the name of the ECU is: “BECM-B+EnergyCtrl”

Table 23 - ZEVonUDS physical request vehicle information request message

Message Direction:	External test equipment → ECU #1		
Message Type:	Physical Request (DoCAN or DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	22	SIDRQ
#2	DID (HB): F80A: ECU’s/module’s acronym and text name	F8	DID_HB
#3	DID (LB): F80A: ECU’s/module’s acronym and text name	0A	DID_LB

Table 24 - ECU#1 request vehicle information response

Message Direction:	ECU #1 → External test equipment		
Message Type:	Response (DoCAN or DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	62	SIDPR
#2	DID (HB): F80A: ECU"s/module"s acronym and text name	F8	DID_HB
#3	DID (HB): F80A: ECU"s/module"s acronym and text name	0A	DID_LB
#4	Data A: "B"	42	ECUNAME_A
#5	Data B: "E"	45	ECUNAME_B
#6	Data C: "C"	43	ECUNAME_C
#7	Data D: "M"	4D	ECUNAME_D
#8	Data E: "-" delimiter	2D	ECUNAME_E
#9	Data F: "B"	42	ECUNAME_F
#10	Data G: "+"	2B	ECUNAME_G
#11	Data H: "E"	45	ECUNAME_H
#12	Data I: "n"	6E	ECUNAME_I
#13	Data J: "e"	65	ECUNAME_J
#14	Data K: "r"	72	ECUNAME_K
#15	Data L: "g"	67	ECUNAME_L
#16	Data M: "y"	79	ECUNAME_M
#17	Data N: "C"	43	ECUNAME_N
#18	Data O: "t"	74	ECUNAME_O
#19	Data P: "r"	72	ECUNAME_P
#20	Data Q: "l"	6C	ECUNAME_Q
#21	Data R: filler byte	00	ECUNAME_R
#22	Data S: filler byte	00	ECUNAME_S
#23	Data T: filler byte	00	ECUNAME_T

- InfoType $F80A: ECUNAME; supported by ECU#2; the name of the ECU is: "TCM -TransmisCtrl"

Table 25 - ZEVonUDS physical request vehicle information request message

Message Direction:	External test equipment → ECU #2		
Message Type:	Physical Request (DoCAN or DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	22	SIDRQ
#2	DID (HB): F80A: ECU's/module's acronym and text name	F8	DID_HB
#3	DID (LB): F80A: ECU's/module's acronym and text name	0A	DID_LB

Table 26 - ECU#1 request vehicle information response

Message Direction:	ECU #2 → External test equipment		
Message Type:	Response (DoCAN or DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	62	SIDPR
#2	DID (HB): F80A: ECU"s/module"s acronym and text name	F8	DID_HB
#3	DID (HB): F80A: ECU"s/module"s acronym and text name	0A	DID_LB
#4	Data A: "T"	54	ECUNAME_A
#5	Data B: "C"	43	ECUNAME_B
#6	Data C: "M"	4D	ECUNAME_C
#7	Data D: " " (Or ECU number (1,2,3…) if multiple ECU"s)	00	ECUNAME_D
#8	Data E: "-" delimiter	2D	ECUNAME_E
#9	Data F: "T"	54	ECUNAME_F
#10	Data G: "r"	72	ECUNAME_G
#11	Data H: "a"	61	ECUNAME_H
#12	Data I: "n"	6E	ECUNAME_I
#13	Data J: "s"	73	ECUNAME_J
#14	Data K: "m"	6D	ECUNAME_K
#15	Data L: "i"	69	ECUNAME_L
#16	Data M: "s"	73	ECUNAME_M
#17	Data N: "C"	43	ECUNAME_N
#18	Data O: "t"	74	ECUNAME_O
#19	Data P: "r"	72	ECUNAME_P
#20	Data Q: "l"	6C	ECUNAME_Q
#21	Data R: filler byte	00	ECUNAME_R
#22	Data S: filler byte	00	ECUNAME_S
#23	Data T: filler byte	00	ECUNAME_T

7.2 Request Regulated Diagnostic Trouble Codes Using Service $19 - Subfunction $42

7.2.1 Functional Description

The purpose of this service is to enable the external test equipment to obtain regulated DTCs.

For ZEVonUDS ECUs send a Service $19 request for all DTCs related to ZEV Propulsion. Each ECU that has DTCs related to ZEV Propulsion matching the requested StatusMask shall respond with one message containing all has DTCs related to ZEV Propulsion. The ECU will do a bitwise AND between the masks in the request message and the DTC information stored in event memory. If an ECU does not find a match during the process, either that there is no DTC which matches the requested status mask or severity mask; or that the ECU does not support one or more bits in the requested status mask or severity mask, then it shall respond with a message indicating no DTCs are stored.

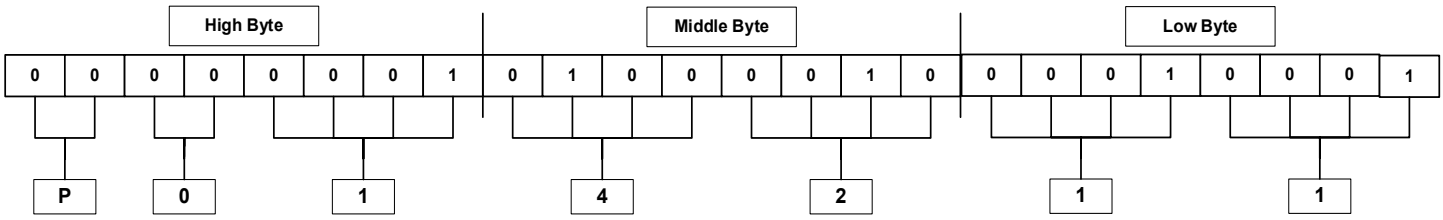

Figure 6 - Diagnostic trouble code encoding example: P014211

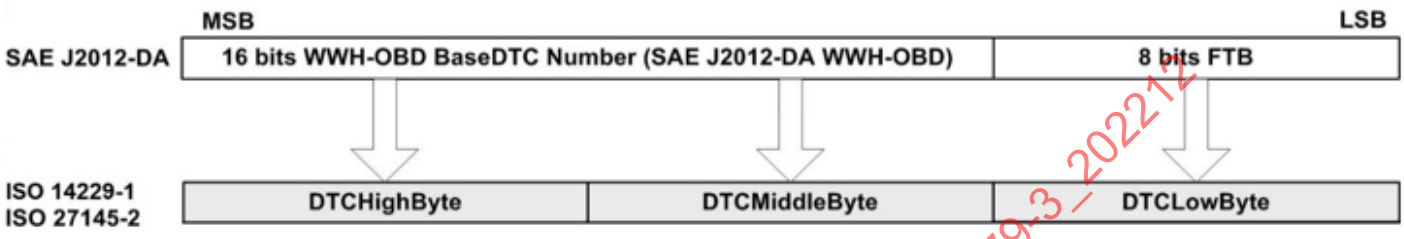

Figure 7 - UDS diagnostic trouble code for Format_04

Refer to ISO 14229-1.

7.2.2 Message Data Bytes

7.2.2.1 Request ZEV Propulsion DTC Request Message Definition

Table 27 - Request ZEV propulsion diagnostic trouble codes with confirmed/pending status request message

Data Byte	Parameter Name	Cvt	Byte Value (Hex)	Mnemonic
#1	Request ReadDTCInformation request SID	M	19	SIDRQ
#2	DTCInformationType = reportWWHOBDDTCByMaskRecord	M	42	RWWHOBDDTCBMR
#3	FunctionalGroupIdentifier = ZEV Propulsion group	M1	33	FGID
#4	DTCStatusMask = confirmedDTC/PendingDTC	M2	08/04	DTCSM
#5	DTCSeverityMask = DTCClass_1	M3	02	DTCSVM

1 M = Mandatory — Only the Function Group Identifier $33 = “ZEV propulsion-system group” is supported by this document. A physical request with any other unsupported Functional Group will result a negative response from the ECU in case of a functional request there will be no response.

2 M = Mandatory — Bit 3 confirmedDTC in DTCStatusMask must either be set to 1, or Bit 2 PendingDTC must be set to 1. The other bits in DTCStatusMask may also be set to 1 but this may lead to a different result. There will be no negative response if other bits than the confirmedDTC bit is set to 1. See Table 2 for a description of the status mask bits.

3 M = Mandatory - Local regulation specifies which classes are required to be supported. Normally Bit 1 DTCClass_1 in DTCSeverityMask is supported and must be set to 1. If the other bits in DTCSeverityMask are set to 1 then the ECU will respond with those DTCs (if any) which severity corresponds to the requested severity mask.

For more information about “DTCSeverityMask,” “DTCStatusMask,” and “FunctionalGroupIdentifier,” see 6.1.2.

7.2.2.2 Request ZEV Propulsion DTC Response Message Definition

Table 28 - Request ZEV propulsion diagnostic trouble codes with confirmed status response message

Data Byte	Parameter Name	Cvt	Byte Value (Hex)	Mnemonic
#1	Request ReadDTCInformation response SID	M	59	SIDPR
#2	DTCReportType = reportWWHOBDDTCByMaskRecord	M	42	RWWHOBDDTCBMR
#3	FunctionalGroupIdentifier = ZEV Propulsion group	M1	33	FGID
#4	DTCStatusAvailabilityMask	M2	XX	DTCSAM
#5	DTCSeverityAvailabilityMask	M3	02	DTCSVAM
#6	DTCFormatIdentifier = [SAE_J2012DA_DTCFormat_04 SAE_J1939-73_DTCFormat]	M4	 04 02	 J2012DADTCF04 J1939-73DTCF
 #7 #8 #9 #10 #11 : #n-4 #n-3 #n-2 #n-1 #n	DTCAndSeverityRecord[] = [DTCSeverity#1 DTCHighByte#1 (MSB) DTCMiddleByte#1 DTCLowByte#1 statusOfDTC#1 : DTCSeverity#m DTCHighByte m (MSB) DTCMiddleByte m DTCLowByte m statusOfDTC m]	 Ca Ca Ca Ca Ca : Cb Cb Cb Cb Cb	 02 00-FF 00-FF 00-FF 00-FF : 02 00-FF 00-FF 00-FF 00-FF	DTCASR_ DTCS DTCHB DTCMB DTCLB SODTC : DTCS DTCHB DTCMB DTCLB SODTC

a C = Conditional — This parameter is only present if DTC information is available to be reported.
b C = Conditional — This parameter is only present if more than one DTC information is available to be reported. Every DTC will be reported at maximal once in a response.
1 M = Mandatory — Only the Function Group Identifier $33 = "ZEV propulsion-system group" is supported.
2 M: = Mandatory — See Table 2 for a description of the status mask bits. Refer to ISO-14229-1 for DTCStatusAvailabilityMask requirements.
3 M = Mandatory — Local regulation specifies which classes are required to be supported. Normally Bit 1 DTCClass_1 in DTCSeverityMask is supported and therefore the value must be set to 2.
4 M: = Mandatory — Only one DTCFormat shall be supported per ECU. Passenger cars/LDT shall use SAE_J2012_DA_DTCFormat_04. Medium duty/Heavy duty vehicles shall support either SAE_J2012_DA_DTCFormat_04 or SAE_J1939-73_DTCFormat

For more information about this topic, see 6.1.2.

7.2.3 Parameter Definition

For specification of request and response parameters refer to ISO 14229-1

7.2.4 Message Example

For ZEVonUDS ECUs the example below shows how the "Request Regulated ZEV Propulsion DTCs" service is implemented. The external test equipment requests regulated ZEV Propulsion DTCs from the vehicle. The ECU#1 (BECM) has six DTCs stored, and the ECU #2 (EBCM) has no DTC stored.

- ECU #1 (BECM): 014211, 01951C, 023400, 02CD00, 035713, 0A2211
- ECU #2 (EBCM): No DTCs

Table 29 - ZEVonUDS physical request ZEV propulsion diagnostic trouble codes with confirmed status request message

Message Direction:	External test equipment → Physical request to each ECU		
Message Type:	Physical Request (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	ReadDTCInformation request SID	19	SIDRQ
#2	DTCInformationType = reportWWHOBDDTCByMaskRecord	42	RWWHOBDDTCBMR
#3	FunctionalGroupIdentifier = ZEV Propulsion Group	33	FGID
#4	DTCStatusMask = confirmedDTC	08	DTCSM
#5	DTCSeverityMask = DTCClass_1	02	DTCSVM

Table 30 - ECU#1 request ZEV propulsion diagnostic trouble codes with confirmed status response message

Message Direction:	ECU#1 → External test equipment		
Message Type:	Response (DoIP or DoCAN)		
Data Byte	**Parameter Name**	**Byte Value (Hex)**	**Mnemonic**
#1	ReadDTCInformation response SID	59	SIDPR
#2	DTCReportType = reportWWHOBDDTCByMaskRecord	42	RWWHOBDDTCBMR
#3	FunctionalGroupIdentifier = ZEV Propulsion Group	33	FGID
#4	DTCStatusAvailabilityMask	FF	DTCSAM
#5	DTCSeverityAvailabilityMask	02	DTCSVAM
#6	DTCFormatIdentifier = SAE_J2012DA_DTCFormat_04	04	J2012DADTCF04
	DTCAndSeverityRecord[]#1 = [		DTCASR_
#7	DTCSeverity #1	02	DTCS
#8	DTCHighByte #1 (HB)	01	DTCHB
#9	DTCMiddleByte #1 (MB)	42	DTCMB
#10	DTCLowByte #1 (LB)	11	DTCLB
#11	statusOfDTC #1]	AF	SODTC
	DTCAndSeverityRecord[]#2 = [		DTCASR_
#12	DTCSeverity #2	02	DTCS
#13	DTCHighByte #2 (HB)	01	DTCHB
#14	DTCMiddleByte #2 (MB)	95	DTCMB
#15	DTCLowByte #2 (LB)	1C	DTCLB
#16	statusOfDTC #2]	AF	SODTC
	DTCAndSeverityRecord[]#3 = [		DTCASR_
#17	DTCSeverity #3	02	DTCS
#18	DTCHighByte #3 (HB)	02	DTCHB
#19	DTCMiddleByte #3 (MB)	34	DTCMB
#20	DTCLowByte #3 (LB)	00	DTCLB
#21	statusOfDTC #3]	AF	SODTC
	DTCAndSeverityRecord[]#4 = [		DTCASR_
#22	DTCSeverity #4	02	DTCS
#23	DTCHighByte #4 (HB)	02	DTCHB
#24	DTCMiddleByte #4 (MB)	CD	DTCMB
#25	DTCLowByte #4 (LB)	00	DTCLB
#26	statusOfDTC #4]	AF	SODTC
	DTCAndSeverityRecord[]#5 = [		DTCASR_
#27	DTCSeverity #5	02	DTCS
#28	DTCHighByte #5 (HB)	03	DTCHB
#29	DTCMiddleByte #5 (MB)	57	DTCMB
#30	DTCLowByte #5 (LB)	13	DTCLB
#31	statusOfDTC #5]	AF	SODTC

Message Direction:	ECU#1 → External test equipment		
Message Type:	Response (DoIP or DoCAN)		
Data Byte	**Parameter Name**	**Byte Value (Hex)**	**Mnemonic**
	DTCAndSeverityRecord#6 = [		DTCASR_
#32	DTCSeverity #6	02	DTCS
#33	DTCHighByte #6 (HB)	0A	DTCHB
#34	DTCMiddleByte #6 (MB)	22	DTCMB
#35	DTCLowByte #6 (LB)	11	DTCLB
#36	statusOfDTC #6]	AF	SODTC

Table 31 - ECU#2 request ZEV propulsion diagnostic trouble codes with confirmed status response message

Message Direction:	ECU#2 → External test equipment		
Message Type:	Response (DoIP or DoCAN)		
Data Byte	**Parameter Name**	**Byte Value (Hex)**	**Mnemonic**
#1	ReadDTCInformation response SID	59	SIDPR
#2	DTCReportType = reportWWHOBDDTCByMaskRecord	42	RWWHOBDDTCBMR
#3	FunctionalGroupIdentifier = ZEV Propulsion Group	33	FGID
#4	DTCStatusAvailabilityMask	FF	DTCSAM
#5	DTCSeverityAvailabilityMask	02	DTCSVAM
#6	DTCFormatIdentifier = SAE_J2012DA_DTCFormat_04	04	J2012DADTCF04_

7.2.4.1 UDS Negative Response Messages to a physical ZEVonUDS request

The example below shows a physical ZEVonUDS request ZEV propulsion related diagnostic trouble codes for ECU#1 with an incorrect request message.

Table 32 - ZEVonUDS incorrect physical request ECU#1 ZEV propulsion diagnostic trouble codes with confirmed status request message

Message Direction:	External test equipment → ECU#1		
Message Type:	Physical Request (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	ReadDTCInformation request SID	19	SIDRQ
#2	DTCInformationType = reportWWHOBDDTCByMaskRecord	42	RWWHOBDDTCBMR
#3	FunctionalGroupIdentifier = ZEV Propulsion Group	33	FGID
#4	DTCStatusMask = confirmedDTC	08	DTCSM

The table below shows a negative response to physical ZEVonUDS request ZEV propulsion related diagnostic trouble codes from ECU#1 on a request with an incorrect message format.

Table 33 - ECU#1 request ZEV propulsion diagnostic trouble codes with confirmed status negative response message incorrect message length or invalid format

Message Direction:	ECU #1 → External Test Equipment		
Message Type:	Response (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Negative Response Service Identifier	7F	SIDNR
#2	Request ReadDTCInformation request SID	19	SIDRQ
#3	NRC: IncorrectMessageLengthOrInvalidFormat	13	NR_IMLOIF

7.3 Clear/Reset Regulated Diagnostic Information Using Service $14

7.3.1 Functional Description

The purpose of this service is to provide a means for the external test equipment to command ECUs to clear all diagnostic information from the regulated ZEV propulsion system. This includes:

- Confirmed diagnostic trouble codes (accessed with Service $19)
- Pending diagnostic trouble codes (accessed with Service $19)
- Distance traveled while malfunction notification is activated (accessed with Service $22, DID $F421)
- Number of warm ups since DTCs cleared (accessed with Service $22, DID $F430)
- Distance traveled since DTCs cleared (accessed with Service $22, DID $F431)
- Engine run time while malfunction notification is activated (accessed with Service $22, DID $F44D)
- Engine run time since DTCs cleared (accessed with Service $22, DID $F44E)

Additional manufacturer-specific “clearing/resetting” actions may also occur in response to this request message. All ECUs shall respond to this request message with ignition ON and with the propulsion system inactive.

For safety and/or technical design reasons, ECUs that cannot perform this operation under other conditions, such as with the propulsion system active, shall send a negative response message with response code $22 - conditionsNotCorrect.

7.3.2 Message Data Bytes

7.3.2.1 Clear/Reset Regulated Diagnostic Information Request Message Definition

Table 34 - Request clear/reset ZEV propulsion diagnostic information request message

Data Byte	Parameter Name	Cvt	Byte Value (Hex)	Mnemonic
#1	Request Clear diagnostic information request SID	M	14	SIDRQ
#2	groupOfDTC [DTCHighByte]	M	FF	DTCHB
#3	groupOfDTC [DTCMiddleByte]	M	FF	DTCMB
#4	groupOfDTC [DTCLowByte] (“ZEV propulsion group”/”All groups”)	M1	33/FF	DTCLB

1 M = Mandatory — Only the groupOfDTC $33 = “ZEV propulsion group” and groupOfDTC $FF = “all groups” are supported by this document.
A functional request with any unsupported groupOfDTC will result no response.
A physical request with any unsupported groupOfDTC will result with negative response.

The groupOfDTC has been introduced to distinguish commands sent by the test equipment between different functional system groups within an electrical architecture which consists of many different ECUs. If an ECU has implemented software of the ZEV Propulsion System as well as other systems which may be inspected it is important that only the DTC information of the requested functional system group is reported.

ZEVonUDS ECUs use the same group identifier as the “emission-related systems” group identifier. For other cases there are more groupOfDTC (e.g., for Safety systems) defined in ISO-14229-1.

7.3.2.2 Clear/Reset Regulated Diagnostic Information Response Message Definition

Table 35 - Request clear/reset ZEV propulsion diagnostic information response message

Data Byte	Parameter Name	Cvt	Byte Value (Hex)	Mnemonic
#1	Request Clear diagnostic information response SID	M	54	SIDPR

7.3.3 Parameter Definition

For specification of request and response parameters refer to ISO14229-1.

7.3.4 Message Example for Clear Diagnostic Information on DoCAN

The example below shows how the “Clear/reset ZEV propulsion-related diagnostic information” service is implemented via DoCAN. The external test equipment commands the vehicle to “Clear/reset ZEV propulsion-related diagnostic information.”

Table 36 - ZEVonUDS functional request (DoCAN) clear/reset ZEV propulsion diagnostic information request message

Message Direction:	External test equipment → All ECUs		
Message Type:	Functional Request (DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Clear diagnostic information request SID	14	SIDRQ
#2	groupOfDTC [DTCHighByte]	FF	DTCHB
#3	groupOfDTC [DTCMiddleByte]	FF	DTCMB
#4	groupOfDTC [DTCLowByte] (“ZEV propulsion group”/”All groups”)	33/FF	DTCLB

Table 37 - ECU#1 request clear/reset ZEV propulsion diagnostic information DoCAN response message

Message Direction:	ECU #1 → External Test Equipment		
Message Type:	Response (DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Clear diagnostic information request SID	54	SIDPR

Table 38 - ECU#2 request clear/reset ZEV propulsion diagnostic information DoCAN response message

Message Direction:	ECU #2 → External Test Equipment		
Message Type:	Response (DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Clear diagnostic information request SID	54	SIDPR

7.3.5 Message Example for Clear Diagnostic Information on DoIP

The example below shows how the “Clear/reset ZEV propulsion-related diagnostic information” service is implemented via DoIP. The external test equipment commands the vehicle to “Clear/reset ZEV propulsion-related diagnostic information.”

Table 39 - ZEVonUDS physical request (DoIP) clear/reset ZEV propulsion diagnostic information request message

Message Direction:	External test equipment → ECU #1		
Message Type:	Physical Request (DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Clear diagnostic information request SID	14	SIDRQ
#2	groupOfDTC [DTCHighByte]	FF	DTCHB
#3	groupOfDTC [DTCMiddleByte]	FF	DTCMB
#4	groupOfDTC [DTCLowByte] (“ZEV propulsion group”/”All groups”)	33/FF	DTCLB

Table 40 - ECU#1 request clear/reset ZEV propulsion diagnostic information DoIP response message

Message Direction:	ECU #1 → External Test Equipment		
Message Type:	Response (DoIP)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Clear diagnostic information request SID	54	SIDPR

The example below shows a negative response to “Clear/reset emission-related diagnostic information” for an ECU that cannot clear diagnostic information when the propulsion system is active.

Table 41 - ECU#1 request clear/reset ZEV propulsion diagnostic information negative response message condition not correct

Message Direction:	ECU #1 → External Test Equipment		
Message Type:	Response (DoIP or DoCAN)		
Data Byte	**Description (All Values Are in Hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Negative Response Service Identifier	7F	SIDNR
#2	Clear/reset emission-related diagnostic information request SID	14	SIDRQ
#3	NRC: conditionsNotCorrect	22	NR_CNC

7.4 Routine Control Using Service $31

If specific vehicle routines are required by regulation, those routines shall be executed using service $31. Some routines may require specific vehicle enablement criteria.

For details on implementation requirements refer to ISO-14229-1.

8. ADDRESSING SCHEME

ECUs are capable of being addressed by either functional address (broadcast) or physical address (point to point).

The ECUs are required to support all requests by functional and physical addressing. Exceptions are defined in 8.3.

8.1 Functional Addressing (DoCAN)

Functional addressing is used for three main use cases:

8.1.1 Protocol Identification

The Client sends a functionally addressed service $22 $F810 request and builds a list of all ECUs responding to that request.

8.1.2 Identify the vehicle

The Client sends a functionally addressed service $22 $F802 request to get the VIN from the vehicle.

8.1.3 ClearDTCs

The Client sends a functionally addressed service $14 $FFFF33 request to clear all DTCs in the vehicle.

$P2_{Reload}$ ensures that the Client will get all functional responses but they may not be received within $P2_{Client}$=50ms.

8.2 Functional Addressing (DoIP)

Functional addressing on DoIP is limited to one primary purpose: The identification of the ECUs that support ZEV critical propulsion functions. After the ZEV propulsion system has been identified, the remainder of the messaging is done by physical addressing (this is due to the nature of TCP communication itself).

8.2.1 Protocol Identification

The DoIP client sends a functionally addressed $22 $F810 request using Target Address (TA) $E000 and Source Address (SA) $0E00 to the DoIP server(s) and builds a list of all ECUs responding to that request.

8.3 Physical Addressing

Physical addressing is used for all other requests. The Client should first identify the protocol, identify the vehicle and build a list of ECUs. It is allowed that the Client sends physical requests in parallel to different ECUs. Guidance presented in this section applies to DoCAN and DoIP protocols.

Use cases for Physical addressing:

8.3.1 Identify the Supported Functionality of the ECU

The Client requests PIDs/ InfoType Supported information by requesting service $22 $F4xx/$F5xx/$F7xx/$F8xx supported information and builds a list of the supported information for a selected ECU.

8.3.2 Read Data Stream Parameters

8.3.2.1 The Client starts to request data stream parameters ($F4xx range, $F5xx range or $F7xx range) up to six DIDs can be requested in a single request.

8.3.2.2 The Client starts to request vehicle information parameters ($F8xx range) only one (1) vehicle DID can be requested in a single request due to the lack of the Number of Data Items (NODI) information.

8.3.3 Request DTC Information

The Client requests DTC information from the ECU and learns the DTCFormat.

8.3.4 ClearDTCs

The ECU is allowed to execute a physical addressed $14 $FFFF33 request to clear all DTCs in alignment with usage notes for coordinated code clear in SAE J1979 DA.

8.4 First Frame Escape Sequence (FF_ES) for DoCAN ZEVonUDS

An increased amount of OBD data available from ECU Servers may drive message lengths to exceed 4KB in size. To handle the increased data length, the First Frame Escape Sequence (FF_ES) must be used.

NOTE: FF_ES is defined in ISO 15765-2.

An outcome of this is that message responses larger than 4KB could exist for the following subservices of Service $19: reportWWHOBDDTCByMaskRecord.

9. NOTES

9.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY SAE VEHICLE EE SYSTEM DIAGNOSTIC STANDARDS COMMITTEE

APPENDIX A - CAN REQUIREMENTS

A.1 DEFINITION FOR ISO 15765-4

Table A1 - Definition of ISO 15765-4 application timing parameter values

Parameter	Min Value ms	Max Value ms	Description
$P2_{CAN\_Client}$	0	50	This is a system-wide parameter related to diagnostic response times. Each server (ECU) is required to respond to a request between $P2_{CAN\_min}$ and $P2_{CAN\_max}$. P2client also includes the transportation time from server to client. A client (tester) shall wait for at least $P2_{CAN\_max}$ for the single-frame (SF) or first-frame (FF) of a response. $P2_{CAN\_Client}$ is the time until the first indication of a multiple frame response message (FirstFrame). The client shall not process the response until the complete message (last ConsecutiveFrame) has been received. For clients (testers) which also support UDSonCAN for enhanced diagnostics or for OBDonUDS/ZEVonUDS ECUs, a $P2_{reload}$ mechanism is required. Upon receiving the SF or FF the client (tester) shall reload its $P2_{CAN}$ timer with a value of at least $P2_{CAN\_max}$ and restart the timer. Once the client's (tester's) $P2_{CAN\_Client}$ timer expires without receiving a SF or FF the client (tester) may assume no more responses are forthcoming.
$P2^*_{CAN\_Client}$	0	5000	Time between the successful reception of a negative response message with NRC $78 and the next response message (positive or negative message). Refer to ISO 14229-1 for a list of which services support the use of NRC $78.
$P4_{Server}$	0	600000	The timing parameter $P4_{Server}$ is the time between the reception of a request (T_Data.indication) and the start of transmission of the final response (T_Data.request). ISO 14229-2 only specifies P4 on the server side but in this document it shall be read as the requirement for the vehicle, i.e., the maximum time before the Client can receive the final response. This means that the ECU can send an NRC $78 but must send the final response within the $P4_{Server}$ timing specified for that specific service or data parameter. Examples: For most services $P4_{Server}$ is 50ms meaning that the ECU must respond within 50ms. For clearing DTCs the $P4_{Server}$ is 5000ms meaning that the ECU shall be able to clear all OBD DTCs within 5s, but it must send an NRC $78 within P2 timing.

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 or in ISO 14229-2.

APPENDIX B - DoIP REQUIREMENTS

B.1 TIMING

Table B1 - Definition of ISO 13400 application timing parameter values

Parameter	Min Value ms	Max Value ms	Description
$P6_{Client}$	5000	*(1)	Timeout for the client to wait after the successful transmission of a request message (indicated via T_Data.con) for the complete reception of the corresponding response message (indicated via T_Data.ind).
$P6^*_{Client}$	10000	*(1)	Enhanced timeout for the client to wait after the reception of a negative response message with negative response code 0x78 (indicated via T_Data.ind) for the complete reception of the corresponding response messages (indicated via T_Data.ind).

(1) The maximum value a client uses to wait for the complete reception of the corresponding response message is left to the discretion of the client provided it is greater than the specified minimum value. However, the vehicle shall respond within the minimum value.

All other DoIP timing requirements can be found in ISO 13400-2.

B.2 ZEVonUDS DoIP LOGICAL ADDRESS ASSIGNMENT

ZEVs using DoIP shall support functional group logical address 0xE000. Manufacturer specific functional group logical addresses are also permitted but outside the scope of ZEVonUDS.

Table B2 - Regulated ZEV logical address assignment

Addressing Message Type	Target Address (TA)	Source Address (SA)	Description
Functional request	$E000_{16}$	$0E00_{16}$	SA = ZEV external test equipment TA = all ZEV-relevant server(s)/ECU(s)
Physical request[b]	$YYXX_{16}$[a]	$0E00_{16}$	SA = ZEV external test equipment TA = one ZEV-relevant server/ECU
Physical response[b]	$0E00_{16}$	$YYXX_{16}$[a]	SA = one ZEV-relevant server/ECU TA = ZEV external test equipment

[a] $YYXX_{16}$ range from $E001_{16}$ to $E3FF_{16}$.
[b] Physical request and response $YYXX_{16}$ shall be the same for each diagnostic entity.

B.3 ROUTING ACTIVATION

For routing activation requests and responses for ZEVonUDS, VM-specific payload data is not permitted.

Table B3 - ZEVonUDS DoIP routing activation

Value	Description	Required Action	Support
00_{16}	Default	None	Mandatory
01_{16}	Diagnostic communication required for regulated ZEV Propulsion Systems	None	Mandatory[a]
02_{16}-DF_{16}	ISO/SAE Reserved		
$E0_{16}$	Central Security	VM-specific	Optional
$E1_{16}$ to FF_{16}	Available for additional VM-Specific Use	VM-specific	Optional

[a] 0x01 is the only routing activation within scope of this document and has priority over other activation types.