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CLASS B DATA COMMUNICATION NETWORK MESSAGES: DETAILED HEADER FORMATS AND PHYSICAL ADDRESS ASSIGNMENTS

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1. Scope—This SAE Recommended Practice defines the information contained in the header and data fields of both diagnostic and non-diagnostic messages for automotive serial communications based on SAE J1850 Class B networks. This document describes and specifies the header fields, data fields, field sizes, scaling, representations, and data positions used within messages.

The general structure of a SAE J1850 message frame without in-frame response is shown in Figure 1. The structure of a SAE J1850 message with in-frame response is shown in Figure 2. Figures 1 and 2 also show the scope of frame fields defined by this document for non-diagnostic messages. Refer to SAE J1979 for specifications of emissions related diagnostic message header and data fields. Refer to SAE J2190 for the definition of other diagnostic message header and data fields. The description of the network interface hardware, basic protocol definition, the electrical specifications, and the CRC and Checksum fields (shown in the figures as ERR) are given in SAE J1850.

SAE J1850 defines two and only two formats of message headers. They are the Single Byte header format and the Consolidated header format. The consolidated header format has two forms, a single byte form and a 3 byte form. This document covers all of these formats and forms to identify the contents of messages which could be sent on a SAE J1850 network.

	<--- SAE J2178 --->			
SOF	Header Field	Data Field	ERR	EOF

FIGURE 1—SCOPE OF SAE J2178 FOR A SAE J1850 FRAME WITHOUT IN-FRAME RESPONSE (IFR)

	<--- SAE J2178 --->				<-J2178->	
SOF	Header Field	Data Field	ERR	EOD	IFR	EOF

FIGURE 2—SCOPE OF SAE J2178 FOR A SAE J1850 FRAME WITH IN-FRAME RESPONSE (IFR)

This document consists of four parts, each published separately.

Part 1 of SAE J2178 (this part, Titled: Detailed Header Formats and Physical Address Assignments) describes the two allowed forms of message header formats, single byte and consolidated. It also contains the physical node address range assignments for the typical sub-systems of an automobile. The details of this part are more fully described in paragraph 3.1 of this document.

Part 2 of SAE J2178 (Titled: Data Parameter Definitions) defines the standard parametric data which may be exchanged on SAE J1850 (Class B) networks. The parameter scaling, ranges, and transfer functions are specified.

Part 3 of SAE J2178 (Titled: Target Address for Single Byte Forms of Headers) defines the message assignments for the single byte header format and the 1 byte form of the consolidated header format.

Part 4 of SAE J2178 (Titled: Target Address (Second Byte) for Three Byte Headers) defines the message assignments for the second byte in the 3 byte form of the consolidated header format.

2. Reference and Related Documents, Terms, Definitions, Abbreviations, and Acronyms

2.1 Applicable Documents—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 J1213/1—Glossary of Vehicle Networks for Multiplex and Data Communication

SAE J1850—Class B Data Communication Network Interface

SAE J1930—Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms

SAE J1979—E/E Diagnostic Test Modes

SAE J2190—Enhanced E/E Diagnostic Test Modes

2.2 Terms and Definitions

Data [Data Field]—Data and data field are used interchangeably in this document and they both refer to a field within a frame that may include bytes with parameters pertaining to the message and/or secondary ID and/or extended addresses and/or test modes which further defines a particular message content being exchanged over the network.

Extended Address—The extended address is a means to allow a message to be addressed to a specific geographical location or zone of the vehicle, independent of any node's physical address.

FRAME—A frame is one complete transmission of information which may or may not include an In-Frame Response. The frame is enclosed by the start of frame and end of frame symbols. For Class B networks, each frame contains one and only one message (see "message" definition).

FUNCTIONAL ADDRESSING—Functional addressing allows a message to be addressed or sent to one or more nodes on the network interested in that function. Functional addressing is intended for messages that may be of interest to more than a single node. For example, an exterior lamp "off" message could be sent to all nodes controlling the vehicle exterior lamps by using a functional address. The functional address consists of a primary ID and may include a secondary ID.

HEADER [HEADER FIELD]—The header (or header field, used interchangeably) is a 1 or 3 byte field within a frame which contains information about the message priority, message source and target addressing, message type, and in-frame response type.

IN-FRAME RESPONSE (IFR) TYPE—The IFR type identifies the form of the in-frame response which is expected within that message.

LOAD—The load command indicates the operation of directly replacing the current/existing value of a parameter with the parameter value(s) contained in the message.

MESSAGE—A message consists of all of the bytes of a frame excluding the delimiter symbols (SOF, EOD, EOF, NB, IBS).

MODIFY—The modify command indicates the operation of using the message data parameter value to change (e.g., increment, decrement, or toggle) the current/existing value.

PARAMETER—A parameter is the variable quantity included in some messages. The parameter value, scaling, offset, units, transfer function, etc., are unique to each particular message. (The assigned parameters are contained herein.)

PHYSICAL ADDRESSING—Physical addressing allows a message to be addressed to a specific node or to all nodes or to a nonexistent, null node. The information in this message is only of relevance to a particular node, so the other nodes on the bus should ignore the message, except for the case of the "all nodes" address.

PRIMARY ID—The primary ID identifies the target for this functional message. This is the primary discriminator used to group functions into main categories.

PRIORITY—The priority describes the rank order and precedence of a message. Based upon the SAE J1850, Class B arbitration process, the message with the highest priority will win arbitration.

REPORT—A report indicates the transmission of parametric data values, based on: a change of state; a change of value; on a periodic rate basis; or as a response to a specific request.

REQUEST—A request is a command to, or a query for data, or action from another node on the network.

RESPONSE DATA—The response data is the information from a node on the network in response to a request from another node on the network. This may be an in-frame response or a report type of message.

SECONDARY ID—The secondary ID (along with the primary ID) identifies the functional target node for a message. The purpose of the secondary ID field within the frame is to further define the function or action being identified by the primary ID.

2.3 Abbreviations and Acronyms

CRC—Cyclic Redundancy Check

CS—Checksum

EOD—End of Data

EOF—End of Frame

ERR—Error Detection (CRC or CS)

IBS—Inter-Byte Separation

ID—Identifier
IFR—In-Frame Response
LSB—Least Significant Bit / Byte
MSB—Most Significant Bit / Byte
NB—Normalization Bit
PID—Parameter Identification number
SLOT—Scaling, Limit, Offset, and Transfer function
SOF—Start of Frame

3. General Information

3.1 Part 1 Overview—The messages defined by this four part document are specified for networks using single byte headers or consolidated 1 and 3 byte headers as specified in SAE J1850. Sections 4 and 5 of Part 1 provide the system architecture for the different possible headers used in Class B network communication (see Appendix A for supporting discussion). Section 6 of Part 1 defines the data fields used by the different header byte formats. Section 7 of Part 1 defines the physical address assignments.

Figure 3 shows an overview of this part (Part 1) which encompasses the different possible messages and their component parts.

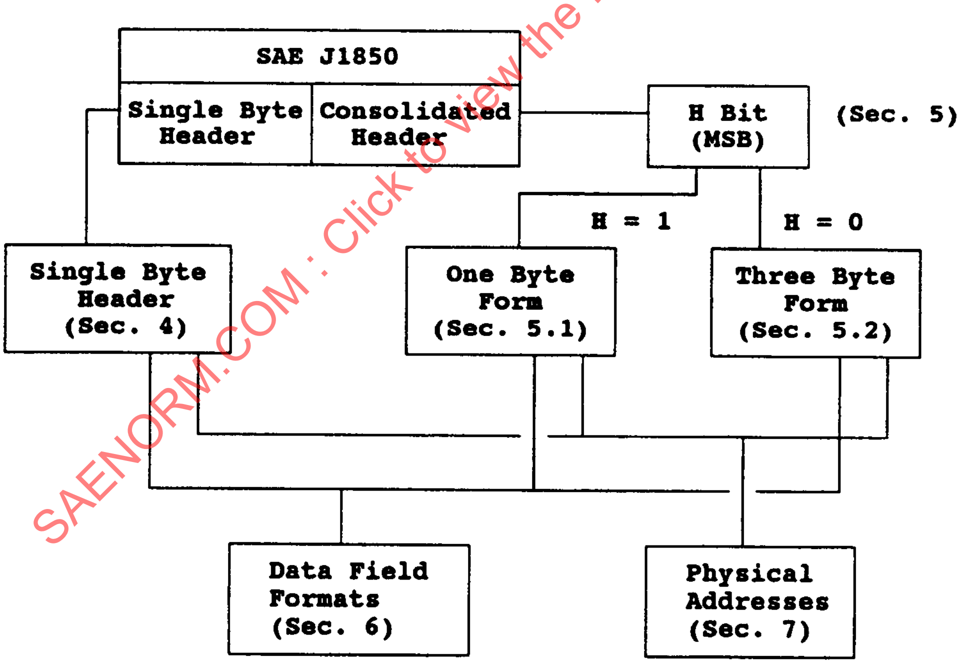

FIGURE 3—PART 1 OVERVIEW

SAE J1850 defines two and only two formats of message headers. They are the Single Byte header format and the Consolidated header format. The consolidated header format has two forms, identified by the value of the H Bit. The two forms are: a 1 byte form and a 3 byte form. The information in the header field for both formats contains target, source, priority and message type information, while the data field contains additional addressing and/or parametric information and/or diagnostic test modes. This information is explicitly defined in some headers and implicitly defined in others. Messages defined by this document (Parts 1, 2, 3, and 4) are classified generally into two types:

a. Requests, that is, commands (load or modify) or queries for data, and

b. Responses, that is, reports or acknowledgements.

When a node generates a request, the target nodes which are responsible for the requested data or function must respond by reporting the requested information or by performing the requested function. For responses (that is, reports or acknowledgements), data information that a node responds with may have been previously requested by another node, or reported by the node when the desired information has changed, or reported by the node on a periodic basis.

Part 1 of this document describes the overall structure of messages. In total, parts 1, 2, 3, and 4:

a. Fully defines SAE (automotive industry) standard messages.

b. Reserves messages for future SAE standardization.

c. Reserves messages for manufacturers to allocate, which are typically unique or proprietary to that manufacturer.

In order to comply with this document, implementations need to use the defined messages on SAE J1850 networks in the exact way that they are defined here. However, there are a large number of message codes which are reserved for each manufacturer to independently allocate.

3.2 In-Frame Response Field Formats

3.2.1 In-Frame Response Type 0—The in-frame response type 0 is used to indicate the form without any in-frame response.

3.2.2 In-Frame Response Type 1—The in-frame response type 1 is a single byte response from a single responder. The response byte shall be the physical address of a receiver of the message. No CRC or CS checking byte is included for this response data.

3.2.3 In-Frame Response Type 2—The in-frame response type 2 is a single byte response from multiple responders. The response byte(s) shall be the physical address of the receiver(s) of the message. No CRC or CS checking is included for the response data.

3.2.4 In-Frame Response Type 3—The in-frame response type 3 is a multiple byte response from a single responder. The response bytes shall be data (generally not its address) from a single responder. The second CRC or CS checking byte is included for the data integrity of the response data. The actual in-frame response data shall be 1 byte in length, as a minimum.

4. Single Byte Header Messages and Format—For single byte header messages, the entire byte is used to define the message identifier (ID) as shown in Figure 4. Standard message identifiers that utilize this header format are found in SAE J2178; Part 3. Single byte header messages use a checksum (CS) for data integrity.

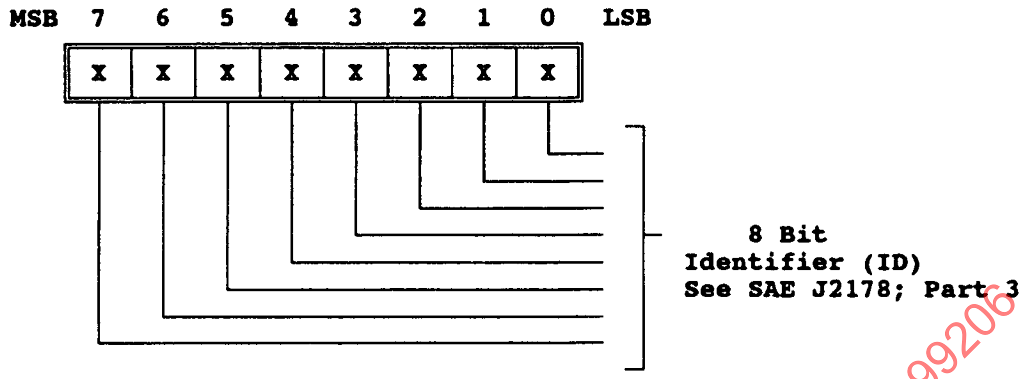

FIGURE 4—SINGLE BYTE HEADER FORMAT

All single byte header messages utilize one of the four in-frame response (IFR) types. These four types are illustrated as follows:

a. IFR Type 0—No response allowed. The number of data bytes cannot exceed ten. See Figure 5.

SOF	Header	Data	CS	EOF

FIGURE 5—SINGLE BYTE HEADER, IFR TYPE 0

b. IFR Type 1—Single byte response from a single responder. The response byte is the physical address of a receiver of the message. No CS is included for the response data. The number of data bytes plus the single response byte cannot exceed ten. See Figure 6.

SOF	Header	Data	CS	EOD	ID	EOF

FIGURE 6—SINGLE BYTE HEADER, IFR TYPE 1

c. IFR Type 2—Single byte responses from multiple responders. The response byte(s) are the physical addresses of the receiver(s) of the message. No CS is included for the response data. The number of data bytes plus the "N" response bytes cannot exceed ten. See Figure 7.

SOF	Header	Data	CS	EOD	ID 1	-	ID N	EOF

FIGURE 7—SINGLE BYTE HEADER, IFR TYPE 2

d. IFR Type 3—Multiple byte response from a single responder. The response bytes are data from a single responder. A second CS is included for the data integrity of the response data. The number of data bytes, including the in-frame response (IFR) data, cannot exceed nine. The actual in-frame response data must be one byte in length, as a minimum. See Figure 8.

SOF	Header	Data	CS	EOD	IFR DATA	CS	EOF

FIGURE 8—SINGLE BYTE HEADER, IFR TYPE 3

5. ***Consolidated Header Messages and Format***—The consolidated header format includes both a 1 byte form and a 3 byte form. All consolidated header format messages use a CRC code for data integrity.

In order to accommodate a 1 byte header form and a 3 byte header form on the same network, bit 4 (H bit) in the first byte of the message has been defined to indicate the header form. This bit is defined in Table 1.

TABLE 1—"H" BIT ASSIGNMENT

H Bit	Header Byte Form
0	3 Byte Form
1	1 Byte Form

5.1 One Byte Form of the Consolidated Header Format—The 1 byte form utilizes 7 bits for the message identifier (ID) and bit 4 (the H bit) = 1 to indicate the 1 byte form. Figure 9 illustrates this message header form. Standard message identifiers that utilize this header form are defined in SAE J2178; Part 3.

All 1 byte header form messages of the consolidated header format utilize one of the four in-frame response (IFR) types. These four types are illustrated as follows:

a. Type 0—No response allowed. The number of data bytes cannot exceed ten. See Figure 10.

b. IFR Type 1—Single byte response from a single responder. The response byte is the physical address of a receiver of the message. No CRC is included for the response data. The number of data bytes plus the single response byte cannot exceed ten. See Figure 11.

c. IFR Type 2—Single byte responses from multiple responders. The response byte(s) are the physical address of the receiver(s) of the message. No CRC is included for the response data. The number of data bytes plus the N response bytes cannot exceed ten. See Figure 12.

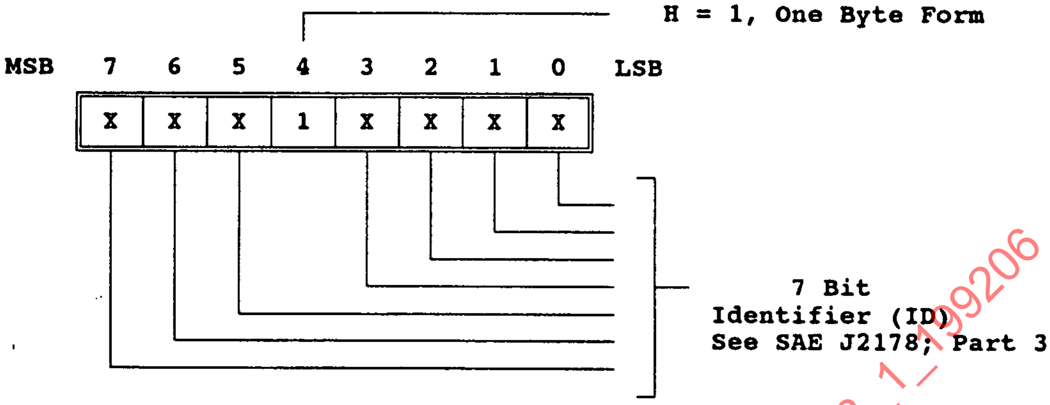

FIGURE 9—CONSOLIDATED HEADER, SINGLE BYTE FORM

SOF	Header	Data	CRC	EOF

FIGURE 10—ONE BYTE CONSOLIDATED HEADER, IFR TYPE 0

SOF	Header	Data	CRC	EOD	ID	EOF

FIGURE 11—ONE BYTE CONSOLIDATED HEADER, IFR TYPE 1

SOF	Header	Data	CRC	EOD	ID 1	-	ID N	EOF

FIGURE 12—ONE BYTE CONSOLIDATED HEADER, IFR TYPE 2

d. IFR Type 3—Multiple byte response from a single responder. The response bytes are data from a single responder. The second CRC is included for the data integrity of the response data. The number of data bytes, including the in-frame response (IFR) data, cannot exceed nine. The actual in-frame response data must be 1 byte in length as a minimum. See Figure 13.

SOF	Header	Data	CRC	EOD	IFR DATA	CRC	EOF

FIGURE 13—ONE BYTE CONSOLIDATED HEADER, IFR TYPE 3

5.2 Three Byte Form of the Consolidated Header Format—This header form utilizes the first 3 bytes of the message. In this form, the "H" bit is a zero (0), signifying that the 3 byte header form is used for this message. The remaining 7 bits of the first byte contain information about priority and message type (KYZZ). The second byte contains the target address information. The target can be either functionally addressed or physically addressed. The third byte contains the physical address of the source of the message. Arbitration is always resolved by the end of the third byte, since the source address must be unique. Figure 14 illustrates the 3 byte header form.

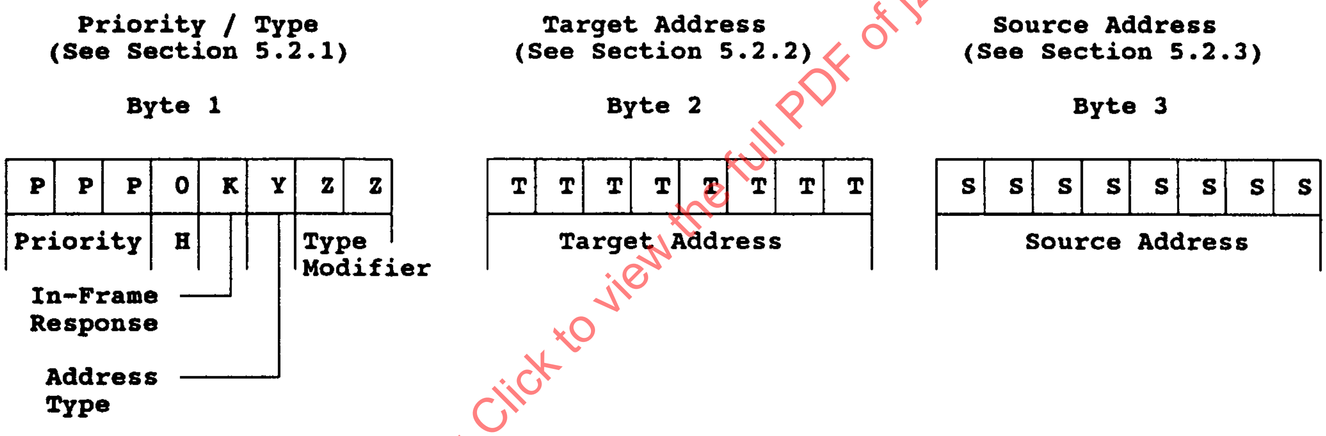

FIGURE 14—CONSOLIDATED HEADER, THREE BYTE FORM

5.2.1 PRIORITY/TYPE—BYTE 1—The priority/type byte contains information about priority, in-frame response, addressing type, and type modifier. Each of the field definitions are described in the following paragraphs.

5.2.1.1 *Priority (PPP Bits)*—The priority field is 3 bits in length which are the most significant bits of the first byte. The priority bit assignments are shown in Table 2.

5.2.1.2 *In-Frame Response (K Bit)*—The necessity for in-frame response is encoded into a single bit in the priority/type byte. This bit definition is shown in Table 3.

5.2.1.3 *Addressing Type (Y Bit)*—Message addressing is encoded with a single bit in the priority/type byte. This bit definition is shown in Table 4.

5.2.1.4 *Type Modifier (ZZ Bits)*—The type modifier is encoded as a 2 bit field and is used in conjunction with the in-frame response bit (K) and the address type bit (Y) to define sixteen message types, see Table 5.

TABLE 2—PRIORITY FIELD ASSIGNMENTS

PPP Bits	Priority	
000	0	Highest
001	1	.
010	2	.
011	3	.
100	4	.
101	5	.
110	6	.
111	7	Lowest

TABLE 3—"K" BIT ASSIGNMENT

K Bit	In-Frame Response
0	Required
1	Not Allowed

TABLE 4—"Y" BIT ASSIGNMENT

Y Bit	Addressing Type
0	Functional
1	Physical

5.2.1.5 *In-Frame Response (IFR) Types*—All 3 byte form messages of the consolidated header format listed in Table 5 utilize one of four in-frame response (IFR) types. These four types are illustrated as follows:

a. IFR Type 0—No response allowed. The number of data bytes cannot exceed eight. See Figure 15.

SOF	Header	Data	CRC	EOF

FIGURE 15—THREE BYTE CONSOLIDATED HEADER, IFR TYPE 0

b. IFR Type 1—Single byte response from a single responder. The response byte is the physical address of a receiver of the message. No CRC is included for the response data. The number of data bytes plus the single response byte cannot exceed eight. See Figure 16.

SOF	Header	Data	CRC	EOD	ID	EOF

FIGURE 16—THREE BYTE CONSOLIDATED HEADER, IFR TYPE 1

TABLE 5—THE SIXTEEN MESSAGE TYPES

H	PPP	KYZZ	Type Num.	Response (K)	Address Type (Y)	IFR Type	Message Type (Name)
0	XXX	0000	0	Required	Functional	2	Function
0	XXX	0001	1	Required	Functional	1	Broadcast
0	XXX	0010	2	Required	Functional	2	Function Query
0	XXX	0011	3	Required	Functional	3	Function Read
0	XXX	0100	4	Required	Physical	1	Node-to-Node
0	XXX	0101	5	Required	Physical	Reserved	Reserved - MFG.
0	XXX	0110	6	Required	Physical	Reserved	Reserved - SAE
0	XXX	0111	7	Required	Physical	Reserved	Reserved - MFG.
0	XXX	1000	8	Not Allowed	Functional	0	Function (Command/Status)
0	XXX	1001	9	Not Allowed	Functional	0	Function (Request/Query)
0	XXX	1010	10	Not Allowed	Functional	0	Function Extended (Command/Status)
0	XXX	1011	11	Not Allowed	Functional	0	Function Extended (Request/Query)
0	XXX	1100	12	Not Allowed	Physical	0	Node-to-Node
0	XXX	1101	13	Not Allowed	Physical	0	Block Transfer
0	XXX	1110	14	Not Allowed	Physical	0	Reserved - MFG.
0	XXX	1111	15	Not Allowed	Physical	0	Reserved - MFG.

NOTES
1. Functional Addresses for the 3 byte header form of header are defined in SAE J2178; Part 4. Physical Address Ranges are defined in Section 7.
2. Message types 8 and 9 use the functional data format #2 only. Message types 10 and 11 use the functional data format #3 only.
3. Reserved-SAE indicates reserved for future SAE Committee action. Reserved-MFG indicates that manufacturers are allowed to allocate these definitions without requiring any commonality between motor vehicle manufacturers.

c. IFR Type 2—Single byte responses from multiple responders. The response byte(s) are the physical address of the receiver(s) of the message. No CRC is included for the response data. The number of data bytes plus the N response bytes cannot exceed eight. See Figure 17.

SOF	Header	Data	CRC	EOD	ID 1	–	ID N	EOF

FIGURE 17—THREE BYTE CONSOLIDATED HEADER, IFR TYPE 2

d. IFR Type 3—Multiple byte response from a single responder. The response bytes are data from a single responder. The second CRC is included for the data integrity of the response data. The number of data bytes, including the in-frame response (IFR) data, cannot exceed seven. The actual in-frame response data must be 1 byte in length, as a minimum. See Figure 18.

SOF	Header	Data	CRC	EOD	IFR DATA	CRC	EOF

FIGURE 18—THREE BYTE CONSOLIDATED HEADER, IFR TYPE 3

5.2.2 Target Address—Byte 2—The second byte of the 3 byte form of the consolidated header format contains either a functional or physical target address. The physical address assignments are found in section 7 of this part, while functional message address assignments are in Part 4 (of SAE J2178).

5.2.3 Source Address—Byte 3—The third byte of the 3 byte format of the consolidated header format is the physical address of the source of the message. Physical address assignments are found in Section 7. These physical address assignments shall be unique for each node of a network.

6. Data Fields—In both message header formats, single byte and consolidated, the data field can usually be encoded in the same way. This section briefly describes the different ways that information can be formatted in the data field. The data field immediately follows the header field. The number of bytes in this field will vary, based upon the content of the header field. The maximum data field length is limited by the requirements of SAE J1850. Because of differences in functionally and physically addressed or with in-frame response data, these cases are defined separately.

6.1 Functional Data Field Formats

6.1.1 Functional Data Field Format 0—One of the functional data field formats is, in fact, no additional bytes of data (an empty data field). The message consists of the header, error checking byte, and in-frame response bytes. This is the format used for functional message types 2 and 3. Because the data field does not actually exist but to allow referencing in other parts of this document, it has been identified as the functional data field format 0.

6.1.2 Functional Data Field Format 1—In the simplest case including data (format 1), the data field contains only parametric data. The first byte of the data field in this case contains the most significant byte of data. The data field must contain 1 byte as a minimum. Figure 19 illustrates this message format. This data field format may be used for message types 0 and 1 only.

....	Data 1	...	Data n	....

FIGURE 19—FUNCTIONAL DATA FIELD FORMAT 1

6.1.3 Functional Data Field Format 2—In a data field format 2 message, the data field contains a byte used as an identifier which further defines the target function being addressed. In this format type, the data field would appear as shown in Figure 20. This data format may be used for message types 0, 1, 8 and 9.

....	Secondary ID	....

FIGURE 20—FUNCTIONAL DATA FIELD FORMAT 2

The secondary ID consists of a parameter / quantity bit Q (see 6.1.3.1) in which binary data (such as on/off or yes/no) can be encoded. There is a listing of the possible uses for this bit in other parts of this document. The control bit C (see 6.1.3.2) is used to distinguish between an immediate load of data or a modify of the current data for command messages. For message types 9 and 11, the control bit distinguishes between request and query. The remaining 6 bits specify an ID address (see 6.1.3.3). The order of these bits within the secondary ID byte is shown in Figure 21.

....	MSB		LSB	....
....	Q 1 Bit	C 1 Bit	ID 6 Bits	....

FIGURE 21—SECONDARY ID BYTE FORMAT

In many cases, a single data bit (the Q bit) is not adequate to define the parameter being sent. In this case, the identifier field is followed by a data field as illustrated in Figure 22. The combination of primary and secondary ID define if additional data is used by that message.

....	Secondary ID	Data 1	....	Data N	....

FIGURE 22—FUNCTIONAL DATA FIELD FORMAT 2, WITH DATA BYTES

6.1.3.1 *The Parameter / Quantity Bit "Q"*—The parameter / quantity bit represents the data or information value for single, binary values. If the information being transmitted has one of two opposite values, it is reflected as shown in Table 6. The specific meaning or relevance of this bit is defined for each message in other parts of this document.

TABLE 6—"Q" BIT ASSIGNMENT

Q Bit	Parameter/Quantity
0	No/False/Off/Down/..
1	Yes/True/On/Up/..

6.1.3.2 *The Control Bit "C"*—The control bit represents an action to be taken with the associated data values. Table 7 shows the two possible states for this bit. If the "C" bit indicates a load, the associated data value replaces the current/existing value. If the "C" bit indicates a modify or toggle, the current/existing data value is manipulated by the transmitted data value, based on the definition of each specific message (the 6 secondary identification address bits). For example, if the message indicates a toggle, the current/existing value is changed to the opposite state, independent of what that current/existing data value had been. For message types 9 and 11, the control bit distinguishes between request and query. The relevance of this bit is defined by the primary and secondary ID values and are specified in other parts of this document.

TABLE 7—"C" BIT ASSIGNMENT

C Bit	Command	Request/Query
0	Load	Request
1	Modify/Toggle	Query

6.1.3.3 *The Secondary Identification Address*—The secondary identification address field is used to further identify the particular function or operation being addressed by this message. It is used to distinguish a function when the primary ID is not sufficient, or to define a specific operation to be performed by the function addressed by the primary ID. These secondary identification addresses are assigned in parts 3 and 4 of this document.

6.1.4 FUNCTIONAL DATA FIELD FORMAT 3—In a data field format 3 message, depending on the particular primary ID, the data field may also contain an extended address byte which defines the geographical location within the vehicle of the target function being addressed following the secondary ID byte. As an example, in a functional message whose primary ID target is window motion, an extended address byte is needed to identify which window, e.g., driver, passenger, all; along with the secondary ID byte needed to identify an operation such as Up or Down. This data field format may be used for message types 0 and 1 and must be used for message types 10 and 11. In this data field type, the data field appears as shown in Figure 23.

....	**Secondary ID**	**Extended Address**	....

FIGURE 23—FUNCTIONAL DATA FIELD FORMAT 3, WITH EXTENDED ADDRESS

The extended address byte is used to determine where, geographically on a vehicle, a particular function is located. The exact definition of the extended address values can be found in 6.3. The secondary ID in Figure 23 is used as defined in 6.1.3. As an example, to roll the rear driver's side window down, the header would contain information that identifies window motion as the functional target. The first data byte would contain a 6-bit ID identifying the function Down with the Q-bit used to indicate enable the down or disable the down command, followed by the extended address, which would indicate that the particular window being addressed is on the rear driver's side. The C-bit is unused (default value = 0) in this particular message.

As in the other data field formats, a parameter data field may also be needed and in this case it is then appended to the end of the other identifiers. This format is shown in Figure 24.

....	**Secondary ID**	**Extended Address**	**Data 1**	**...**	**Data N**	....

FIGURE 24—FUNCTIONAL DATA FIELD FORMAT 3, WITH DATA BYTES

6.1.5 FUNCTIONAL DATA FIELD FORMAT 4—In this data field format message, the data field contains a byte which defines the diagnostic test mode of the target function being addressed. In this type, the data field would appear as shown in Figure 25. This data format may be used for message types 0, 1, 8, and 9.

....	**Test Mode**	....

FIGURE 25—FUNCTIONAL DATA FIELD FORMAT 4

The test mode byte is used to determine which diagnostic function is involved. It may then be followed by a "Parameter Identification" (PID) number or other parameter data fields. In this case, the additional data bytes follow the test mode byte. This format is shown in Figure 26. This is the format for functionally addressed diagnostic messages such as those found in SAE J1979.

....	Test Mode	Data 1	...	Data N	....

FIGURE 26—FUNCTIONAL DATA FIELD FORMAT 4, WITH DATA BYTES

6.2 Physical Data Field Formats—The previous section (6.1) defined the data field formats for functionally addressed messages. This section (6.2) defines the data field formats for physically addressed messages.

6.2.1 PHYSICAL DATA FIELD FORMAT 0—One of the physical data field formats is, in fact, no additional bytes of data (an empty data field). The message consists of the header, error checking byte, and may be with or without in-frame response bytes. This is the format used for the acknowledgement message type. This message type simply confirms to another node that this node has correctly received the message it is acknowledging. Because this data field does not actually exist but to allow referencing in other parts of this document, it has been identified as the physical data field format 0.

6.2.2 PHYSICAL DATA FIELD FORMAT 1—(Node to Node)

Physical data field format 1 is generally associated with the node-to-node message types. This message type is the one utilized for enhanced E/E diagnostic test modes (see SAE J2190).

This format assumes the 3 byte form of the consolidated header format. The single byte format and the 1 byte form of the consolidated header format are covered in physical data field format 2. Many of the specific diagnostic messages are defined in SAE J2190. This description of the format is consistent with that document but expands the definition to allow the format to be used in other messages as well. In particular, the manufacturer specific applications of this node-to-node message are expected to follow this format. The basic format is similar to the functional data field format 4. The format is shown in Figure 27.

....	Physical Test Mode	....

FIGURE 27—PHYSICAL DATA FIELD FORMAT 1

The format will often include data bytes as shown in Figure 28. The content of the test mode byte indicates if additional data bytes are used.

....	Phy. Test Mode	Data 1	....	Data N	....

FIGURE 28—PHYSICAL DATA FIELD FORMAT 1, WITH DATA BYTES

The physical test mode byte details are shown in Figure 29. The description of the individual parts of this byte are described in the following paragraphs.

	MSB		LSB	
....	I 1 Bit	R 1 Bit	ID 6 Bits	....

FIGURE 29—PHYSICAL TEST MODE BYTE FORMAT

6.2.2.1 *The Industry/Manufacturer Bit "I"*—The industry/manufacturer bit represents the organization responsible for the definition of this test mode. The information that has been defined by SAE (I = 0) can be interpreted in the same way for all vehicles that use those definitions. The bit assignment is shown in Table 8. The specific meaning for the SAE (industry) messages are defined in SAE J2190. SAE has also reserved for future definition some of the I = 1 test mode bytes. Manufacturer defined test modes can be independently defined by each vehicle manufacturer and there is no attempt made to make these definitions common between manufacturers.

TABLE 8—"I" BIT ASSIGNMENT

I Bit	Industry / Manufacturer
0	Industry (SAE Defined)
1	Industry (SAE Reserved/ Manufacturer Defined)

NOTE—See SAE J2190 for specific assignments.

6.2.2.2 *The Request/Response Bit "R"*—The request/response bit represents the direction of information flow contained in this message. Table 9 shows the two possible states for this bit. If the "R" bit indicates a request, the associated data bytes, if any, indicate the information being requested. If the "R" bit indicates a response, the data, if any, represent the response information previously requested.

TABLE 9—"R" BIT ASSIGNMENT

R Bit	Request/Response
0	Request
1	Response

6.2.2.3 *The Test Mode Identification Reference*—The test mode identification reference field is used to further identify the particular operation being addressed by this message. It is used to define a specific test mode to be performed by, or reported to, the node addressed by the target byte. These test mode identification addresses are assigned in SAE J2190 for the industry standard case.

6.2.3 PHYSICAL DATA FIELD FORMAT 2—(Diagnostic Test Modes)

In order to maximize commonality between the different header byte formats, the physical data field format 2 is essentially the same as for physical data field format 1 with the insertion of the physical target address byte ahead of the physical test mode byte. This allows the single byte header format and the 1 byte form of the consolidated header format to operate consistently with the 1 byte header form. The format is shown in Figures 30 and 31 for the two cases, with or without additional data bytes. The number of data bytes, if used, are not fixed length, unless so specified in other documents.

....	Physical Target Address	Physical Test Mode	....

FIGURE 30—PHYSICAL DATA FIELD FORMAT 2

....	Physical Target Address	Physical Test Mode	Data 1	...	Data N	....

FIGURE 31—PHYSICAL DATA FIELD FORMAT 2, WITH DATA BYTES

6.2.4 Physical Data Field Format 3—(Block Transfer)

This physical data field format is unique and dedicated to the transfer of large blocks of data from one physical node to another node of the network. It would have very limited application if it were restricted to the maximum message length requirements of SAE J1850. Therefore, this data format is allowed to exceed that limitation. The physical data field format 3 is shown in Figure 32.

MSB

...	Test Mode -SAEJ2190	Transfer Type	MSB Block Length	LSB Block Length	MSB-Start Address	Middle Address	LSB-Start Address	>

LSB

>	DATA 1	...	Data N	MSB Checksum	LSB Checksum	...

FIGURE 32—PHYSICAL DATA FIELD FORMAT 3—BLOCK TRANSFER

Since the message length limitation of SAE J1850 has been extended, the data field format includes additional error checking bytes. Each group of bytes in this format is described in the following paragraphs.

Note—This format is normally limited to use for service diagnostics or module/vehicle manufacture. It should not normally be used during vehicle operation because of the potentially long interruption of other vehicle message traffic.

6.2.4.1 *The Transfer Type Byte*—The first byte of this physical data field format defines the type of block transfer that is being transmitted. The transfer type byte is reserved for future definition. It has been included as a place holder to allow future definition by SAE or manufacturers.

6.2.4.2 *The Block Length Bytes*—The next 2 bytes of this physical data field format define the length of the data block (N) included in the block. The value of N represents the number of data bytes, not the total number of bytes in the data field. The maximum value of N is 0FFF Hex for a data block maximum length of 4095 bytes. The upper nibble (upper 4 bits) of the MSB of the block length is thus reserved for future definition and should be set to zero as its default value.

6.2.4.3 *The Starting Address Bytes*—The next 3 bytes identify the starting address of the data block being transmitted. In other words, it is the memory location where data byte 1 is located. The other data bytes of the block (data 2 to data N) will then represent, sequentially, in ascending address order, the additional data bytes of the block.

6.2.4.4 *The Data Bytes*—The data itself contains from 1 to N data bytes being transferred between nodes.

6.2.4.5 *The Block Checksum Bytes*—Because the block length is most likely longer than most other messages on the network, additional error checking is required. The last 2 bytes are a calculated checksum value based on the contents of the data block only. The calculation begins with the first data byte (Transfer Type) and continues to the last data byte (data N). The checksum is a 16 bit sum of the values included. The general checksum calculation is comparable to the SAE J1850 checksum extended to 16 bits. The transmitted checksum should match the received, calculated checksum to verify correct reception.

NOTE—The header is not included in this checksum calculation.

NOTE—The data field described previously is followed by the error checking byte of the SAE J1850 format (ERR byte, CS or CRC) to verify the integrity of the whole message, the same as all other Class B messages.

6.3 Extended Addressing—The extended addressing defines an extended (geographical) location in the vehicle. The extended address field (RR XXX YYY) is divided into three sub-fields:

a. The two most significant bits (RR) are reserved for future use. (00 is the defined value for geographic location.)
b. The three next most significant bits (XXX) indicate rows from front (001) to rear (111).
c. The three least significant bits (YYY) indicate columns from left (001) to right (111).

The codes XXX = 000 (for rows) and YYY = 000 (for columns) indicate that ALL rows and/or ALL columns are indicated. In other words, to address all of the items in a specific row, regardless of which column, use XXX = 000. For all items in the same column, independent of which row, use YYY = 000. This can be useful if needed to address all headlamps, for example, to turn them all on, but for lamp outage, the particular location of the headlamp may be desirable.

A map illustrating 49 zones of the vehicle is shown in Figure 33. It generally represents a top view of the vehicle and supports both Left/Right and Driver/Passenger side references.

LEFT SIDE FRONT SURFACE (RR 001 001)	DRIVER'S SIDE FRONT SURFACE (RR 001 010)	LEFT CENTER FRONT SURFACE (RR 001 011)	CENTER POINT FRONT SURFACE (RR 001 100)	RIGHT CENTER FRONT SURFACE (RR 001 101)	PASSENGER SIDE FRONT SURFACE (RR 001 110)	RIGHT SIDE FRONT SURFACE (RR 001 111)
LEFT SIDE UNDER HOOD (RR 010 001)	DRIVER'S SIDE UNDER HOOD (RR 010 010)	LEFT CENTER UNDER HOOD (RR 010 011)	CENTER POINT UNDER HOOD (RR 010 100)	RIGHT CENTER UNDER HOOD (RR 010 101)	PASSENGER SIDE UNDER HOOD (RR 010 110)	RIGHT SIDE UNDER HOOD (RR 010 111)
LEFT SIDE AFT BULKHEAD (RR 011 001)	DRIVER'S SIDE AFT BULKHEAD (RR 011 010)	LEFT CENTER AFT BULKHEAD (RR 011 011)	CENTER POINT AFT BULKHEAD (RR 011 100)	RIGHT CENTER AFT BULKHEAD (RR 011 101)	PASSENGER SIDE AFT BULKHEAD (RR 011 110)	RIGHT SIDE AFT BULKHEAD (RR 011 111)
LEFT SIDE AFT "A" PILLAR (RR 100 001)	DRIVER'S SIDE AFT "A" PILLAR (RR 100 010)	LEFT CENTER AFT "A" PILLAR (RR 100 011)	CENTER POINT AFT "A" PILLAR (RR 100 100)	RIGHT CENTER AFT "A" PILLAR (RR 100 101)	PASSENGER SIDE AFT "A" PILLAR (RR 100 110)	RIGHT SIDE AFT "A" PILLAR (RR 100 111)
LEFT SIDE MID VEHICLE (RR 101 001)	DRIVER'S SIDE MID VEHICLE (RR 101 010)	LEFT CENTER MID VEHICLE (RR 101 011)	CENTER POINT MID VEHICLE (RR 101 100)	RIGHT CENTER MID VEHICLE (RR 101 101)	PASSENGER SIDE MID VEHICLE (RR 101 110)	RIGHT SIDE MID VEHICLE (RR 101 111)
LEFT SIDE TRUNK (RR 110 001)	DRIVER'S SIDE TRUNK (RR 110 010)	LEFT CENTER TRUNK (RR 110 011)	CENTER POINT TRUNK (RR 110 100)	RIGHT CENTER TRUNK (RR 110 101)	PASSENGER SIDE TRUNK (RR 110 110)	RIGHT SIDE TRUNK (RR 110 111)
LEFT SIDE REAR SURFACE (RR 111 001)	DRIVER'S SIDE REAR SURFACE (RR 111 010)	LEFT CENTER REAR SURFACE (RR 111 011)	CENTER POINT REAR SURFACE (RR 111 100)	RIGHT CENTER REAR SURFACE (RR 111 101)	PASSENGER SIDE REAR SURFACE (RR 111 110)	RIGHT SIDE REAR SURFACE (RR 111 111)

XXX = ROW -- FROM FRONT TO REAR 000 = ALL ROWS
YYY = COLUMN -- FROM SIDE TO SIDE 000 = ALL COLUMNS
RR = 00 (GEOGRAPHIC LOCATION)

FIGURE 33—EXTENDED ADDRESS MAP

Appendix B shows some examples of this extended addressing as it identifies some common items in passenger vehicles.

7. ***Physical Address Assignments***—The physical address assignment ranges for nodes on a network are shown in Table 10. It is important to note that node address assignments on any network must be unique. In other words, no two nodes can have the same physical address assignment.