SURFACE VEHICLE RECOMMENDED PRACTICE

J1978™-2 DEC2025

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OBD-II Scan Tool - Second Generation Protocols

RATIONALE

This document has been revised to include further DoIP content, editorial revisions, and clarifications.

FOREWORD

On-board diagnostic (OBD) regulations require passenger cars and light- and medium-duty trucks to support the communication of a minimum set of diagnostic information with off-board “generic” test equipment (e.g., OBD II scan tool). This document describes the minimum capabilities that must be supported by an OBD-II scan tool (e.g., handheld scan tools, PC-based diagnostic computers, etc.) that are intended to communicate with an OBD-compliant vehicle to retrieve the OBD information. SAE J1978 was originally developed to meet U.S. OBD requirements for 1996 and later model year vehicles. SAE J1978-2 represents the second document in the SAE J1978 OBD-II scan tool family of recommended practices. The document has been created to represent industry advancement of allowed second generation protocols for OBD-II “generic” scan tool use. Also, as part of the SAE J1978 document family, the separate first document, SAE J1978-1, contains recommended practice information on allowed first generation OBD data links.

INTRODUCTION

SAE J1978-2 defines a set of user functions necessary for a scan tool that supports the diagnostic scan tool use case of emission-related and zero emissions-related subsystems that utilize on-board diagnostic (OBD) capability on second generation protocols. Additionally, this document offers recommended practices for key topics that the scan tool must support, such as required communication protocols, scan tool power management, applicable diagnostic connector, and guidance on user interface text. This document strives to share, within the scope of legislated emissions-related and zero emissions-related OBD, the description of the interaction between a vehicle’s OBD system and an external OBD-II “generic” scan tool.

Acknowledging early OBD-II “generic” scan tool document development, it is important to note that SAE J1978-2 is one of several SAE documents necessary for understanding the diagnostic scan tool use case. For full comprehension of this use case, there are applicable ISO documents that must be considered.

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1. SCOPE

SAE J1978-2 specifies a complementary set of functions to be provided by an OBD-II scan tool. These functions provide complete, efficient access to all regulated OBD services on any vehicle that is compliant with SAE J1979-2 and SAE J1979-3.

The content of this document is intended to satisfy the requirements of an OBD-II scan tool as required by current U.S. OBD regulations.

This document specifies:

- A means of establishing communications between an OBD-equipped vehicle and an OBD-II scan tool.
- A set of diagnostic services to be provided by an OBD-II scan tool in order to exercise the services defined in SAE J1979-2 and SAE J1979-3. In addition, SAE J1978-1 covers first generation protocol functionality defined in SAE J1979 plus automatic protocol determination for all SAE J1979/J1979-2/J1979-3 application content.
- The presentation of the SAE J1978 document family, where SAE J1978-2 covers second generation protocol functionality defined in SAE J1979-2 and SAE J1979-3, and SAE J1978-1 covers first generation protocol functionality defined in SAE J1979 and protocol determination for SAE J1979, SAE J1979-2, and SAE J1979-3.

The SAE J1978 document family does not preclude the inclusion of additional capabilities or functions in an OBD-II scan tool. However, it is the responsibility of the OBD-II scan tool designer to ensure that no such capability or function can adversely affect either an OBD-equipped vehicle, which may be connected to the OBD-II scan tool, or an OBD-II scan tool itself.

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 (U.S. and Canada only) or +1 724-776-4970 (outside U.S. and Canada), www.sae.org.

SAE J1699-2 Test Cases for OBD-II Scan Tools and I/M Test Equipment

SAE J1850 Class B Data Communications Network Interface

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

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

SAE J1939 Serial Control and Communications Heavy-Duty Vehicle Network - Top-Level Document

SAE J1939-73 Application Layer - Diagnostics

SAE J1939DA J1939 Digital Annex

SAE J1962 Diagnostic Connector

SAE J1978 OBD-II Scan Tool

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SAE J1978-1 OBD-II Scan Tool: First Generation Protocols

SAE J1979 E/E Diagnostic Test Modes

SAE J1979-2 E/E Diagnostic Test Modes: OBDonUDS

SAE J1979-3 E/E Diagnostic Test Modes: Zero Emission Vehicle Propulsion Systems on UDS (ZEVonUDS)

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 J3005-1 Permanently or Semi-Permanently Installed Diagnostic Communication Devices

2.1.2 ISO Publications

Copies of these documents are available online at www.iso.org/store.

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

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 14229-1:2020 Road vehicles - Unified diagnostic services (UDS) - Part 1: Application layer

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

ISO 14230 Road vehicles - Diagnostic systems - Keyword Protocol 2000

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

ISO 15031-3 Road vehicles - Communication between vehicle and external equipment for emissions-related diagnostics - Part 3: Diagnostic connector and related electrical circuits: Specification and use

ISO 15765-4 Road vehicles - Diagnostics on controller area network (CAN) - Part 4: Requirements for emissions-related systems

ISO 27145-3 Road vehicles - Road vehicles - Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements - Part 3: Common message dictionary

ISO/IEC 10731:1994 Information technology - Open Systems Interconnection - Basic Reference Model - Conventions for the definition of OSI services

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3. DEFINITIONS

ECU SERVER: Diagnostic application responsible for serving diagnostic information.

EXTERNAL DIAGNOSTIC CLIENT: Diagnostic application within semi-permanent attached device to vehicle SAE J1962 data link connector responsible for requesting diagnostic information.

FIRST GENERATION PROTOCOLS: Protocols that have been developed for and are in use by the OBD-II system interface for scan tool communication to vehicle ECU servers. Period of allowed use for first generation protocols is defined by CARB 1968.2 OBD II regulation.Protocols SAE J1850 PWM, SAE J1850 VPW, ISO 14230-4 Fast Initialization, ISO 14230-4/ISO 9141-2 5 baud initialization, and ISO 15765-4 DoCAN are first generation protocols used with the SAE J1979 (OBDonEDS) application layer.

INTERNAL DIAGNOSTIC CLIENT: Diagnostic application within vehicle-mounted ECU responsible for requesting diagnostic information.

OBD-II SCAN TOOL: A software application operating with interface hardware that supports features defined in this recommended practice.

SECOND GENERATION PROTOCOLS: Protocols that have been developed for and are in use by the OBD-II system interface for scan tool communication to vehicle ECU servers. Period of allowed use for second generation protocols is defined by CARB 1968.2 OBD II regulation. Protocols ISO 15765-4 (DoCAN) and ISO 13400 (DoIP) are second generation protocols used with the SAE J1979-2 (OBDonUDS) and SAE J1979-3 (ZEVonUDS) application layer.

4. ABBREVIATIONS

Addr	Address
DID	Data identifier
DoCAN	Diagnostic communication over controller area network
DoIP	Diagnostic communication over internet protocol
DoK-line	Diagnostic communication over K-line
DTC	Diagnostic trouble code
DTCEDRN	DTC extended data record number
DTCMREC	DTC mask record
DTCSM	DTC status mask
DTCSSRN	DTC snapshot record number
DTCSVM	DTC severity mask
ECM	Engine control module
ECU	Electronic control unit
EDR	Extended data record
EDS	Emission diagnostic services
FGID	Functional group identifier
FTB	Failure type byte
GODTC	Group of DTC
IUMPR	In-use monitor performance ratio
IPT	In-use performance tracking
ITID	Infotype identifier
I/M	Inspection and maintenance

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MID	Monitor identifier
MIL	Malfunction indicator lamp
NRC	Negative response code
OBDMID	On-board diagnostics monitor identifier
OBD	On-board diagnostics
OBDonEDS	On-board diagnostics on emission diagnostic services
OBDonUDS	On-board diagnostics on unified diagnostic services
PWM	Pulse width modulation
RGID	Readiness group identifier
RID	Routine identifier
rpm	Revolution per minute
SF	Sub-function
SID	Service identifier
SMAD	Supplemental monitor activity data
SPN	Suspect parameter number
TCM	Transmission control module
TID	Test identifier
UDP	User datagram protocol
UDS	Unified diagnostic services
VPW	Variable pulse width
ZEVonUDS	Zero emission vehicle on unified diagnostic services

5. SYMBOLS

%	Percentage
A	Ampere
°C	Degree Celsius
°F	Degree Fahrenheit
kbps	Kilobit per second
kPa	Kilopascal
mA	Milliampere
mph	Miles per hour
ms	Millisecond
Min^{-1}	1/minute
s	Second
V	Volt, voltage

6. CONVENTIONS

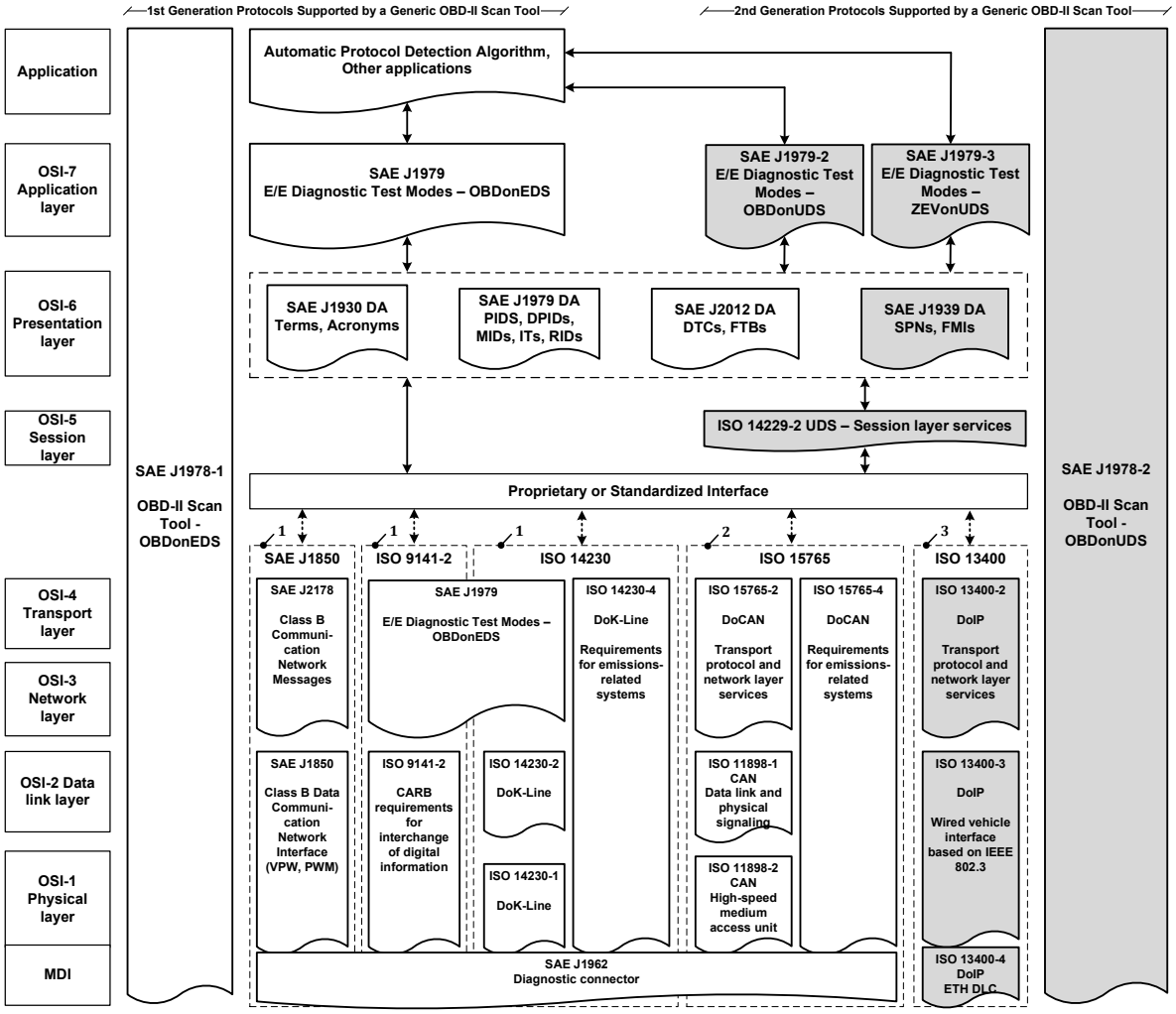
SAE J1978-2 is based on the conventions discussed in open systems interconnection - basic reference model - and conventions for the definition of OSI services (refer to ISO/IEC 10731:1994) as they apply to diagnostic services.

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7. DOCUMENT OVERVIEW

SAE J1978-2 specifies the data record structures and references SAE J1930DA, SAE J1979DA, SAE J2012DA, and SAE J1939DA. SAE J1979-2 specifies applicable emissions-related diagnostic services for the OBD-II scan tool described herein. SAE J1979-3 specifies applicable zero-emissions vehicle-related diagnostic services for the OBD-II scan tool described herein. Further, SAE J1979 shall specify applicable diagnostic services for the OBD-II scan tool that are applicable to emission vehicles that use first generation protocols.

The protocol initialization identifies whether ISO 15765-4 DoCAN (either OBDonUDS, ZEVonUDS, or OBDonEDS), SAE J1850 PWM/VPW, ISO 14230-4 DoK-Line Fast Initialization, ISO 14230-4 DoK-Line/ISO 9141-2 5 baud initialization is the protocol supported by the vehicle. Related SAE and ISO documents reference these standards as applicable protocols for emissions-related OBD.



Note	Description
1	SAE J1850, ISO 9141-2, ISO 14230 DoK-line protocols are supported by SAE J1978-1
2	ISO 15765 protocol is supported by SAE J1978-1 and SAE J1978-2
3	ISO 13400 is supported by SAE J1978-2

Figure 1 - OBD II scan tool diagnostic services document reference (per OSI model)

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The document reader is also informed that the white boxes are supported by SAE J1978-1 (first generation protocols supported by an OBD-II scan tool), and the gray shaded boxes are supported by SAE J1978-2 (second generation protocols supported by an OBD-II scan tool).

8. REQUIRED FUNCTIONS OF THE OBD-II SCAN TOOL

For guidance on this category, please refer to the equivalent named section contained in SAE J1978-1.

9. COMMUNICATION PROTOCOLS

For guidance on the category of first generation protocols, please refer to the equivalent named section contained in SAE J1978-1.

For second generation protocols, please refer to the ISO 14229-3 standard.

10. CONNECTIONS TO THE VEHICLE

For guidance on the category of connection to a first generation protocol, please refer to the equivalent named section contained in SAE J1978-1.

For connection to a second-generation protocol that: (a) uses DoCAN, please refer to the SAE J1962/ISO 15031-3 standards or (b) uses DoIP, please refer to the ISO 13400-4 standard.

NOTE 1: For UDP communication on IPV4, the test equipment shall use only limited broadcast as defined in ISO 13400-2.

NOTE 2: For test equipment $P6_{client}$ timer configuration, please reference the maximum value defined in ISO 27145-3.

11. AUTOMATIC DETERMINATION OF COMMUNICATION INTERFACE

For guidance on this category, please refer to the equivalent named section contained in SAE J1978-1.

12. NETWORK ACCESS - SECOND GENERATION PROTOCOLS

NOTE: For SAE J1850 PWM, SAE J1850 VPW, ISO 14230-4 DoK-Line Fast Initialization, ISO 14230-4 DoK-Line/ISO 9141-2 5 baud initialization, and ISO 15765-4 DoCAN protocol support by an OBD-II scan tool, refer to SAE J1978-1 for guidance on network access functionality.

12.1 Multiple Tester Communication

For guidance on this category, including internal diagnostic clients, please refer to the equivalent named section contained in SAE J1978-1.

12.1.1 General

For guidance on this category, please refer to the equivalent named section contained in SAE J1978-1.

12.1.2 Behavior of an OBD-II Scan Tool

For guidance on this category, please refer to the equivalent named section contained in SAE J1978-1.

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12.2 Handling of No Response from the Vehicle

A vehicle module may not respond to a request message from the OBD-II scan tool because of incorrect transmission or because the module does not support that message. If a response is not received within the time-out period prescribed by the protocol, the OBD-II scan tool shall:

a. Retransmit the request message after a 200-ms minimum time-out.

b. If there is still no response, transmit a service 0x22 DID 0xF810 request message in order to determine if communication with the vehicle is currently possible and if the data desired is available.

c. If a service 0x22 DID 0xF810 response is received, transmit other messages, if available, to determine whether the desired data is supported by the vehicle.

d. If the above steps fail, then indicate to the user, as appropriate, that communication with the vehicle cannot be performed, that communication with the module cannot be performed, or that the information the user has selected is unavailable.

e. For compatibility to enhanced diagnostic communication (i.e., refer to ISO 14229-3) and to make the functionality of the external tester more robust, the following mechanism is allowed:

    1. If data is received from one control module, then the OBD-II scan tool is allowed to restart its timer in order to wait for further responses from other control modules. This is called P2reload.

    2. The client should respect the P2reload concept but may send the next request when it has received all responses. It does not need to wait the full P2reload time if it knows how many ECUs should send responses and it has received all those responses.

12.3 Handling of Multiple Responses from the Vehicle

For guidance on this category, please refer to the equivalent named section contained in SAE J1978-1.

12.4 Message Structure

Communication between the OBD-II scan tool and the vehicle consists of repeated cycles of the OBD-II scan tool issuing a request message to the vehicle module(s) and the vehicle module(s) responses. The structure of these messages is specified in SAE J1979-2 and SAE J1979-3. SAE J2012 and SAE J1939-73 specify the usage of diagnostic trouble codes, which may be contained in response messages. SAE J1930 specifies the approved terms, DID acronyms, and module names that may be contained in response messages.

12.5 Diagnostic Trouble Codes Monitoring

The OBD-II scan tool shall be capable of continuously obtaining, converting, and displaying OBD emissions-related DTCs and the accompanying DTC Status from the vehicle. The OBD-II scan tool shall determine the DTC format reported by the server by evaluating the DTCFormatIdentifier as specified in ISO 14229-1. The OBD-II scan tool shall continuously obtain and display DTCs while this function is selected.

Specifically, the five data bytes that comprise data for a DTC are described as follows:

12.5.1 SAE J2012 DTC Format 0x04 Descriptive Information

12.5.1.1 The 1-Byte DTC Severity

The 1-byte DTC severity byte hexadecimal number, its descriptive text, or both, shall be displayed. DTC severity and descriptive text are specified in SAE J1979-2.

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12.5.1.2 The 2-Byte DTC Number

The 2-byte DTC Number (in BCD), its descriptive text, or both shall be displayed. DTCs and their descriptive text are specified in SAE J2012DA.

12.5.1.3 The 1-Byte DTC Failure Type

The 1-byte DTC failure type byte hexadecimal number, its descriptive text, or both shall be displayed. DTC failure type bytes and their descriptive text are specified in SAE J2012DA.

12.5.1.4 The 1-Byte DTC Status Number

The 1-byte DTC status byte hexadecimal number, its descriptive text, or both shall be displayed. DTC status bits and their descriptive text are specified in SAE J1979-2.

12.5.2 SAE J1939 DTC Format 0x02 Descriptive Information

12.5.2.1 The 1-Byte DTC Severity

The 1-byte DTC severity byte hexadecimal number, its descriptive text, or both, shall be displayed. DTC severity and descriptive text are specified in SAE J1979-2.

12.5.2.2 The 19-Bit DTC Number

The 19-bit DTC number, its descriptive text, or both, shall be displayed. Suspect Parameter Number (SPN) interpretation is specified in SAE J1979-2. DTCs (SPNs) and their descriptive text are specified in SAE J1939DA. Use of a bit range represents the SAE J1939 SPN, which forms the DTC description.

12.5.2.3 The 5-Bit DTC Failure Mode Indicator

The 5-bit DTC failure mode indicator hexadecimal number, its descriptive text, or both, shall be displayed. Failure Mode Indicator (FMI) interpretation is specified in SAE J1979-2. DTC failure mode indicators and their descriptive text are specified in SAE J1939DA. Use of a bit range represents the SAE J1939 Failure Mode Indicator (FMI), which forms the DTC failure mode indicator.

12.5.2.4 The 1-Byte DTC Status Number

The 1-byte DTC status byte hexadecimal number, its descriptive text, or both, shall be displayed. DTC status bits and their descriptive text are specified in SAE J1979-2.

12.6 Obtain and Display Current Data/Freeze Frame, Test Results, and Vehicle Identification Data

The OBD-II scan tool shall create an internal table in its memory to maintain a list of supported DIDs/MIDs/TIDs/ITIDs for each ECU that responds to a service request message with the requested “supported DID/MID/TID/ITID” (e.g., 0xF400, 0xF420, ... 0xF4E0).

If bit 0 of Data D is reported as 0, that indicates that no additional DIDs/MIDs/TIDs/ITIDs are supported by that ECU.

If bit 0 of Data D is reported as 1, that indicates that additional DIDs/MIDs/TIDs/ITIDs are supported by that ECU. The OBD-II scan tool does not need to request any additional “supported DIDs/MIDs/TIDs/ITIDs” if bit “0” of Data D is reported as 0 by all ECUs.

The OBD-II scan tool shall test for support of DID 0xF44F and 0xF450, which include OBD-II scan tool configuration information. If supported, the modified scaling factors provided by these two DIDs shall be applied by the OBD-II scan tool when requesting these DIDs listed in the DID 0xF44F and 0xF450 definitions (refer to SAE J1979DA).

The OBD-II scan tool shall request or display data from an ECU only when that ECU indicated it supports that data item. The OBD-II scan tool shall not display data from an ECU if that ECU indicated it does not support that data item.

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The OBD-II scan tool shall be capable of obtaining, converting, and displaying:

a. OBD current data as described in SAE J1979DA specifying all emission-related data. For each data item, an OBD-II scan tool display text string and the formatting of the data value is specified in the SAE J1979DA column “display criteria” (e.g., rpm: xxxxx min-1).

b. OBD emissions-related freeze frame data (same data display as specified in 12.6.a).

c. Test parameters and results data as described in SAE J1979DA, specifying details of what data is available, the messages to be used to request the data, the messages to be used to return the data, the conversion values for the data, and the format to be used to display the data.

d. Vehicle information as described in SAE J1979DA. In order to be able to decode vehicle information, guidance is for the OBD-II scan tool to request at least one but not more than six DIDs per request.

When current data items or test parameters and results are selected for display, the OBD-II scan tool will continuously request of the vehicle the data to be displayed and will display the data received in the corresponding response messages. When freeze frame is selected for display, the OBD-II scan tool does not need to continuously request and display those items.

Where applicable, the OBD-II scan tool shall indicate whether a test limit is a high limit or a low limit. Where applicable, the display of test results shall also show the test ID (TID) and monitor ID (MID).

Data from the vehicle may indicate which items are supported, in which case this information shall be made available to the user by the OBD-II scan tool. The OBD-II scan tool shall also allow users to specify requests for services, DIDs, TIDs, etc., irrespective of whether the vehicle has indicated support for such items.

12.7 Code Clearing

The OBD-II scan tool shall be capable of sending a request to clear OBD emissions-related DTCs, freeze frame data, and diagnostic tests status information. The OBD-II scan tool shall require the user to confirm such a request prior to transmission.

Permanent DTCs (Service 0x19, subfunction 0x55) will not be cleared by any request to clear OBD emissions-related DTCs. According to SAE J1979-2, Permanent DTCs can only be cleared by the vehicle being driven in accordance with the prescribed drive cycle for clearing such DTCs.

12.8 On-Board Diagnostic Evaluations

12.8.1 Completed On-Board System I/M Monitor Readiness Tests

Immediately after the OBD-II scan tool has successfully established communication with the vehicle, it shall check the status of the system I/M monitor readiness tests. If the supported tests have not all been completed, the OBD-II scan tool shall indicate to the user: “Not all supported on-board system I/M monitor readiness tests have been completed” or equivalent. The equipment shall also allow the user to identify any I/M monitor readiness tests that have not been completed.

12.8.2 On-Board System I/M Monitor Readiness Tests - Support Status

The OBD-II scan tool shall indicate to the user which of the tests specified by SAE J1979-2 service 0x22, DID 0xF501 are supported.

When the ECU server indicates support for service 0x22, DID 0xF501, then data A - F are supported and thus the scan tool can determine which I/M monitor readiness tests are supported. For an ECU Server response message for DID 0xF501 data, the OBD-II scan tool shall use bits 0-3 of data bytes B, C, D, E, and F to determine which I/M monitor readiness bits are supported. The I/M monitor readiness information displayed shall be appropriate for the ignition type.

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12.8.3 On-Board System I/M Monitor Readiness Tests - Ready Status

When the ECU server indicates support for service 0x22, DID 0xF501, then data A - F are supported and thus the scan tool can determine which I/M monitor readiness tests are set to ready. For an ECU Server response message for DID 0xF501 data, the OBD-II scan tool shall use bits 4-7 of data bytes B, C, D, E, and F to determine which I/M monitor readiness bits are ready. The I/M monitor readiness information displayed shall be appropriate for the ignition type.

12.8.4 Malfunction Indicator Lamp - Status and Control

The OBD-II scan tool shall be capable of indicating if the MIL has been commanded ON and, if so, by which module or modules. The OBD-II scan tool shall indicate to the user the commanded MIL status specified by SAE J1979-2 service 0x22 DID 0xF501 data A, bit 7, shall be used to indicate MIL ON/MIL OFF status.

13. USER INTERFACE

13.1 Display

The OBD-II scan tool shall be capable of displaying simultaneously at least two items of OBD emissions-related current data items, emissions-related freeze frame data items, or emissions-related diagnostic trouble codes. A list of the OBD current data and freeze frame data items, their parameter IDs, data resolution and data conversion information, units, and display formats are provided in SAE J1979DA. The display shall be capable of displaying alphanumeric characters. The display shall at least support the SI units as specified in SAE J1979DA. Unit conversions specified in SAE J1979DA shall be used.

DTCs shall be displayed as specified in A.4.

As a minimum, the data values of two data items must be displayed simultaneously. For each displayed parameter data item, a display of data identifier (DID) for the data item and ECU name of the reporting module that supplied the parameter data item must be easily accessible if not displayed with the parameter data values. The units of measurement associated with the data items shall be:

a. Displayed with the data values.

b. Easily accessible on the display.

c. Readily available to the user (e.g., on the body of the external test equipment).

Having this information available in a user manual separate from the body of the OBD-II scan tool does not satisfy this requirement.

13.2 User Input

The OBD-II scan tool shall present the user the following functions as specified by services (refer to SAE J1979-2):

a. Select between the standardized functions required by OBD regulation, e.g.:

    1. System I/M monitor readiness test status display.

    2. MIL status and control.

    3. Display current data.

    4. Display freeze frame data.

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5. Display diagnostic trouble codes:
    i. Pending.
    ii. Confirmed.
    iii. Permanent.
6. Clear emissions-related data.
7. Display test parameters and results.
8. Read vehicle identification.

b. Select for simultaneous display at least two OBD emissions-related items of any one of the following categories:
    1. Current data.
    2. Freeze frame data.
    3. Diagnostic trouble codes.
    4. Test parameters and results.

c. Confirm a request to clear and/or reset OBD emissions-related diagnostic information.

d. Request and allow control operation of an on-board system, test, or component.

Responses from multiple modules to requests for a current data item or a freeze frame data item are treated as separate data items for selection and display purposes.

14. POWER REQUIREMENTS

For guidance on this category, please refer to the equivalent named section contained in SAE J1978-1.

15. ELECTROMAGNETIC COMPATIBILITY (EMC)

For guidance on this category, please refer to the equivalent named section contained in SAE J1978-1.

16. CONFORMANCE TESTING

The test cases, once specified by the SAE J1699 task force, shall be performed successfully five consecutive times on each sample unit to be considered passed.

17. NOTES

17.1 Revision Indicator

A change bar (I) 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.

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APPENDIX A - RECOMMENDED EXTERNAL TEST EQUIPMENT COMMON USER INTERFACE DISPLAYS

A.1 GENERAL DATA DISPLAY GUIDELINES

The following are recommendations about the display layout and formatting of the OBD-II scan tool when data parameters, DTCs, I/M monitor readiness, OBD test results, and vehicle/ECU identification data are to be displayed. The support of parameter formats, DTC formats, and information types require general implementation guidelines for the OBD-II scan tool on how to display information to the automotive technicians in a common user interface format. The examples provided in this appendix do neither address nor show provisions for multiple languages, e.g., reserved text string space per text string.

General data display guidelines shall be followed to achieve a common user interface format when displaying emissions-related data on an external test equipment display.

The following guidelines apply:

- Each information/data shall be displayed in conjunction with the ECU/module name (ECUNAME, if supported by the ECU/module - refer to SAE J1979DA - service 0x22 ITID 0xF80A) or address in order to simplify the relation between emissions-related data and ECU/module.
- External test equipment with smaller type displays shall use the abbreviated terms as defined in SAE J1930DA, SAE J1979DA, and SAE J2012DA. External test equipment with larger type displays shall use the full text descriptors as defined in the above SAE documents (see Section 2).
- A consistent display layout shall be followed to ease readability.
- The data shall follow SAE J1979DA guidelines described “display criteria” column.

A.2 SELECT FUNCTION MENU DISPLAY

The OBD-II scan tool shall provide a “select function” menu that displays all available features depending on the supported services/diagnostic modes of all emissions-related OBD ECU/modules installed in the vehicle. After automatically determining the applicable protocol and supported functions with data, the OBD-II scan tool shall only display supported items in the select function menu.

Table A1 provides an example as well as test menu text strings to be displayed depending on the protocol identified.

Table A1 - Select menu display example

Select Function for Data Display
Vehicle Identification
Diagnostic Trouble Codes - Confirmed, Pending, Permanent
DTC Readiness by Readiness Group
Freeze Frame
Clear Diagnostic Information
I/M Monitor Readiness
Current Data
OBD Test Results
In-Use Monitor Performance Ratio
Supplemental Monitor Activity
Failure Specific B1 Counter
In-Use Performance Tracking
Activate OBD Tests

The key press or touch navigation of the “select menu” should provide scroll capability if the display size is too small to display all menu selections. By no means shall the above example limit the OBD-II scan tool developers to add other features, e.g., a function key for each menu item, or change the order or appearance of the menu items.

OBD-II scan tool manufacturers are free to implement a different menu structure to promote their products.

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A.3 VEHICLE IDENTIFICATION DATA DISPLAY

The vehicle identification data items as specified in SAE J1979DA shall be displayed to show each vehicle identification data item.

A.3.1 Vehicle Identification Data Important Implementation Points

Shown below are key details about implementing this feature:

a. The OBD-II scan tool has to first determine supported vehicle identification data using service 0x22, ITID 0xF800, then request supported vehicle information type identifiers (ITIDs 0xF801-F8FF) as specified in SAE J1979DA.

b. Information type identifiers that belong together should be presented on the display next to each other. An example would be ITIDs for Cal ID and CVN.

c. A minimum of two data parameters shall be displayed simultaneously.

d. The text abbreviation (acronym) or text full description for each data item shall be displayed. Refer to SAE J1930DA and SAE J1979DA.

e. The ECU acronym, full-length description, or ECU/module address that supplied the data item(s) shall be displayed with the data values.

f. User experience shall include a display full text to display acronym text switch.

g. Refresh of vehicle identification (static) data shall be left to the discretion of the OBD-II scan tool implementation. For retrieving (dynamic) data over a data link, the OBD-II scan tool implementation should follow recommended guidance from SAE J3005-1. For tool display updates, the OBD-II scan tool should strive to refresh displayed data at a minimum of five updates per second.

Further data display template and example guidance for vehicle identification data are provided in the following subsections.

A.3.2 Identification Data Display Template

The following vehicle identification data display template should be used to format vehicle identification data items as specified in SAE J1979DA.

Breakdown of columns shown in Table A2:

a. ECU Acronym / Descriptor / Address column on the left displays the ECU/module ECUNAME (acronym or full-length descriptor), if supported by the ECU/module (service 0x22, ITID 0xF80A). If ECUNAME is not supported, then the responding ECU address, in hexadecimal number format and derived from the header of the ECU response message, shall be displayed.

b. Parameter Number column displays the hexadecimal numbers, which represent the data identifier.

c. Parameter column displays the descriptive text string for the data identifier.

d. Parameter Value column displays the parametric value for the data identifier (conversion and format per SAE J1979DA).

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Table A2 - Vehicle identification data display template

ECU Acronym / Descriptor / Address	Parameter Number	Parameter	Parameter Value
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #1 Address	SID 0x62, data bytes 2,3 (ITID #1; ITIDHB, ITIDLB), …	ITID Data Item #1 Text Descriptor	SID 0x62, ITID #1, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #1 Address	SID 0x62, data bytes 2,3 (ITID #2; ITIDHB, ITIDLB), …	ITID Data Item #2 Text Descriptor	SID 0x62, ITID #2, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #1 Address	SID 0x62, data bytes 2,3 (ITID #3; ITIDHB, ITIDLB), …	ITID Data Item #3 Text Descriptor	SID 0x62, ITID #3, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #1 Address	SID 0x62, data bytes 2,3 (ITID #4; ITIDHB, ITIDLB), …	ITID Data Item #4 Text Descriptor	SID 0x62, ITID #4, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #1 Address	SID 0x62, data bytes 2,3 (ITID #5; ITIDHB, ITIDLB), …	ITID Data Item #5 Text Descriptor	SID 0x62, ITID #5, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #1 Address	…	…	…
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #1 Address	SID 0x62, data bytes 2,3 (ITID #n; ITIDHB, ITIDLB), …	ITID Data Item #n Text Descriptor	SID 0x62, ITID #n, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #2 Address	SID 0x62, data bytes 2,3 (ITID #1; ITIDHB, ITIDLB), …	ITID Data Item #1 Text Descriptor	SID 0x62, ITID #1, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #2 Address	SID 0x62, data bytes 2,3 (ITID #2; ITIDHB, ITIDLB), …	ITID Data Item #2 Text Descriptor	SID 0x62, ITID #2, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #2 Address	SID 0x62, data bytes 2,3 (ITID #3; ITIDHB, ITIDLB), …	ITID Data Item #3 Text Descriptor	SID 0x62, ITID #3, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #2 Address	SID 0x62, data bytes 2,3 (ITID #4; ITIDHB, ITIDLB), …	ITID Data Item #4 Text Descriptor	SID 0x62, ITID #4, data bytes 4,…, n.
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #2 Address	…	…	…
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #2 Address	SID 0x62, data bytes 2,3 (ITID #n; ITIDHB, ITIDLB), …	ITID Data Item #n Text Descriptor	SID 0x62, ITID #n, data bytes 4,…, n.
…	…	…	…
SID 0x62, ITID 0xF80A, Data A-D, or Data F-T, or ECU #n Address	SID 0x62, data bytes 2,3 (ITID #n; ITIDHB, ITIDLB), …	ITID Data Item #n Text Descriptor	SID 0x62, ITID #n, data bytes 4,…, n.

A.3.3 Identification Data Display Example

This identification data display example shows data items that were received from two emissions-related ECUs/modules. For proper referral to the ECUs, use the module address or ITID 0xF80A ECUNAME, if supported by the ECU/module. The data items and numbers shown in this example are derived from the vehicle information examples specified in SAE J1979-2, SAE J1979-3, and data definition from SAE J1979DA.

The vehicle identification data display example shows data items that were received from two emissions-related ECUs. Use of ECUNAME is shown to improve the user experience of identifying the responding ECU. Vehicle identification data parameter number, with vehicle identification data parameter description text, are displayed. Vehicle identification data parameter number and description text are defined by SAE J1979DA and SAE J1939DA. In this example, there are 14 vehicle identification data parameters with data values.

The following identification data display example should be used to display identification data items as specified in SAE J1979DA.

Breakdown of columns shown in Table A3 (reference row one values):

a. ECU Acronym / Descriptor/ Address = “ECM / Engine Control”

b. Parameter Number = “0xF802 / 0xF802”

c. Parameter description text string = “VIN”/“Vehicle Identification Number”

d. Parameter value (formatted per SAE J1979DA) = “1G1JC5444R7252367/1G1JC5444R7252367”

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Table A3 - Vehicle identification data display example

ECU Acronym / Descriptor / Address	Parameter Number	Parameter	Parameter Value
ECM	0xF802	VIN	1G1JC5444R7252367
ECM	0xF804	CALID#1	JMB*36761500
ECM	0xF806	CVN#1	1791BC82
ECM	0xF804	CALID#2	JMB*47872611
ECM	0xF806	CVN#2	16E062BE
ECM	0xF80A	ECU Name	ECM–Engine Control
ECM	0xF80D	ESN	BRAND 3217486
ECM	0xF80F	EROTAN	DOC-CR-934567
ECM	0xF810	PROTOCOL ID	OBDonUDS
ECM	0xF811	GTR	GTR_005_000
ECM	0xF812	FEOCNTR	2390
ECM	0xF813	TGEFN	123456789ABC
TCM	0xF804	CALID#1	JMA*431299110000
TCM	0xF806	CVN#1	98123476

Display Acronym Text ↑ ↓ Display Full Text

ECU Acronym / Descriptor / Address	Parameter Number	Parameter	Parameter Value
Engine Control	0xF802	Vehicle Identification Number	1G1JC5444R7252367
Engine Control	0xF804	Calibration Identifier #1	JMB*36761500
Engine Control	0xF806	Calibration Verification Number #1	1791BC82
Engine Control	0xF804	Calibration Identifier #2	JMB*47872611
Engine Control	0xF806	Calibration Verification Number #2	16E062BE
Engine Control	0xF80A	ECU Name	ECM–Engine Control
Engine Control	0xF80D	Engine Serial Number	BRAND 3217486
Engine Control	0xF80F	Exhaust Regulation Or Type Approval Number	DOC-CR-934567
Engine Control	0xF810	Protocol Identification	OBDonUDS
Engine Control	0xF811	GTR Number	GTR_005_000
Engine Control	0xF812	Fueled Engine Operation Ignition Cycle Counter	2390
Engine Control	0xF813	Certification Test Group/Engine Family Number	123456789ABC
Trans Control	0xF804	Calibration Identifier #1	JMA*431299110000
Trans Control	0xF806	Calibration Verification Number #1	98123476

A.4 DIAGNOSTIC TROUBLE CODE DISPLAYS

The diagnostic trouble code data items as specified in SAE J1979DA shall be displayed to show each diagnostic trouble code data item.

A.4.1 Diagnostic Trouble Code Important Implementation Points

Shown below are key details about implementing this feature:

a. The OBD-II scan tool shall be capable of continuously obtaining, converting, and displaying OBD emissions-related diagnostic trouble codes (DTCs) from the vehicle.

b. The display template and examples in this section should be used to show confirmed, pending, or permanent DTCs.

c. The diagnostic trouble code with failure type, descriptive text, and status shall be displayed.

d. A summary that displays DTC type (Confirmed, Pending, Permanent) count information with reporting ECU Name shall be displayed.

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e. The OBD-II scan tool shall be capable of displaying DTC formats specified in SAE J1979-2 and defined in SAE J2012DA (DTC format byte 0x04 defines an SAE J2012 DTC) and SAE J1939DA (DTC format byte 0x02 defines an SAE J1939-73 DTC).

f. If the OBD-II scan tool has determined the format byte is equivalent to SAE J2012DA formatted DTCs, the “DTC Number” column shall display the two-byte main code and single-byte failure mode identifier. On the OBD-II scan tool display, a “dash” character shall separate DTC code and failure byte information.

g. If the OBD-II scan tool has determined the format byte is equivalent to SAE J1939-73 formatted DTCs, the “DTC Number” column shall display the two-byte suspect parameter number (SPN) and single-byte failure mode identifier (FMI). On the OBD-II scan tool display, a “dash” character shall separate DTC code and failure byte information.

h. An ECU may respond to a request for DTCs with no DTC and Severity Record data (specified in SAE J1979-2 as data bytes #7 to #n). In this situation, the ECU is indicating there are no DTCs to report. In the DTC Summary use case, the diagnostic application GUI should display “0” in the appropriate area of the GUI. In the DTC Display use case, the diagnostic application GUI should display “No DTCs” in the appropriate area of the GUI.

i. To determine the DTC description text string, the OBD-II scan tool has to decode DTC data bytes, then associate the data bytes to a DTC text descriptor lookup table in a diagnostic application. Once the lookup is complete, the text characters are displayed on the OBD-II scan tool GUI.

j. To determine the DTC failure description text string, the OBD-II scan tool has to decode DTC low byte, then associate the data byte to an FMI text descriptor lookup table in a diagnostic application. Once the lookup is complete, the text characters are displayed on the OBD-II scan tool GUI.

k. The text abbreviation (acronym) or text full description for each data item shall be displayed. Refer to SAE J1930DA and SAE J1979DA.

l. The ECU acronym, full-length description, or ECU/module address that supplied the data item(s) shall be displayed with the data values.

m. Depending on the display size and user interface features, the user experience designer should strive to display the DTC Summary using a single graphic user interface plus individual DTCs in a separate graphic user interface.

n. Refresh of diagnostic trouble code data shall be left to the discretion of the OBD-II scan tool implementation. For retrieving (dynamic) data over a data link, the OBD-II scan tool implementation should follow recommended guidance from SAE J3005-1. For tool display updates, the OBD-II scan tool should strive to refresh displayed data at a minimum of five updates per second.

Further data display template and example guidance for diagnostic trouble code summary and diagnostic trouble code display data are provided in the following subsections.

A.4.2 Diagnostic Trouble Code Summary Display Template

The following diagnostic trouble code summary data display template should be used to format diagnostic trouble code data items as specified in SAE J2012DA, SAE J1939DA, and SAE J1979DA.

For quick assessment of vehicle DTCs, the OBD-II scan tool shall make available a summary display of DTC count by type (Confirmed, Pending, Permanent) and total DTC count each associated to the reporting ECU name. A sample of a DTC summary display template is shown below.

Breakdown of columns shown in Table A4:

a. ECU Acronym / Descriptor / Address column on the left displays the ECU/module ECUNAME (acronym or full-length descriptor), if supported by the ECU/module (service 0x22, ITID 0xF80A). If ECUNAME is not supported, then the responding ECU address, in hexadecimal number format and derived from the header of the ECU response message, shall be displayed.

b. Confirmed DTCs column displays the number of confirmed DTCs stored per ECU/module

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