

Enhanced E/E Diagnostic Test Modes

TABLE OF CONTENTS

1.	Scope	4
2.	References	4
2.1.1	SAE Publications	4
2.1.2	ISO Publications	4
2.1.3	California ARB Documents	4
2.1.4	Federal EPA Documents	4
3.	Definitions	4
4.	Technical Requirements	5
4.1	Test Mode Values	5
4.2	Physical Addressing	6
4.3	Miscellaneous Requirements	6
4.3.1	Message Response Time	6
4.3.2	Automatic Return to Normal Operation	7
4.3.3	Diagnostic Message Length	7
4.3.4	Message Response	7
5.	Test Modes	8
5.1	Modes \$00 through \$0F - Physically Addressed SAE J1979 Messages	8
5.2	Mode \$10 - Initiate Diagnostic Operation	9
5.2.1	Functional Description	9
5.2.2	Message Data Bytes	9
5.3	Mode \$11 - Request Module Reset	9
5.3.1	Functional Description	9
5.3.2	Message Data Bytes	10
5.4	Mode \$12 - Request Diagnostic Freeze Frame Data	10
5.4.1	Functional Description	10
5.4.2	Message Data Bytes	11
5.5	Mode \$13 - Request Diagnostic Trouble Code Information	11
5.5.1	Functional Description	11
5.5.2	Message Data Bytes	13
5.6	Mode \$14 - Clear Diagnostic Information	14
5.6.1	Functional Description	14
5.6.2	Message Data Bytes	15

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2008 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER:

Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
<http://www.sae.org>

SAE WEB ADDRESS:

SAE J2190 Cancelled OCT2008

5.4.7	Mode \$17 - Request Status of Diagnostic Trouble Codes	16
5.7.1	Functional Description	16
5.7.2	Message Data Bytes.....	17
5.8	Mode \$18 - Request Diagnostic Trouble Codes by Status	18
5.8.1	Functional Description	18
5.8.2	Message Data Bytes.....	19
5.9	Mode \$20 - Return to Normal Operation	20
5.9.1	Functional Description	20
5.9.2	Message Data Bytes.....	20
5.10	Modes \$21 to \$23 - Request Diagnostic Data	21
5.10.1	Functional Description	21
5.10.2	Mode \$21 Message Data Bytes.....	22
5.10.3	Mode \$22 Message Data Bytes.....	23
5.10.4	Mode \$23 Message Data Bytes.....	24
5.11	Mode \$24 - Request Scaling and Offset / PID	25
5.11.1	Functional Description	25
5.11.2	Message Data Bytes.....	25
5.11.3	Scaling Byte 1	26
5.11.4	Scaling Byte 2.....	27
5.11.5	Scaling Bytes 3 to n	27
5.12	Mode \$25 - Stop Transmitting Requested Data	28
5.12.1	Functional Description	28
5.12.2	Message Data Bytes.....	28
5.13	Mode \$26 - Specify Data Rates	29
5.13.1	Functional Description	29
5.13.2	Message Data Bytes.....	29
5.14	Mode \$27 - Security Access Mode	30
5.14.1	Functional Description	30
5.14.2	Message Data Bytes.....	31
5.15	Mode \$28 - Disable Normal Message Transmission	32
5.15.1	Functional Description	32
5.15.2	Message Data Bytes.....	32
5.16	Mode \$29 - Enable Normal Message Transmission	33
5.16.1	Functional Description	33
5.16.2	Message Data Bytes.....	33
5.17	Mode \$2A - Request Diagnostic Data Packet(s)	33
5.17.1	Functional Description	33
5.17.2	Message Data Bytes.....	34
5.18	Mode \$2B - Dynamically Define Data Packet by Single Byte Offsets.....	35
5.18.1	Functional Description	35
5.18.2	Message Data Bytes.....	35
5.18.3	Message Example	36
5.19	Mode \$2C - Dynamically Define Diagnostic Data Packet.....	37
5.19.1	Functional Description	37
5.19.2	Message Data Bytes.....	38
5.19.3	Message Example	39
5.20	Mode \$2F - Input/Output Control by PID	41
5.20.1	Functional Description	41
5.20.2	Message Data Bytes.....	41
5.21	Mode \$30 - Input/Output Control by Data Value ID	42
5.21.1	Functional Description	42
5.21.2	Message Data Bytes.....	42
5.22	Modes \$31 to \$33 - Perform Diagnostic Routine by Test Number	43
5.22.1	Functional Description	43
5.22.2	Message Data Bytes.....	44

SAE J2190 Cancelled OCT2008

5.23	Modes \$34 to \$37 - Data Transfer.....	46
5.23.1	Functional Description	46
5.23.2	Message Data Bytes.....	46
5.24	Modes \$38 to \$3A - Perform Diagnostic Routine at a Specified Address.....	48
5.24.1	Functional Description	48
5.24.2	Message Data Bytes.....	48
5.25	Mode \$3B - Write Data Block	50
5.25.1	Functional Description	50
5.25.2	Message Data Bytes.....	51
5.26	Mode \$3C - Read Data Block	52
5.26.1	Functional Description	52
5.26.2	Message Data Bytes.....	52
5.27	Mode \$3F - Test Device Present (no operation performed)	53
5.27.1	Functional Description	53
5.27.2	Message Data Bytes.....	53
5.28	Mode \$7F - General Response Message.....	54
5.28.1	Functional Description	54
5.28.2	Message Data Bytes.....	54
5.28.3	Message Examples	55
5.28.4	Response Codes	56

Appendix A -Diagnostic Test Mode Assignments	61
--	----

- 1. Scope**—This SAE Recommended Practice describes the implementation of Enhanced Diagnostic Test Modes, which are intended to supplement the legislated Diagnostic Test Modes defined in SAE J1979. Modes are defined for access to emission related test data beyond what is included in SAE J1979, and for non-emission related data. This document describes the data byte values for diagnostic messages transmitted between diagnostic test equipment, either on-vehicle or off-vehicle, and vehicle electronic control modules. No distinction is made between test modes for emission related and non-emission related diagnostics. These messages can be used with a diagnostic serial data link such as described in SAE J1850 or ISO 9141-2.

For each test mode, this document includes a functional description of the test mode, request and report message data byte content, and an example if useful for clarification.

- 1.1 Rationale**—J2190 is being canceled as it is very old document and has very little current use. This has not been superseded by any later SAE documents, but has been superseded by some ISO documents, which at a very high level include information that was in SAE J2190, but go into considerably more detail. ISO 14230-3:1999 is intended for ISO 14230 (ISO 9141 based) serial data links, ISO 15765-3:2004 is intended for ISO 15765 (CAN) data links, and ISO 14229-1:2006 is "Unified Diagnostic Services" intended for all current and future serial data links.

2. References

- 2.1 Applicable Publications**—The following publications form a part of this specification to the extent specified herein. The latest issue 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—E/E Systems Diagnostic Terms, Definitions, Abbreviations and Acronyms
 SAE J1962—Diagnostic Connector
 SAE J1978—OBD II Scan Tool
 SAE J2012—Recommended Format and Messages for Diagnostic Trouble Codes
 SAE J2178—Class B Data Communication Network Messages
 SAE J2186—E/E Data Link Security

2.1.2 ISO PUBLICATIONS—Available from ANSI, 1 West 42nd Street, New York, NY 10036-8002.

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

2.1.3 CALIFORNIA ARB DOCUMENTS

Mail out #93-27—Title 13, California Code of Regulations, Section 1968.1 Malfunction and Diagnostic System

May 21, 1993 Requirements—1994 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines

2.1.4 FEDERAL EPA DOCUMENTS

40 CFR Part 86—Control of Air Pollution From New Motor Vehicles and New Motor Vehicle Engines; Federal Register Regulations Requiring On-board Diagnostics

3. **Definitions**

3.1 **Data Bytes**—Bytes between header bytes and error detection byte.

3.2 **Diagnostic Test Mode**—See SAE J1930.

3.3 **Offset**—A number used to refer to a data value by specifying its relative position in a list of data values.

3.4 **Pid—Parameter Identification Number**—A unique identifier used to refer to a specific data value within a module.

3.5 **Seed / Key**—See SAE J2186

3.6 **Dpid—data Packet Identification Number**—An identifier used to refer to a **set** of data values within a module.

3.7 **Byte**—A group of eight bits of data, bits 0 through bit 7, where bit 7 is the most significant bit and bit 0 is the least significant bit.

3.8 **\$**—Prefix defining a hexadecimal number

3.9 **Nibble**—Four bits of data. A byte may be split into two nibbles.

3.10 **EPA**—Environmental Protection Agency (Federal Agency)

3.11 **Carb**—California Air Resources Board (State Agency)

3.12 **Obd II**—Second generation of On-Board Diagnostic regulations required by the California Air Resources Board.

4. Technical Requirements

- 4.1 Test Mode Values**—Figure 1 indicates the assignment of test mode values, and indicates the type of message and where they are defined, either in SAE J1979, this document, or by the manufacturer.

Test mode values \$00 - \$0F and \$40 - \$4F are reserved to be defined in SAE J1979, which currently only includes functionally addressed messages. Usage of shaded test mode values will be defined in this document. Appendix A indicates the test mode values currently defined by both SAE J1979 and SAE J2190.

There is a one-to-one correspondence between request messages and response messages, with bit 6 of the test mode value indicating the message type.

Test Mode Value	Message type (bit 6)	Where defined
00 - 0F	Request (bit 6 = 0)	SAE J1979
10 - 1F		SAE J2190
20 - 2F		
30 - 3F		
40 - 4F	Response to Modes \$00-\$3F (bit 6 = 1)	SAE J1979
50 - 5F		SAE J2190
60 - 6F		
70 - 7F		
80 - 8F	Request (bit 6 = 0)	Reserved for future expansion as needed
90 - 9F		
A0 - AF		Defined by vehicle manufacturer
B0 - BF		
C0 - CF	Response to Modes \$80-\$BF (bit 6 = 1)	Reserved for future expansion as needed
D0 - DF		
E0 - EF		Defined by vehicle manufacturer
F0 - FF		

FIGURE 1—TEST MODE VALUES

- 4.2 Physical Addressing**—Physical addressing is used for all diagnostic test mode messages defined in this document. Typically when using SAE J1850, this type of addressing requires that the target address of the device for which the message is intended be included in the header of the message. In ISO 9141, the addressing is typically done during initialization. Only that device being addressed will respond to the request. Each device will need to be assigned a unique address to be used for communication purposes.

4.3 Miscellaneous Requirements

- 4.3.1 MESSAGE RESPONSE TIME—The vehicle controllers should respond to a diagnostic request within 100 ms of a request. If there is no response within this time period, the tool can assume no response will be received.
- 4.3.2 AUTOMATIC RETURN TO NORMAL OPERATION—During a diagnostic procedure, the on-board controllers will often be put into an abnormal mode of operation to aid in diagnostics. Examples are to report diagnostic data periodically, to disable normal message transmission, or substitute an input or output parameter. In practice, the test procedure should return all on-board controllers to a normal mode of operation at the end of the procedure.

If a test device is disconnected from the vehicle before the on-board controllers have returned to normal operation, the controllers should automatically detect that the tool is disconnected and return to a normal mode of operation. This should be accomplished by the on-board controller looking for a diagnostic message from the test device, which should be apparent from the message header. If a diagnostic message is not received for a 5 s period of time, the on-board controller should automatically return to normal operation.

Some diagnostic procedures may require more than 5 s without a required diagnostic message. For these cases, this document specifies a "test tool present" message to be transmitted by the test device at least once every 5 s if there is no other message. On-board controllers should consider this as a diagnostic message and continue in the current mode of operation.

On-board controllers should also return to normal operation at power up or after a controller reset.

- 4.3.3 DIAGNOSTIC MESSAGE LENGTH—This document only defines the data bytes to be used in a diagnostic message. The actual number of data bytes in a message, referred to as "n" in the message data byte descriptions in this document, depends on the requirements of the test mode and the maximum number of bytes available in a diagnostic message. The maximum number of bytes available depends on the maximum allowable message length and the number of bytes used as a message header, error detection byte(s), or for other protocol specific purposes.

For example, the SAE J1850 data link effectively limits the total number of bytes in a message to 12. If the message strategy includes a 3 byte header, 1 byte CRC, and 1 byte in-message response, then 7 data bytes are available for SAE J2190 functionality. If the message strategy includes a 3 byte header and 1 byte CRC, then 8 data bytes are available.

If other data links are used as the diagnostic data link, such as ISO 9141, there may be other message length limitations and, therefore, different limits on the number of data bytes available for SAE J2190 functionality.

- 4.3.4 MESSAGE RESPONSE—All diagnostic request messages, except "Test Device Present (Mode \$3F)," should receive a response from the target module. A response is optional for the "Test Device Present" message. There are two types of response messages, specific and general. Specific response messages are uniquely paired with each request message, and repeat enough data bytes of the request message to identity the specific request. The "General Response Message (Mode \$7F)" has a single test mode value. The response message to be used for a request depends on the type of the request and whether or not the module can perform the request.

When the request is for data and the module can perform the request (positive response), only the specific form of the response can be used. The response will either be a single message, multiple messages with additional data, or periodic multiple messages with updated data values.

If the request is for action, such as a request for entering a mode of operation or command to perform a function, and the module can perform the request (positive response), either the specific response message or general response message can be used. Those requests for which either response type is a valid response have both response types indicated in this document.

If the request for either data or action cannot be performed by the module (negative response), only the general response message can be used.

Figure 2 summarizes the valid response types for different types of requests.

	Positive response	Negative response
Request for data	Specific response only	General response only
Request for action	Specific or general response allowed	General response only

FIGURE 2—VALID RESPONSE TYPES

With the General Response Message a response code is returned. Response codes can indicate a negative or positive response. Standard response codes are included in the section with the definition of the General Response Message.

5. Test Modes

5.1 Modes \$00 through \$0F—Physically Addressed SAE J1979 Messages—Modes \$00 through \$0F are reserved to be defined in SAE J1979. The data byte content of the response to an SAE J1979 request when the device is addressed physically should be identical to the data byte content of the response when the device is addressed functionally. The only device that will respond to this request is the device to which the request is directed.

The response to one of these requests will be a Mode \$40 through \$4F message.

The same PID list as specified in SAE J1979 will apply when the device is physically addressed using the same test mode value. Although SAE J1979 reserves 256 PID values to be defined in that document, SAE J1979 specifies that PID values \$21 to \$3F are reserved to be defined in this document. Possible values which may be considered to be included are:

- Number of header bytes and format
- Use of CRC versus checksum for error detection
- Use of in-message response
- Maximum number of data bytes allowed
 - (based on header and in-message response)
- Use of manufacturer specific pins in the SAE J1962 connector

5.2 Mode \$10—Initiate Diagnostic Operation

- 5.2.1 FUNCTIONAL DESCRIPTION—The purpose of this mode is to inform devices on the serial data link that a diagnostic tool is ready to start diagnostic procedures using the data link. The on-board devices may need to alter their normal operation in order for the diagnostic procedures to be effective. One example is that the system may need to reduce the amount of data being sent on the data link to make more time available for the diagnostic messages. Another possibility is that the system may need to degrade its normal operation in order to be able to process the diagnostic requests. Systems that rely on data from modules being diagnosed may not receive data from those modules as frequently as normal. Use of this mode could inform the receiving modules that diagnostic procedures are in progress and they should not set diagnostic trouble codes based on not receiving data at the normal frequency.

An optional "level of diagnostics" byte may be used to indicate how much the normal operation must be altered in order to accommodate the extra diagnostic procedures. These levels and their corresponding amount of change must be predefined in the module by the module manufacturer. The level of diagnostics can be changed by sending a subsequent Mode \$10 command.

- 5.2.2 MESSAGE DATA BYTES—(See Figure 3.)

	Data Bytes (Hex)			
	#1	#2	#3 to #n-1	#n
Request from Tool to Vehicle				
Request diagnostic operation	10	Level (opt.)		
Positive Response from Vehicle to Tool (either of the following is a valid response)				
Confirm diagnostic operation	50	Level (opt.)		
General response	7F	Optional data bytes may be included (see Mode \$7F description).		Resp. Code - 00

FIGURE 3—MESSAGE DATA BYTES FOR MODE \$10

5.3 Mode \$11—Request Module Reset

- 5.3.1 FUNCTIONAL DESCRIPTION—This mode requests the module to effectively perform a module power on reset. The response message may be sent either before or after the module is reset. The response message may also be sent by modules whenever they perform a power on reset, whether requested by this test mode or not.

An optional data byte may be included in the request to indicate different levels of reset. Examples are:

- First time ever connected to vehicle
- First time after battery disconnect
- After a full normal power down / power up cycle
- After minor power supply interruption

5.3.2 MESSAGE DATA BYTES—(See Figure 4.)

	Data Bytes (Hex)			
	#1	#2	#3 to #n-1	#n
Request from Tool to Vehicle				
Request module reset	11	Level (opt.)		
Positive Response from Vehicle to Tool (either of the following is a valid response)				
Confirm module reset	51	Level (opt.)		
General response	7F	Optional data bytes may be included (see Mode \$7F description).		Resp. Code - 00

FIGURE 4—MESSAGE DATA BYTES FOR MODE \$11

5.4 Mode \$12—Request Diagnostic Freeze Frame Data

- 5.4.1 FUNCTIONAL DESCRIPTION—The purpose of this mode is to allow access to data values which were stored during freeze frame conditions specified by the vehicle manufacturer. Data content, data format, and method of retrieval are specified by the vehicle manufacturer. Typical uses for this mode are to report data stored upon detection of a system malfunction. Multiple frames of data may be stored before and/or after the malfunction is detected. The request for information includes a frame number followed by an optional indication of the data requested.

If the optional data byte is not used, or is \$00, then all data for the requested freeze frame will be reported. If the optional byte is used, then the vehicle manufacturer will define the different methods used to specify which data is requested.

The on-board module will respond to this message by transmitting the requested data.

5.4.2 MESSAGE DATA BYTES—(See Figure 5.)

	Data Bytes (Hex)			
	#1	#2	#3	#4 to #n
Request from Tool to Vehicle				
Request diagnostic freeze frame data	12	Frame No.	Method to request data (optional) examples are: Request all data (not included or 00) Request by offset (1 byte) Request by PID (2 bytes) Request by memory address (3 bytes) Request by Data Packet ID Request starting address for data DTC which caused data to be stored Other manufacturer specific method	
Positive Response from Vehicle to Tool				
Report diagnostic freeze frame data	52	Frame No.	Data byte	Additional optional data bytes that are in response to the request may be added to fill the message up to the maximum number of available data bytes.

FIGURE 5—MESSAGE DATA BYTES FOR MODE \$12

5.5 Mode \$13—Request Diagnostic Trouble Code Information

- 5.5.1 FUNCTIONAL DESCRIPTION—The purpose of this mode is to enable a diagnostic test tool to obtain stored emission and non-emission related diagnostic trouble code (DTC) information.

This mode includes the option to request DTC information by function, where function is either powertrain body, chassis, or undefined. These are the functions used in SAE J2012 to group trouble codes. The first two bits of the first nibble for requests by function are encoded using the same convention as when codes are reported:

- 00 - powertrain
- 01 - chassis
- 10 - body
- 11 - undefined

For requests by function using this test mode, the second two bits of the first nibble are 00, and the second nibble is all zeroes. This translates to the following function groups for DTC requests:

- \$00 - powertrain codes
- \$40 - chassis codes
- \$80 - body codes
- \$C0 - undefined

In addition, this document defines \$FF as the function group to request DTC information for all functions.

This test mode can be used to either request diagnostic trouble codes, or request the number of diagnostic trouble codes. There are two ways this mode can request DTCs.

All codes can be requested by including only the test mode value in the request.

Codes can be requested by function group (Powertrain, Chassis, Body, Undefined, or All) by sending the function group followed by \$00 as data bytes 2 and 3 (\$00 00, \$40 00, \$80 00, \$C0 00, or \$FF 00). Requesting codes for all function groups by including \$FF 00 yields the same response as not including function group in the request, but may be desired by a manufacturer for consistency with other messages.

There are also two ways this mode can request the number of DTCs.

Number of codes can be requested by including the function group as data byte 2, and not including data byte 3 (\$FF as data byte 2 must be supported as a minimum to request the total number of DTC).

Number of codes can be requested by function group (Powertrain, Chassis, Body, Undefined, or All) by sending the function group followed by \$FF as data bytes 2 and 3 (\$00 FF, \$40 FF, \$80 FF, \$C0 FF, or \$FF FF). Requesting number of codes for all function groups by including \$FF FF yields the same response as including only \$FF as data byte 2 in the request, but may be desired by a manufacturer for consistency with other messages.

The response to a Mode \$13 request for DTC will be one or more Mode \$53 messages. If no codes are stored in the module, then the module will respond with one of the following:

Mode \$53 with no additional data bytes

Mode \$53 padded with \$00 00 to fill response

Diagnostic trouble codes are transmitted as two bytes. The first two bits (high order) of the first byte for each code will be zeroes to indicate a powertrain code (refer to SAE J2012 - "Recommended Format and Messages for Diagnostic Trouble Codes" for additional interpretation of this structure). The second two bits will indicate the first digit of the diagnostic code (0 through 3). The second nibble of the first byte and the entire second byte are the next three digits of the actual code reported as Binary Coded Decimal (BCD). A powertrain trouble code transmitted as \$0143 should be interpreted as P0143, as shown in Figure 6.

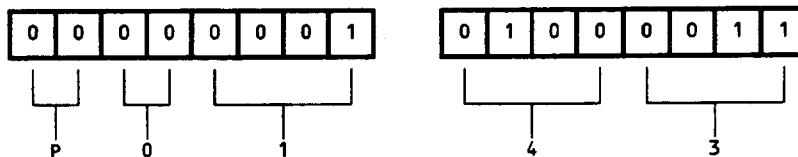


FIGURE 6—DIAGNOSTIC TROUBLE CODE EXAMPLE

5.5.2 MESSAGE DATA BYTES—(See Figure 7.)

	Data Bytes (Hex)			
	#1	#2	#3	#4 to #n
Request from Tool to Vehicle (either of the following messages can be used to request DTC)				
Request all DTC	13			
Request DTC by function group where group is: 00 - powertrain 40 - chassis 80 - body C0 - undefined FF - all	13	Group	00	
Request from Tool to Vehicle (either of the following messages can be used to request number of DTC)				
Request number of DTC by function where group is: 00 - powertrain 40 - chassis 80 - body C0 - undefined FF - all	13	Group		
FF in byte 3 is an optional byte used to maintain a fixed length request	13	Group	FF	
Positive Response from Vehicle to Tool (Multiple messages may be required to report the DTCs)				
Report stored DTC - response to request for DTC	53	Diagnostic trouble code or 00 00 (optional)	Additional optional diagnostic trouble codes may be added to fill the message up to the maximum number of available data bytes.	
Report # of stored DTC - response to request for number of DTC	53	Number of codes		

NOTE—Refer to SAE J2012 for encoding method for trouble codes.

FIGURE 7—MESSAGE DATA BYTES FOR MODE \$13

5.6 Mode \$14—Clear Diagnostic Information

- 5.6.1 FUNCTIONAL DESCRIPTION—The purpose of this mode is to provide a means for the external test device to command on-board modules to clear all diagnostic information. This information includes primarily diagnostic trouble codes, but can also include freeze frame data or other on-board test results that may be stored as a result of the trouble code being set. This extra information is device dependent.

There are three ways this mode can be used. If only the test mode value is included in the request, then all diagnostic information stored in the module is to be cleared.

Diagnostic information can optionally be cleared by function (Powertrain, Chassis, or Body) by sending P0000, C0000, or B0000 as data bytes 2 and 3. These must be encoded using the same convention as when codes are reported (see description for Mode \$13). The first two bits of the first nibble are:

- 00 - powertrain
- 01 - chassis
- 10 - body
- 11 - undefined

This translates to the following values for data bytes #2 and #3:

- \$00 00 - powertrain codes
- \$40 00 - chassis codes
- \$80 00 - body codes
- \$C0 00 - undefined

Diagnostic information can also optionally be cleared for a single trouble code by including the trouble code to clear as optional bytes in the request. The information stored with an individual trouble code would need to be clearly identified within the module and cleared at the same time.

Caution when clearing by single trouble code: This capability should not be provided and used unless consideration is given to the possible consequences of this option. If a single fault caused multiple trouble codes to be set, and a service technician found a defective component, repaired it, and cleared a single trouble code associated with that fault, then the device would still contain trouble codes that were set based on that fault. The next technician to check codes would read those codes, and if he did not know the vehicle history, he may try to repair the vehicle based only on the remaining trouble codes, which could waste time and result in replacement of good components.

Allowing use of this feature to clear emission related trouble codes should be considered very carefully to guard against improper diagnosis. Difficult interpretation can result if the system allowed clearing a single emission related trouble code. CARB required information could report that trouble codes are stored, but they would not be reported when an SAE J1979 Mode \$04 message is sent to request those codes. Freeze frame data could be stored for a given trouble code, but that code would not be reported as stored.

5.6.2 MESSAGE DATA BYTES—(See Figure 8.)

	Data Bytes (Hex)				
	#1	#2	#3	#4 to #n-1	#n
Request from Tool to Vehicle					
Clear stored diagnostic information	14	Data bytes 2 and 3 are optional if not used - clear all information if 00 00 - clear all powertrain information if 40 00 - clear all chassis information if 80 00 - clear all body information if C0 00 - clear all Cx xx DTC information if FF 00 - clear all information any other value - trouble code to clear			
Positive Response from Vehicle to Tool (either of the following is a valid response)					
Diagnostic information cleared	54	repeat data bytes 2 and 3 of request, if used			
General response	7F	Optional data bytes may be included (see Mode \$7F description).			Resp. Code - 00

FIGURE 8—MESSAGE DATA BYTES FOR MODE \$14

5.7 Mode \$17—Request Status of Diagnostic Trouble Codes

- 5.7.1 FUNCTIONAL DESCRIPTION—The purpose of this mode is to provide a means to determine the status of diagnostic trouble codes.

This mode is nearly identical in operation to Mode \$13, except that only a single DTC, followed by the status of that DTC, is reported in a single response. This mode also allows a request for the status of a single DTC. The discussion of function groups and the method of reporting DTCs is identical to the description in Mode \$13.

This test mode can be used to either request status of diagnostic trouble codes, or request the number of diagnostic trouble codes with a status bit set. There are three ways this mode can request DTCs.

All codes can be requested by only including the test mode value in the request.

Codes can be requested by function group (Powertrain, Chassis, Body, Undefined, or All) by sending the function group followed by \$00 as data bytes 2 and 3 (\$00 00, \$40 00, \$80 00, \$C0 00, or \$FF 00). Requesting codes for all function groups by including \$FF 00 yields the same response as not including function group in the request, but may be desired by a manufacturer for consistency with other messages.

Status of a single trouble code can be requested by including the trouble code as data bytes 2 and 3 in the request.

There are two ways this mode can request the number of DTCs with a status bit set.

Number of codes can be requested by including the function group as data byte 2, and not including data byte 3 (\$FF as data byte 2 must be supported as a minimum to request the total number of DTC).

Number of codes can be requested by function group (Powertrain, Chassis, Body, Undefined, or All) by sending the function group followed by \$FF as data bytes 2 and 3 (\$00 FF, \$40 FF, \$80 FF, \$C0 FF, or \$FF FF). Requesting number of codes for all function groups by including \$FF FF yields the same response as including only \$FF as data byte 2 in the request, but may be desired by a manufacturer for consistency with other messages.

Multiple Mode \$57 response messages may be reported due to a single Mode \$17 request message, depending on the type of request and the number of diagnostic trouble codes stored in the module. Each response message will report the status of a single DTC. If no codes are stored in the module, then the module will respond with one of the following:

Mode \$57 with no additional data bytes

Mode \$57 with \$00 00 for DTC and \$00 for status

5.7.2 MESSAGE DATA BYTES—(See Figure 9.)

	Data Bytes (Hex)			
	#1	#2	#3	#4
Request from Tool to Vehicle (any of the following messages can be used to request DTC)				
Request status of all DTC	17			
Request status of DTC by function group where group: 00 - powertrain 40 - chassis 80 - body C0 - undefined FF - all	17	Group	00	
Request status of specific DTC	17	Diagnostic Trouble Code		
Request from Tool to Vehicle (either of the following messages can be used to request number of DTC)				
Request number of DTC with a status bit set by function where group is: 00 - powertrain 40 - chassis 80 - body C0 - undefined FF - all	17	Group		
FF in byte 3 is an optional byte used to maintain a fixed length request	17	Group	FF	
Positive Response from Vehicle to Tool (Multiple messages may be required to report the DTCs)				
Report status of stored DTC	57	Diagnostic trouble code or 00 00 (optional)		Status of DTC or 00 (optional if DTC not reported): same definition as Data Byte #2 for Mode \$18
Report # of stored DTC with any status bit set	57	Number of codes		

FIGURE 9—MESSAGE DATA BYTES FOR MODE \$17

5.8 Mode \$18—Request Diagnostic Trouble Codes by Status

- 5.8.1 FUNCTIONAL DESCRIPTION—This mode is used to retrieve diagnostic trouble codes based on the status by which they have been stored. There are various conditions under which codes are generated, for example, under normal customer driving conditions versus "on demand" codes which are generated by tests performed by the service technician. Another difference is that some codes illuminate a warning lamp while other codes do not. Some codes are retained in memory for at least 40 warmup cycles while some codes are retained only for one ignition/power up cycle.

This test mode is similar in operation to Mode \$17, except that an additional data byte is inserted as data byte #2 to indicate the specific status bits of interest. Data bytes #3 and #4 in Mode \$18 requests have the same meaning as data bytes #2 and #3 in Mode \$17 requests.

There are many philosophies among the various manufacturers for storing codes. Bit definitions have been assigned to the more commonly accepted methods. Codes stored under that definition can be requested by setting the appropriate bit(s) to "1" to retrieve the set of desired codes.

Table 1 shows the interpretation of each bit of the status byte. This definition is used for both Modes \$17 and \$18. Multiple bits can be set to "1". When requesting codes using Mode \$18, codes with any of the requested status bits will be reported.

TABLE 1—INTERPRETATION OF EACH BIT OF THE STATUS BYTE

bit	status
7	Warning lamp illuminated for this code
6	Warning lamp pending for this code, not illuminate but malfunction was detected
5	Warning lamp was previously illuminated for this code, malfunction not currently detected, code not yet erased
4	Stored trouble code
3	Manufacturer specific status
2	Manufacturer specific status
1	Current code - present at time of request
0	Maturing/intermittent code - insufficient data to consider as a malfunction

Multiple Mode \$58 response messages may be reported to a single request, depending on the number of diagnostic trouble codes stored in the module. Each response message will report up to three DTCs for which at least one of the requested status bits is set. If no codes are stored in the module that meet the requested status, then the module will respond with one of the following:

Mode \$58 with Status Requested and no additional data bytes
 Mode \$58 with \$00 00 as data bytes 3 and 4
 Mode \$58 with \$00 00 repeated to fill response

5.8.2 MESSAGE DATA BYTES—(See Figure 10.)

	Data Bytes (Hex)				
	#1	#2	#3	#4	#5 to #n
Request from Tool to Vehicle (either of the following messages can be used to request DTC)					
Request all DTC with status	18	Status			
Request all DTC with status and function group where group is: 00 - powertrain 40 - chassis 80 - body C0 - undefined FF - all	18	Status	Group	00	
Request from Tool to Vehicle (either of the following messages can be used to request number of DTC)					
Request number of DTC with any specific status bits set by function group 00 - powertrain 40 - chassis 80 - body C0 - undefined FF - all	18	Status	Group		
FF in byte 4 is an optional byte used to maintain a fixed length request	18	Status	Group	FF	
Positive Response from Vehicle to Tool					
Report DTC by status - response to request with test mode and status	58	Status req'd	Diagnostic trouble code or 00 00 (optional)	Additional optional diagnostic trouble codes may be added to fill the message up to the maximum number of available data bytes.	
Report DTC by status - response to request with test mode, status, and data byte #3	58	Status req'd	number of DTC with req'd status		

FIGURE 10—MESSAGE DATA BYTES FOR MODE \$18