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SURFACE VEHICLE RECOMMENDED PRACTICE

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Expanded Diagnostic Protocol for OBD II Scan Tools

Foreword—This Document has also changed to comply with the new SAE Technical Standards Board format.

Title 13, California Code of Regulations, Section 1968.1 "Malfunction and Diagnostic System Requirements 1994 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles With Feedback Control Systems," more commonly known as OBD II, includes the requirement that motor vehicle manufacturers provide information for the diagnosis and service of emissions-related powertrain components using the SAE J1978 OBD II Scan Tool and commonly available non-microprocessor tools (k 2.1).

In order for motor vehicle manufacturers to use an SAE J1978 OBD II Scan Tool to diagnose and service emissions related powertrain components:

a. Vehicles must support a message protocol compatible with the facilities of the OBD II Scan Tool and capable of accessing the vehicle services required to diagnose and service vehicle emissions related powertrain components and systems
b. The SAE J1978 OBD II Scan Tool must include facilities that allow the scan tool user to enter, edit, select, and transmit messages to a vehicle, identify the messages to be received from the vehicle, and receive them; and describe how to process the data in the received messages, and process them.

The vehicle communication interface used for this purpose is the one used by the vehicle to support SAE J1979 messages.

The messages to be transmitted or received and processed must conform to the requirements defined in SAE J1979, SAE J1850, and ISO 9141-2, with the exception that the message header and data fields may be vehicle specific.

The purpose of the Expanded Diagnostic Protocol is to define the encoding techniques to be used:

a. To describe to the SAE J1978 OBD II Scan Tool the messages to be transmitted to a vehicle and how they are to be transmitted,
b. To describe to the SAE J1978 OBD II Scan Tool the messages to be received and processed by the scan tool, and
c. To describe to the SAE J1978 OBD II Scan Tool how to process the data in the received messages.

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1. ***Scope***—This SAE Recommended Practice defines the Expanded Diagnostic Protocol (EDP), the requirements for the SAE J1978 OBD II Scan Tool for supporting the EDP protocol, and associated requirements for diagnosis and service information to be provided by motor vehicle manufacturers.

Appendix A includes worked examples of the use of the protocol.

2. ***References***

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1850—Class B Data Communication Network Interface
SAE J1930—Electrical/Electronic Systems Diagnostic Acronyms, Terms, and Definitions
SAE J1962—Diagnostic Connector
SAE J1978—OBD II Scan Tool
SAE J1979—Common Diagnostic Test Modes
SAE J2008—Recommended Organization of Vehicle Service Information

2.1.2 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 9141-2:1994(E)—Road vehicles—Diagnostic systems—CARB requirements for interchange of digital information

2.2 Other Publications

AIAG-B-1 1984—Automotive Industry Action Group—Bar Code Symbology Standard—3 of 9 Bar Code Symbols
Section 1968.1, Title 13, California Code of Regulations, "Malfunction and Diagnostic System Requirements 1994 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles With Feedback Control Systems"
Environmental Protection Agency 40 CFR Part 86 Control of Air Pollution From New Motor Vehicles and New Motor Vehicle Engines; Regulations Requiring On-Board Diagnostic Systems on 1994 and Later Model Year Light-Duty Vehicles and Light-Duty Trucks

3. ***Definitions***—SAE J1930 is hereby referenced as the basis for all such terms in this document, with the following additions:

3.1 CRC—Cyclic Redundancy Check—A byte of data appended to message data transmitted on SAE J1850 to ensure detection of corrupted data. CRC is defined in SAE J1850.

3.2 DSV—Data Security Verification—A byte of data appended to Extended Diagnostic Protocol definitions to ensure detection of corrupted data in EDP definitions, especially when they are entered and/or edited.

3.3 **EDP**—Extended Diagnostic Protocol—A method of encoding; messages to be transmitted, the selection of messages to be received, and how the data in the received messages are to be processed so that these messages can be processed by the SAE J1978 OBD II Scan Tool.

3.4 **OBD II**—A term commonly used to refer to Section 1968.1, Title 13, California Code of Regulations, "Malfunction and Diagnostic System Requirements 1994 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles With Feedback Control Systems."

3.5 **RDPI**—Received Data Processing Information—The information that describes how to process the data in received messages. This information includes a Received Data Processing Type and may include other type specific information.

3.6 **RDPT**—Received Data Processing Type—A code that indicates which data in the received message is to be processed, how the data is encoded, and how it is to be processed.

3.7 **Codes Used in This Document**—Unless otherwise specified, all codes shown in this document are hexadecimal. All codes shown preceded by a "$" (e.g., $1F) are also hexadecimal.

3.8 **Tolerance for Timing Values**—Unless otherwise specified, all timing values will have a ±10% tolerance (e.g., 10ms = 10 ms ± 1 ms).

3.9 **User Manual and/or Help Facility**—References to "user manual" and/or "help facility" in this document refer to the user manual and/or help facility requirement of SAE J1978 OBD II Scan Tool.

3.10 **Significance of Bytes in a Multiple Byte Field of a Received Message**—With respect to Received Data Processing Type definitions, a multiple byte field in a received message is interpreted first received byte, second received byte, third received byte, etc., and last received byte of the field as the most significant byte, less significant byte(s), and finally, the least significant byte, respectively.

4. ***Introduction***—EDP provides a way of describing to the SAE J1978 OBD II Scan Tool:

   a. Messages to be transmitted to the vehicle, and associated operating information (i.e., message repetition rate, etc.),
   b. The messages to be received from the vehicle and processed,
   c. How to process the data contained in the received messages,
   d. Miscellaneous ISO 9141-2 related information (e.g., stop communication message, idle message, when to use the stop message, idle message parameters, etc.).

   EDP is intended as an open-ended means for allowing motor vehicle manufacturers to communicate, through the OBD II supported communication interface, with vehicle modules using vehicle and module specific messages. EDP, as a minimum, is available to support diagnosing and servicing emissions-related components and systems.

   Motor vehicle manufacturers may include and reference EDP definitions within diagnostic and service procedures for emissions-related components and systems.

5. ***Communication Interfaces and Messages Supported***—The purpose of the functionality defined in this document is to support the use of the SAE J1978 OBD II Scan Tool for communicating with vehicles for the purpose of diagnosing and servicing vehicle emissions-related components and systems. This communication uses messages transmitted to and received from a vehicle that may be unique to a given vehicle manufacturer, model year, vehicle body type, powertrain module, etc. These messages will support facilities unknown at the time this document is developed. Compared to the SAE J1979 messages, these messages may have different message headers and different data fields.

In order to support the communication requirements unique to ISO 9141-2, EDP must support:

a. The user's selection of an address,
b. The transmission of a message that terminates the communication link with the currently addressed module(s), and
c. The definition of an idle message and the characteristics of its transmission.

The other parameters defined by ISO 9141-2 and unmodified by SAE J1978 remain in effect.

EDP messages will use the same vehicle interface that supports the SAE J1979 messages.

Response messages received from an ISO 9141-2 interface must be no longer than 256 bytes.

6. ***SAE J1978 OBD II Scan Tool EDP Support Requirements***—The SAE J1978 OBD II Scan Tool must allow users to enter, edit, and delete EDP definitions, and to select EDP definitions for processing (i.e., execution) and termination.

The SAE J1978 OBD II Scan Tool must be able to repeatedly transmit at least two messages, and monitor for, receive, and process the data in at least four receive message definitions and their associated processing information, simultaneously. A total of at least 256 bytes must be available to retain message bytes received due to active definitions.

The OBD II Scan Tool must allow the entry and retention of a combined total of at least 15 EDP definitions, where each definition may require up to 256 characters. One byte in a definition consists of two characters (e.g., 3C). One field separator (i.e., ",") is one character. One "/" is one character.

The determination of the retention time of EDP definitions after external power is disconnected from the scan tool is left to the discretion of the scan tool manufacturer.

The format of all definitions will include input data security verification (DSV) information and definition length information to minimize data input errors. The scan tool shall indicate to the user the presence of data entry errors in any definition. The scan tool shall allow the user to enter and save definitions that include errors and edit them. The scan tool shall not allow the user to process definitions with errors.

The user's manual/help facility of an SAE J1978 OBD II Scan Tool must document how to enter, edit, delete, select for processing, and select for termination EDP definitions.

The scan tool must support the entry of all the characters used in message definitions, such as hexadecimal data (i.e., 0-9, A-F), a "don't care nibble" identifier character, shown in this document as a "/" (slash), and a field separator character, shown in this document as a "," (comma).

The actual means of performing these actions is left to the scan tool manufacturer. The scan tool user's manual/help facility must describe how to perform these actions.

The processing of EDP definitions shall have no effect on other functions of the SAE J1978 Scan Tool (e.g., automatic determination of OBD II interface, processing of SAE J1979 messages, etc.).

7. *EDP Definitions*

7.1 Introduction—There are four general types of EDP definitions:

a. Control type
b. Transmit type
c. Receive only type
d. Miscellaneous type

Each definition type includes a variable set of individual fields (e.g., id field (see 7.3), length field (see 7.4), type field (see 7.5), transmit message information (tx msg) field (see 7.6), receive filter information (rx filter) field (see 7.7), received data processing information (rx data processing info) field (see 7.8), and data security verification information (DSV) field (see 7.9)), each of which are further described in sections below.

The general forms of the four general EDP definition types are:

For control type definitions:

<id>,<length>,<type>,<DSV>

For transmit type definitions:

<id>,<length>,<type>,<tx msg>,<rx filter>,<rx data processing info>,<DSV>

For receive only type definitions:

<id>,<length>,<type>,,<rx filter>,<rx data processing info>,<DSV>

For miscellaneous type definitions:

<id>,<length>,<type and additional information>,<DSV>

7.2 Validation of Definition Data—The SAE J1978 OBD II Scan Tool will check for the correctness of all values entered for a given definition. Correct values for all fields, including the length of the overall definition, the codes used, the lengths of subfields, and the DSV value are required in order for the definition to be allowed to be processed.

7.3 Id Field—The id of a definition is the identification tag that allows a user to select a given definition for editing, deletion, execution, and termination. Some id values (see 7.3.1) imply automatic execution. Id values are assigned by the vehicle manufacturer. Diagnostic and service information shall reference definitions by their id. The id is available for users to indicate definitions to be edited, deleted, executed, and terminated.

The actual method used by a given SAE J1978 OBD II Scan Tool to enable the user to indicate which definition(s) the user wishes the scan tool to process must be described in the scan tool user's manual/help facility.

If a given definition id is already associated with an EDP definition when another message definition using the same id is successfully entered then the previous definition shall be replaced by the new definition.

Relative to vehicle diagnostic or service procedure documentation, where it would be useful, it is recommended that some meaningful identification (i.e., test name - EGR TEST, procedure name - INITIALIZATION, etc.) be associated in vehicle repair procedures with one or a set of definitions that perform an identifiable diagnostic or service procedure. This associated name could be used to directly access effectively similar facilities in scan tools that support them.

7.3.1 AUTOMATIC EXECUTION FOR DEFINITION IDS 0 TO 9—If a message definition with an id in the range of 0 to 9 is successfully entered into the scan tool then the scan tool shall, in addition to recording this message definition, process it immediately as if it had been entered and selected for processing by the scan tool user. Any currently executing definition having the same definition id shall be terminated and replaced by the new definition.

7.4 Definition Length Field—The length field specifies the length or size of the definition in characters. Definition length is the number of characters in the definition, beginning with the definition id field and ending with the DSV field, inclusive. This includes any "don't care" symbols ("/") and field separators (","). The length field is one byte.

7.5 Definition Type Field—The type field indicates the type of definition.

Control type definitions (see 8.1.1 and 8.2) are used to define general operating parameters such as ones associated with the communication interface. When connected to a given vehicle, the SAE J1978 OBD II Scan Tool will automatically identify the communication interface used by the vehicle for CARB OBD II functions.

Transmit type definitions (see 8.1.2 and 8.2) define messages to be transmitted, how often they are to be transmitted when selected for processing, and optionally, an associated receive message filter and received data processing information.

Receive only type definitions (see 8.1.3 and 8.2) define only a receive message filter and associated received data processing information.

Miscellaneous type definitions are intended to define situations that fall out of the other definition types. Currently there are no miscellaneous definition types.

7.6 Transmit Message Field—The <type> and <tx msg> fields together describe what is to be transmitted and other miscellaneous transmit parameters such as how often the message will be transmitted.

The transmit message field, "<tx msg>", has the form:

aa bb cc ... zz

where:

aa bb cc ... zz are hexadecimal bytes that define the message to be transmitted

The actual message transmitted by the scan tool is determined by the definition type, the interface being used, and the values of aa bb cc ... zz.

If the transmit type is SAE J1979, the transmit message field, "aa bb ... zz", will be interpreted as the SAE J1979 request message mode and mode data. The header for the transmit message and the receive filter information will automatically be as defined by SAE J1979.

As defined in SAE J1850, a CRC will automatically be appended to all messages transmitted on an SAE J1850 interface. As defined in ISO 9141-2, a checksum will automatically be appended to all messages transmitted on an ISO 9141-2 interface.

7.7 **Receive Message Filter Field**—Receive message filter information, <rx filter>, is used by the scan tool to filter messages for processing from all the messages that may be received by the scan tool from the vehicle.

Specifying receive message filter information is optional but generally is a requirement for effective scan tool usage, particularly for SAE J1850 vehicle interfaces. If no receive message filter information is specified in a transmit or a receive only definition, default receive message filter information may be available in some cases. For example, if the transmit type is SAE J1979, then the associated SAE J1979 response message header definition will be used as the default receive message filter. If the vehicle OBD II interface is ISO 9141-2, then the default receive message filter information will be to use any message received.

Only one definition with a null receive message filter field (i.e., this field does not contain any filter information, such as ",,"), may be active at a time (i.e., all received messages will be processed by the received data processing instructions in this definition). All active non-null receive message filter fields shall take precedence over an active definition with a null receive message filter field. That is, any message detected by the scan tool should be processed against the active non-null received filters first, and processed against an active null receive filter last.

As defined in SAE J1850, a CRC will be expected for all messages received on a SAE J1850 interface. As defined in ISO 9141-2, a checksum will be expected for all messages received on an ISO 9141-2 interface.

The received message filter information has the form:

aa bb cc ... zz

where:

aa bb cc ... zz are nibble (i.e., 4 bits) by nibble indicators of whether to ignore or to match a supplied nibble value:

a = /	to ignore a received nibble
= 0 - F	to specify the value the received nibble must match

The comparison of received message data with all currently active receive message filters begins with the first byte of the received message and continues for the length of a given receive message filter. The received message must be at least as long as a given filter for that filter to be used. There is no implied meaning given to the data of the received message that are compared with received message filters. A particular vehicle's message protocol may interpret the data compared to received message filters as partial headers, full headers, headers and data, etc.

7.8 **Received Data Processing Information (RDPI) Field**—Associated with every receive message filter definition is default or specified sets of received data processing information.

Each set of received data processing information defines:

a. Which data in the received message the data processing information applies to
b. How that data is to be interpreted
c. How that data is to be formatted, if displayed
d. Other optional features, such as display constants
e. Other ways in which the data may be processed

If no received data processing information is specified with a given receive message filter, the following default received data processing information will be used:

All data of the received message will be displayed as hexadecimal values, beginning with the first byte of the received message through the last byte of the received message.

The display facilities of a given SAE J1978 OBD II Scan Tool implementation are subdivided into at least two display areas, in keeping with the SAE J1978 OBD II Scan Tool requirement to display simultaneously at least two data values. How a given scan tool actually implements display areas is left to the discretion of the scan tool manufacturer and must be described in the scan tool user's manual/help facility.

More than two display areas may be supported.

If data to be displayed from a given received message is larger than an available display area, the available display area is used as a window, displaying only a portion of the total data to be displayed, beginning with the first character of data to be displayed. The scan tool must allow the user to move the window back and forth over the entire data to be displayed.

The scan tool user's manual/help facility must specify how the display area window is moved back and forth over display data.

The complete set of received data processing information associated with a given received message filter is made up of one or more sets of Receive Data Processing Information <RDPI>:

<rx data processing info> = <RDPI><RDPI> ... <RDPI>

A set of Received Data Processing Instructions <RDPI> is of the form:

<RDPI> = <Received Data Processing Type><additional information>

Received Data Processing Types (RDPT) are further described in 8.3. Any "additional information" depends on the RDPT and is further explained in 8.4.3. The size of each received data processing information is defined by the type and any additional information.

7.9 **Data Security Verification Field**—The Data Security Verification Field <DSV> field is used with the length field to verify the correct entry of a definition into the scan tool. The value of DSV is the simple 1 byte sum without carry of all byte values in the message definition.

Where a "," is a part of a definition, the ASCII value for "," ($2C) will be included in the DSV calculation in place of the ",". Where an "/x" is a part of a definition, the ASCII value for "/" ($2F) and the value 0x will be included in the DSV calculation in place of the "/x". Where an "x/" is a part of a definition, the ASCII value for "/" ($2F) and the value x0 will be included in the DSV calculation in place of the "x/".

8. Codes for EDP Definition Fields

8.1 **Definition Type Codes**—The following sections briefly identify the values for Control, Transmit, and Receive Only definition type codes. These codes are more fully explained in 8.2.

8.1.1 CONTROL DEFINITION TYPE CODES—Figure 1 shows the codes defined for Control Type definitions and a short description of the meaning of the codes:

Type	Description
12	Terminate the current ISO 9141-2 communication connection and begin the ISO 9141-2 addressing and initialization sequence with the given address
13	Define the idle message to be used for ISO 9141-2 communication
14	Define the stop 9141 communication message to be used to terminate ISO 9141-2 communication
17	Set the standard message retransmission interval
18	Use only two display areas
19	Delete all current definitions
1A	Delete a given definition by id
1B	Deactivate all active receive filters
1C	Deactivate a receive filter by definition id

FIGURE 1—CONTROL DEFINITION TYPE CODES

8.1.2 TRANSMIT DEFINITION TYPES—Figure 2 shows the codes defined for Transmit Type definitions and their descriptions:

Type	Description
20	Transmit this message once per selection
21	Transmit this message repeatedly at the standard interval once selected, until selected again, at which time stop the repeated retransmissions
22	Transmit message repeatedly at given interval once selected, until selected again, at which time stop the repeated retransmission
23	Transmit message repeatedly, once selected, at given interval for a given maximum interval, until selected again at which time stop the repeated retransmission
24	Process this message as an SAE J1979 request and transmit once per selection
25	Process this message as an SAE J1979 request and transmit repeatedly at the standard interval once selected, until selected again, at which time stop the repeated retransmission
26	Process this message as an SAE J1979 request and transmit repeatedly at the standard interval once selected, until selected again, at which time stop the repeated retransmission
27	Process this message as an SAE J1979 request and transmit message repeatedly, once selected, at given interval for a given maximum interval, until selected again at which time stop the repeated retransmission

FIGURE 2—TRANSMIT DEFINITION TYPES

8.1.3 RECEIVE ONLY DEFINITION TYPES—Figure 3 shows the code defined for Receive Only Type definitions and its description:

Type	Description
30	Receive only definition

FIGURE 3—RECEIVE ONLY DEFINITION TYPES

8.1.4 VEHICLE MANUFACTURER RESERVED DEFINITION TYPES—Definition type codes $80 - $FF are reserved for use by vehicle manufacturers.

8.2 Definition Type Codes Defined—For each message definition type, the form of the message type information field, the definition of any additional information, and the processing to be performed by the scan tool is shown.

12 Terminate the current ISO 9141-2 communication connection and begin the ISO 9141-2 addressing and initialization sequence with the given address

12 xx

where: xx = ISO 9141-2 address

When a message definition with this message type is processed by a scan tool and ISO 9141-2 is the OBD II communication interface, the scan tool will terminate the current ISO 9141-2 communication link using a stop 9141 message, if one has been defined, or if one is not defined, will terminate all communication for 5 s to force all active communication to terminate. After active communication has been terminated, a minimum of 300 (decimal) ms of bus idle will be allowed before the scan tool will begin the ISO 9141-2 addressing and initialization process, using the address given in the definition.

It is recommended that the scan tool indicate to the user what is going on whenever a 5 s delay is in progress.

13 Define the idle message to be used for ISO 9141-2 communication

13 aa bb ... zz

where: aa bb ... zz defines the idle message to be used to keep the ISO 9141-2 interface from reverting into address mode

This message definition defines the message to be used to keep the ISO 9141-2 communication link with the currently addressed module active.

14 Define the stop message to be used to terminate ISO 9141-2 communication

14 aa bb ... zz

where: aa bb ... zz defines the message to be used to terminate communication on the ISO 9141-2 interface

Subsequent redefinitions of the stop message replace previous definitions. If no aa bb ... zz data follows the 14, any previously defined stop message is deleted and the stop message facility is not available.

17 Set the standard retransmission interval

17 xx

where: xx becomes the standard retransmission interval, in 10 (decimal) ms increments

When a message definition with this message type is processed by a scan tool, the scan tool will begin to use the value specified for current and subsequent messages that are to be retransmitted at the standard rate.

Until a definition of this type specifies a message retransmission interval, an interval of 120 (decimal) ms shall be used. The retransmission interval is the time between the start of one message transmission and the start of the next transmission of the same message.

18 Use only two display areas

18

When a message definition with this message type is processed by a scan tool, the scan tool will use only two display areas, even if the scan tool is able to support more than two.

19 Delete all current message definitions

19

When this message type is processed by a scan tool, the scan tool will delete all current definitions.

1A Delete a given definition

1A xx

where: xx is a definition id

When this message type is processed by a scan tool, the scan tool will delete the message definition associated with the given id.

1B Deactivate all receive filters

1B

When a message definition with this message type is processed by the scan tool, the scan tool will deactivate all currently active receive message filters.

1C Deactivate a given receive filter

1C xx

where: xx is a definition id

When a message definition with this message type is processed by the scan tool, the scan tool will deactivate the receive filter associated with the given definition id.

20 Transmit given message once

20

When a message definition with this message type is processed by a scan tool, the scan tool will transmit the message contained in this definition, and enable any receive filter information contained in this definition. If the processing of this definition causes the limit of a given scan tool for simultaneously active transmit messages or simultaneously active receive filters to be exceeded, the oldest active transmit message will be terminated or the oldest active receive filter will be deactivated.

21 Transmit given message repeatedly at the standard interval

21

When a message definition with this message type is processed by a scan tool, the scan tool will begin to repeatedly transmit at the standard interval the message defined in this definition. The next time this definition is selected, message retransmission will be terminated. When selected again, the message will again begin to be repeatedly retransmitted, and so on.

The receive filter information associated with the definition selected will be added to the set of simultaneously active receive filters when the transmit message begins to be transmitted and will be deleted from the set of simultaneously active receive filters when message transmission is terminated.

22 Transmit a given message repeatedly at a given interval

22 xx

where: xx is the given interval in 10 (decimal) ms

Same processing as for type 21 except that the retransmission interval is specified in the definition.

23 Transmit a given message repeatedly at a given interval for a given maximum interval

23 xx yy yy

where: xx is the given retransmission interval in 10 (decimal) ms, and yy yy is the maximum transmission interval in seconds

Same processing as for type 22 except that the retransmissions will be terminated at the end of the maximum transmission interval or if this definition is selected again.

24 Process as a SAE J1979 request message and transmit it once per selection

24

When a message definition with this message type is processed by a scan tool, the scan tool will process the message as a SAE J1979 message. The transmit information supplied in this definition begins with the SAE J1979 mode value followed by any additional mode specific information. The header for the SAE J1979 message will be according to the OBD II interface type as defined in SAE J1979. The resultant transmit message will be transmitted once per selection. The default receive filter and received data processing information will be as defined for the selected SAE J1979 message.

25 Process this message as an SAE J1979 request and transmit it repeatedly at the standard interval

25

Process the transmit information as is defined for type 24 and transmit this message as is defined for type 21.

26 Process this message as an SAE J1979 request and transmit message repeatedly at given interval

26 xx

where: xx is the given interval in 10 (decimal) ms

Process the transmit information as is defined for type 24 and transmit this message as is defined for type 22.

27 Process this message as an SAE J1979 request and transmit message repeatedly at given interval for a given maximum interval

27 xx yy yy

where: xx is the given retransmission interval in 10 (decimal) ms, and yy yy is the maximum transmission interval in seconds

Process this message as is defined for type 24 and transmit this message as is defined for type 23.

30 Receive only definition

The transmit information field of this definition should be null. Use the receive message filter field of the definition to filter received messages, and process the received messages as defined in the received data processing information field.

8.3 Received Data Processing Type (RDPT) Codes—The following is a list of Received Data Processing Types and a short description of the processing type.

8.3.1 TEXT DISPLAY DATA IN A DEFINITION—Text to be displayed as a part of processing of the data from a received message may be defined in a definition. The text may be displayed before and/or after the processed data. RDPTs within the range $00 to $7F are interpreted as standard ASCII codes. Some of these codes are for non-displayable characters (e.g., $0D for carriage return may cause the scan tool to move to the next line or may cause the scan tool to not do anything) and generally should not be used. Character codes for "A" to "Z" and "a" to "z" may be displayed in the same way, if not supported uniquely.

8.3.2 DATA CONVERSION—Figure 4 shows RDPT codes that identify which data in the received message is to be processed, how the data is to be interpreted, and how the data is to be displayed.

RDPT	Description
80	Display byte(s) as hexadecimal
81	Display nibble(s) as hexadecimal
82	Display byte(s) as bits
83	Display byte(s) as bits with display mask
84	Display nibble(s) as bits
85	Display nibble(s) as bits with display mask
86	Display byte(s) as unsigned decimal
87	Display byte(s) as signed decimal
88	Display byte(s) as signed decimal with signed offset
89	Display byte(s) as = aX + b, X = signed decimal
8A	Display byte(s) as decimal with binary point
8B	Display byte(s) as DTC if not zero
8C	Display byte(s) as ASCII coded data
8D	Display standard string indexed by byte(s)
8E	Display byte(s) as a percentage with given denominator y = x * (100 (decimal) / denominator)
8F	Display byte(s) with a given signed offset as a percentage with a given denominator y = (x + offset) * (100 (decimal) / denominator)
90	Display byte(s) using given scaling data
91	Display byte(s) as BCD data
92	Display one of indexed text set based on logic value of received data ANDed with given bit mask
93	Display one of indexed text set based on inverse logic; value of received data ANDed with given bit mask

FIGURE 4—DATA CONVERSION

8.3.3 MISCELLANEOUS DISPLAY FUNCTIONS—Figure 5 shows RDPT codes that cause the scan tool to display standard text information, clear parts or all of the display, and control the location of the next information to be displayed.

RDPT	Description
98	Display given standard string
99	Clear entire display
9A	Clear given display area
9B	Position to beginning of display
9C	Position to beginning of next display area
9D	Position to beginning of given display area
9E	Clear a given display area and position to the beginning of the display area
9F	Display byte(s) as y = aX + b, X = unsigned decimal
B0	Display 2 blanks
B1	Display 4 blanks
B2	Move right 1 position
B3	Move right 2 positions
B4	Move right 4 positions
B5	Move right a given number of positions

FIGURE 5—MISCELLANEOUS DISPLAY FUNCTIONS

8.3.4 RDPT CODES FOR ALTERING DEFINITION EXECUTION—Figure 6 shows RDPT codes that cause the scan tool to alter the execution of definitions based on the data received. They describe what received data is to be processed, what data is to be compared to the received data, what type of data comparison must be found to cause a change in definition execution, and what change to definition execution is to be made if the comparison is true.

RDPT	Description
A0	If byte(s) equal terminate processing of this definition
A1	If byte(s) equal terminate processing of this definition and start processing of a given definition
A2	If byte(s) equal terminate processing of the given definition
A8	If byte(s) not equal terminate processing of this definition
A9	If byte(s) not equal terminate processing of this definition and start processing of a given definition
AA	If byte(s) not equal terminate processing of the given definition

FIGURE 6—RDPT CODES FOR ALTERING DEFINITION EXECUTION

8.3.5 RDPT CODE FOR UNIQUE PROCESSING OF MULTIPLE RECEIVED MESSAGES—Normally, when multiple messages are received due to the same definition, each received message is processed as the latest version of the same message. The last message received is the last one processed and last one displayed. Any previous messages have been processed and replaced by the next received message. In some cases, however, multiple messages received due to the same definition each convey unique information that must be displayed separately. Examples are the response messages to a SAE J1979 mode 3 - Request DTC's message.

Figure 7 shows the RDPT code that causes the scan tool to separately process multiple messages, received due to the same definition, as unique data. The results of the received message processing of each message are to be concatenated, one after another, from the first received message to the last, within the limits of the scan tool to retain all the received data.

When used, this RDPT code must be the first one in a Received Data Processing Information field. When a scan tool cannot retain any more received messages due to a definition that includes this RDPT code, the scan tool shall indicate such an error to the user, and document this error type in the user/help facility. The scan tool will allow the user to scan the processed data as described in SAE J1978 for displaying any data that cannot all be displayed because of the size of the data is greater than the size of the display.

RDPT	Description
C0	Multiple message received as the result of this definition are to be processed as unique information and displayed, one after the other in the order received, to the limit of the scan tool to retain them. Each selection of the definition that includes this RDPT, or retransmission of any transmit message if included, will restart the collection and processing of received messages.

FIGURE 7—RDPT CODE FOR UNIQUE PROCESSING OF MULTIPLE RECEIVED MESSAGES

8.4 Received Data Processing Type Codes Defined

8.4.1 SYMBOLS USED IN DESCRIBING RECEIVED DATA PROCESSING TYPES—The following defines symbols used in 8.4.3 to describe RDPTs:

xx Indicates an offset, in bytes, to the beginning of a data field in the received message ($00 = first byte in received message, $01 = second byte in received message, $FF = last byte in received message, $FE = second last byte in received message, etc. Note that the last byte of a received message is the message error detection byte. Some hardware may not make this byte available for processing. If the last message byte is referenced in a RDPT, but is not available, the RDPT will be ignored.)

yy Indicates the length of a data field, in bytes

xy Indicates a combination of an offset, in bytes, to the beginning of a data field and the length of a data field, in bytes, where the "x" and "y" are individual nibbles in one definition byte

where:x = offset, in bytes, to the beginning of a data field in the received message ($0 = first byte in received message, $1 = second byte in received message, $F = 16th (decimal) byte in received message, $E = 15th (decimal) byte in received message, etc.)

y = length of data field, in bytes ($1 = one byte, $2 = two bytes, etc.)

xy = $52 defines a 2 byte data field that begins with the 6th byte of the received message

aa Indicates an offset, in nibbles, to beginning of a data field in the received message ($00 = first nibble in received message, $01 = second nibble, etc.). The first nibble of the message is the most significant nibble of the first byte of the message, the second nibble is the least significant nibble of the first byte of the received message.

bb Indicates the length of a data field, in nibbles ($01 = one nibble, $02 = two nibbles, etc.)

cc ... cc Is a given byte field that is compared with the received data. The length of this field is the same as the received data field, i.e., yy or y. A "/" is used in the given data field to indicate a "don't care" compare of a nibble in the received data field.

dd ... dd Indicates a display mask. The size of the display mask is the same as the size of the data field the mask is to be applied to, i.e., yy or bb. For every bit in the mask whose value is 1, the value of the corresponding bit in the data field is to be displayed. For every bit in the mask whose value is 0, the value of the corresponding bit in the data field is NOT to be displayed. The value of a data bit is displayed as a "1" or a "0".

ee or ee ee Indicates a one or two byte index, typically into a list of string constants ($00 or $0000 is index to first entry, $01 or $0001 is index to second entry, etc.)

ff ... ff Is a bit mask for offset to an indexed standard string. One and only one bit in this bit mask must be a "1".

gg ... gg Is a signed offset value. The length of the signed offset gg ... gg is the same as the received data field, i.e., yy.

8.4.2 DEFAULT DATA DISPLAY POSITION—The description of some received data processing type codes refer to display areas. Unless otherwise specified, the first data to be displayed in a given display area will be displayed at the left most position in the display area. All subsequent data to be displayed will follow this data to the right.

Display areas can be top to bottom, left to right, or both. Unless otherwise specified, the first display area will be the top left one. Subsequent display areas will follow left to right, first on the top line, and then from top to bottom for subsequent lines.

8.4.3 RECEIVED DATA PROCESSING TYPES WITH PARAMETERS—The following show received data processing types with any associated additional information. The following use the symbols shown in 8.4.1.

80 Display byte(s) as hexadecimal

80 xy

81 Display nibble(s) as hexadecimal

81 aa bb

82 Display byte(s) as bits

82 xy

83 Display byte(s) as bits with display mask

83 xy dd ... dd

84 Display nibble(s) as bits

84 aa bb

85 Display nibble(s) as bits with display mask

85 aa bb dd ... dd

86 Display byte(s) as unsigned decimal, with a maximum field size in the received data of 4 bytes

86 xy

87 Display byte(s) as signed decimal data, with a maximum field size in the received data of 4 bytes

87 xy

88 Display byte(s) as signed decimal with signed offset with a maximum field size in the received data of 4 bytes

E = N + offset

where: E = value to be displayed
N = value of field in received message
offset = gg ... gg

89 Display byte(s) as y = aX + b, where X = signed decimal received bytes

89 xy jj kk ... kk

where: jj = one byte signed multiplier (a)
kk = signed offset (b) with same length as data byte(s)

8A Display byte(s) as decimal with binary point, with a maximum field size in the received data of 4 bytes

8A xy pp

where: pp = location of binary point in bits from the right end of the data field, $00 = to the right of the right most bit

8B Display byte(s) as DTC(s) if not zero

8B xy

The data length (y) must be a multiple of the DTC data length (i.e., 2 bytes). A DTC code of 0000 is not displayed.

8C Display byte(s) as ASCII codes

8C xy

8D Display standard text indexed by unsigned message byte

8D xy

The index value in the message must be within range of the standard text table (see 8.4.4). If index value is out of range then the tool shall indicate a "data out of range error" and this error shall be explained in the tool user manual/help facility. The maximum field size of the received data is 1 byte.

8E Display byte(s) as percentage with given denominator, with a maximum field size in the received data of 4 bytes

E = N * (100 (decimal)/denominator)

where: E = value to be displayed
N = value of field in received message

8E xy zz ... zz

where: zz ... zz is the denominator, and has the same length as the data field

8F Display byte(s) with given signed offset as a percentage with given denominator, with a maximum field size in the received data of 4 bytes

E = (N + offset) * (100 (decimal)/denominator)

where: E = value to be displayed
N = value of field in received message

8F xy gg ... gg zz ... zz

where: zz ... zz is the signed decimal denominator, and has the same length as the data field

90 Display byte(s) using given scaling data, with a maximum field size in the received data of 4 bytes

90 xy ss

where: ss is scaling value:

bit 7 =scaling type:
0 = binary scaling
1 = decimal scaling

bit 6 - 0 = signed scaling power

If P = absolute value of bits 6 - 0:

for bits 7,6 = 00 then E = N * 2**P
= 01 then E = N / 2**P
= 10 then E = N * 10**P
= 11 then E = N / 10**P

where: E = value to be displayed
N = value of field in received message

91 Display byte(s) as BCD data. If any of received data is out of range then the tool shall indicate a "data out of range error" and this error shall be explained in the tool user manual/help facility.

91 xy

92 Display one of a set of two indexed logic texts (see 8.4.5). The index "ee" determines which text set in 8.4.5 to use. The selection of which of the two texts of the indexed set to display is based on ANDing the given bit mask "ff" with the received message byte at location "xx".

92 xx ff ee

93 Same as for 92, except that the result of the ANDing is inverted before selecting which text to display (see 8.4.5)

93 xx ff ee

98 Display given standard text (see 8.4.4)

98 ee

where: ee = index into standard text table

99 Clear entire display

99

9A Clear given area

9A hh

where: hh = display area id, $00 = top left display area, $01 = next display area

9B Position to beginning of top left display area

9B

9C Position to beginning of next display area

9C

9D Position to beginning of given display area

9D hh

where: hh = display area id, $00 = top left display area, $01 = next display area

9E Clear given display area and position to beginning of the display area

9E hh

where: hh = display area id, $00 = top left display area, $01 = next display area

9F Display byte(s) as y = aX + b, where X = unsigned decimal received byte(s), with a maximum field size in the received data of 4 bytes

9F xy jj kk ... kk

where: jj = one byte signed multiplier (a)
kk = signed offset (b) with same length as data byte(s)

A0 If received byte(s) equal given value then terminate this definition

A0 xy cc ... cc

A1 If received byte(s) equal given value then terminate this definition and start the given definition

A1 xy cc ... cc ww

where: ww = definition id

A2 If received byte(s) equal given value then terminate the given definition

A2 xy cc ... cc ww

where: ww = definition id

A8 If received byte(s) do not equal given value then terminate this definition

A8 xy cc ... cc

A9 If received byte(s) do not equal given value then terminate this definition and start the given definition

A9 xy cc ... cc ww

where: ww = definition id

AA If received byte(s) do not equal given value then terminate the given definition

AA xy cc ... cc ww

where: ww = definition id

B5 Move right given positions

B5 pp

where: pp = number of positions to move

C0 Process multiple received messages uniquely

C0

This RDPT must be the first RDPT in the received data processing information field.

8.4.4 STANDARD TEXT FOR USE WITH RECEIVED DATA PROCESSING TYPES—Figure 8 shows the standard text associated with RDPT's 8D and 98.

Scan tool manufacturers may use alternate text that conveys the same meaning as the standard text, if the alternative text is documented in the user manual/help facility associated with a given scan tool. Abbreviations found in SAE J1930 for the following phases may also be used. Other abbreviations may be used if they are documented in the scan tool user's guide/help facility.

8.4.5 LOGIC TEXT USED WITH RECEIVED DATA PROCESSING TYPES—Figure 9 shows the logic text associated with RDPT's 92 and 93.

Scan tool manufacturers may also use standard abbreviations. Scan tool manufacturers may use alternate text or alternate abbreviations if such are documented in the user manual/help facility associated with a given scan tool.

Each of the following indexed sets consists of two values. Based on the RDPT type, if the resultant logic value after processing the message data and the additional data is "0," then the text shown under the "0" column, for the index value contained in the RDPI, is to be displayed. In a similar way, if the resultant logic value is "1," then the text shown under the "1" column is to be displayed.