



SURFACE VEHICLE RECOMMENDED PRACTICE

J1939™-21

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Data Link Layer

RATIONALE

In the case when two ECUs are using Transport Protocol to transfer the same PG in both directions, and an ECU must abort one of the transfers, the existing message structure has no way to designate which transfer to abort. The addition of the direction indicator in the TP.Conn_Abort message will solve this problem and allow an ECU to select what connection to abort.

FOREWORD

This series of SAE Recommended Practices have been developed by the Truck and Bus Control and Communications Network Committee of the Truck and Bus Electrical and Electronics Steering Committee. The objectives of the committee are to develop information reports, recommended practices, and standards concerned with the requirements, design, and usage of devices that transmit electronic signals and control information among vehicle components. The usage of these Recommended Practices is not limited to truck and bus applications; other applications may be accommodated with immediate support being provided for construction and agricultural equipment, and stationary power systems.

These SAE Recommended Practices are intended as a guide toward standard practice and are subject to change so as to keep pace with experience and technical advances.

This data link layer is used for all SAE J1939 applications. It is the characteristic that is common across all SAE J1939 applications.

TABLE OF CONTENTS

1.	SCOPE	4
2.	REFERENCES	4
2.1	Applicable Documents	4
2.1.1	SAE Publications	4
2.2	Related Publications	4
2.2.1	ISO Publications	4
3.	DEFINITIONS	4
4.	ABBREVIATIONS	5

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Documents

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5.	TECHNICAL REQUIREMENTS.....	6
5.1	Message/Frame Format.....	6
5.1.1	SAE J1939 Message Format (Based on ISO 11898-1 CEFF Format).....	7
5.1.2	Parameter Group Number (PGN)	9
5.1.3	Support of ISO 11898-1 CBFF Format Messages.....	11
5.2	Protocol Data Unit (PDU).....	11
5.2.1	Priority (P)	12
5.2.2	Extended Data Page (EDP).....	12
5.2.3	Data Page (DP).....	12
5.2.4	PDU Format (PF)	13
5.2.5	PDU Specific (PS).....	14
5.2.6	Source Address (SA)	14
5.2.7	Data Field.....	14
5.3	Protocol Data Unit (PDU) Formats.....	15
5.3.1	PDU1 Format	16
5.3.2	PDU2 Format	17
5.4	Message Types.....	18
5.4.1	Command.....	18
5.4.2	Request.....	18
5.4.3	Broadcast/Response.....	21
5.4.4	Acknowledgment.....	21
5.4.5	Group Function	25
5.4.6	Request2.....	27
5.4.7	Transfer.....	29
5.5	Message Priority	30
5.6	Bus Access	31
5.7	Contention-Based Arbitration.....	31
5.8	Error Detection	31
5.9.1	Address Assignment Criteria	32
5.9.2	PGN Assignment Criteria	32
5.9.3	Data Field Definition.....	33
5.10	Transport Protocol Functions.....	33
5.10.1	Message Packetization and Reassembly	33
5.10.2	Connection Management.....	34
5.10.3	Transport Protocol - Connection Management Messages	36
5.10.4	Transport Protocol - Data Transfer Message (TP.DT).....	41
5.10.5	Connection Constraints.....	41
5.11	PDU Processing Requirements	42
5.12	Application Notes	42
5.12.1	High Data Rates.....	42
5.12.2	Request Scheduling.....	42
5.12.3	Device Response Time and Timeout Defaults.....	42
5.12.4	Required Responses.....	43
5.12.5	Transmission of PGs to Specific or Global Destinations	43
5.12.6	CTS Number of Packet Recommendation.....	43
5.12.7	Error Recovery	43
6.	NOTES.....	44
6.1	Revision Indicator.....	44
APPENDIX A	SAE J1939 PDU PROCESSING TYPICAL RECEIVE ROUTINE	45
APPENDIX B	COMMUNICATION MESSAGE TYPES	46
APPENDIX C	TRANSPORT PROTOCOL TRANSFER SEQUENCES	47
APPENDIX D	ASSIGNMENTS OF SPNS FOR SAE J1939-21	53

Figure 1	Protocol data unit	11
Figure 2	SAE J1939 parameter group number template	13
Figure 3	Available PDU formats	16
Figure 4	PDU1 format	17
Figure 5	PDU2 format	18
Figure 6	Request PG definition	19
Figure 7	Acknowledgment PG definition	25
Figure 8	Proprietary a PG definition	26
Figure 9	Proprietary A2 PG definition	26
Figure 10	Proprietary B PG definition	27
Figure 11	Request2 PG format	28
Figure 12	Transfer PG format	30
Figure 13	Format of messages for transport protocol	37
Figure 14	Format of messages for transport protocol (continued)	38
Figure 15	Transport protocol - data transfer message (TP.DT)	41
Table 1	Mapping of SAE J1939 into CAN's arbitration and control fields	8
Table 2	Parameter group number examples (SAE use EDP=0)	10
Table 3	Definition of extended data page and data page use	12
Table 4	PDU specific	14
Table 5	PDU1 and PDU2 transmit, request and response requirements	19
Table 6	Connection abort reason	40

1. SCOPE

The SAE J1939 documents are intended for light, medium, and heavy-duty vehicles used on or off road, as well as appropriate stationary applications which use vehicle derived components (e.g., generator sets). Vehicles of interest include, but are not limited to, on- and off-highway trucks and their trailers, construction equipment, and agricultural equipment and implements.

The purpose of these documents is to provide an open interconnect system for electronic systems. It is the intention of these documents to allow Electronic Control Units to communicate with each other by providing a standard architecture.

This particular document, SAE J1939-21, describes the data link layer using the Classical Extended Frame Format (CEFF) with 29-bit IDs, as defined in ISO 11898-1, December 2015. For SAE J1939, no alternative data link layers are permitted.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

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

SAE J1939-71 Vehicle Application Layer

SAE J1939-81 Network Management

SAE J1939DA Digital Annex

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 11898-1 Road Vehicles - Controller Area Network (CAN) - Part 1: Data Link Layer and Physical Signaling, December 2015

ISO 11992-4 Road Vehicles - Interchange of Digital Information on Electrical Connections Between Towing and Towed Vehicles - Part 4: Diagnostic Communication, May 2014

3. DEFINITIONS

Terms and definitions are defined in SAE J1939.

4. ABBREVIATIONS

ACK	Acknowledgment ¹
ACKM	Acknowledgement PG
BAM	Broadcast Announce Message
CAN	Controller Area Network (refer to ISO 11898-1)
CAN FD	CAN Flexible Data Rate
CAN ID	Controller Area Network Identifier
CBFF	Classical Base Frame Format
CEFF	Classical Extended Frame Format
CM	Connection Management
CRC	Cyclic Redundancy Check
CTS	Clear to Send
DA	Destination Address
DLC	Data Length Code
DP	Data Page
DT	Data Transfer
EDP	Extended Data Page
EOF	End of Frame (refer to ISO 11898-1:2015)
FBFF	FD Base Frame Format (refer to ISO 11898-1:2015)
FDF	FD Format indicator (refer to ISO 11898-1:2015)
FEFF	FD Extended Frame Format
GE	Group Extension
ID	Identifier
IDE	Identifier Extension (refer to ISO 11898-1:2015)
LSB	Least Significant Byte or Least Significant Bit
MF	Manufacturer
MSB	Most Significant Byte or Most Significant Bit

¹ In this document, ACK refers to the Acknowledgement PG (ACKM) with the control byte set to a value indicating positive acknowledgement, rather than the CAN in-frame ACK field.

NA	Not Allowed
NACK	Negative Acknowledgment
P	Priority
PDU	Protocol Data Unit
PF	PDU Format
PG	Parameter Group (a reference to the message)
PGN	Parameter Group Number (a reference to a specific PG/frame identification number)
PS	PDU Specific
RTR	Remote Transmission Request
RTS	Request to Send
SA	Source Address
SOF	Start of Frame (refer to ISO 11898-1:2015)
SPN	Suspect Parameter Number
SRR	Substitute Remote Request
TP	Transport Protocol
T_h	Hold Time
T_r	Response Time
un	Undefined

5. TECHNICAL REQUIREMENTS

The data link layer provides for the reliable transfer of data across the physical link. This consists of sending the CAN Data Frame with the necessary synchronization, sequence control, error control, and flow control. The flow control is accomplished by a consistent message/frame format.

5.1 Message/Frame Format

The SAE J1939 message format conforms to CAN requirements. The CAN specification referenced throughout this document is ISO 11898-1. It should be noted that when there are differences between the ISO 11898-1 specification and SAE J1939, then SAE J1939 is the guiding document. SAE J1939 does not use all of the functions defined in ISO 11898-1.

The definition of the SAE J1939 network requires that node addressing be used to prevent multiple nodes from using the same CAN ID field. Many additional requirements exist in SAE J1939 that are not specified by ISO 11898-1.

ISO 11898-1 contains the specification for four message formats: Classical Base Frame Format (CBFF) and Flexible Data Rate Base Frame Format (FBFF), which use 11-bit IDs; and Classical Extended Frame Format (CEFF) and Flexible Data Rate Extended Frame Format (FEFF), which use 29-bit IDs. ISO 11898-1 compatibility implies that messages of any format can potentially be present on a single network by using certain bit codings that allow for the recognition of the different formats. By contrast, SAE J1939 only supports the CBFF and CEFF CAN Data Frame formats. SAE J1939 only defines a full strategy for standardized communications using the CEFF format. CBFF format messages are for proprietary use following the rules defined in this document. SAE J1939 devices MUST use the CEFF format. CBFF format messages can reside on the network, but only as described in this document.

CAN FD controllers are available and may be connected to an SAE J1939-21 network. SAE J1939-21 does not support the FBFF or FEFF frame formats. CAN FD controllers attached to an SAE J1939-21 network are expected to conform to the SAE J1939 rules outlined in this and other SAE J1939 documents, and must use the 29-bit CEFF arbitration field as defined by J1939-21. CAN FD features must not be used while the SAE J1939-21 network is in operation because J1939 devices are not guaranteed to be CAN FD tolerant.

NOTE: CBFF devices do not respond to SAE J1939 network management messages and are not able to support the strategy for standardized communications.

The CAN Data Frame is parsed into different bit fields. The number and parsing of the bits in the arbitration and control fields differ between CBFF and CEFF messages. CBFF messages contain 11 identifier bits in the arbitration field, and CEFF messages contain 29 identifier bits in the arbitration field. SAE J1939 has further defined the identifier bits in the arbitration field of the CAN Data Frame formats. These definitions can be seen in Table 1.

5.1.1 SAE J1939 Message Format (Based on ISO 11898-1 CEFF Format)

The CEFF-based message encompasses a single Protocol Data Unit (PDU). PDUs consist of seven predefined fields. These fields are assimilated from information provided by the application layer. The fields are:

- Priority (P)
- Extended Data Page (EDP)
- Data Page (DP)
- PDU Format (PF)
- PDU Specific (PS, which can be a Destination Address or Group Extension)
- Source Address (SA)
- Data

These fields are packaged into one or more CAN Data Frames and sent over the physical media to other network devices. It should be recognized that some Parameter Group Number definitions require more than one CAN Data Frame to send their information.

Table 1 shows the arbitration and control fields of the following message formats: 29-bit identifier for CAN CEFF format messages; 29-bit identifier for SAE J1939 messages; 11-bit identifier for CAN CBFF format messages; and the 11-bit identifier for SAE J1939 compatibility. A complete definition for each of the SAE J1939 bit field assignments can be found in the sections that define the SAE J1939 Protocol Data Unit (see 5.2). Throughout this document the CAN Data Frame's Data field is discussed as byte 1 through 8. Byte 1's most significant bit (bit 8) is the first bit sent and is closest to the DLC field. Byte 8's least significant bit (bit 1) is the last of the data bits to be sent and is closest to the CRC Field.

Messages with EDP equal to one and DP equal to one are messages for communication between a towing vehicle and one or more towed vehicles as defined in ISO 11992-4. Therefore, the processing of the CAN Data Frame will not follow the definitions provided by SAE J1939 specifications. The user should consult the ISO 11992-4:2014 specifications for further guidance.

Messages with EDP equal to one and DP equal to zero are reserved for future assignment by the SAE J1939 committee. Any messages present on a SAE J1939 datalink that use these values will require unique handling rules as the rules specified in SAE J1939-21 will not apply to these messages. When messages using these values are defined by the SAE J1939 committee, handling rules will be specified in a future version of the SAE J1939-21 document.

Table 1 - Mapping of SAE J1939 into CAN'S arbitration and control fields

29-bit Identifiers CAN	29-bit Identifiers SAE J1939	Frame Bit Position	11-bit Identifiers CAN	11-bit Identifiers SAE J1939†
SOF	SOF*	1	SOF	SOF*
ID 28	P 3	2	ID 28	P 3
ID 27	P 2	3	ID 27	P 2
ID 26	P 1	4	ID 26	P 1
ID 25	EDP	5	ID 25	SA 8
ID 24	DP	6	ID 24	SA 7
ID 23	PF 8	7	ID 23	SA 6
ID 22	PF 7	8	ID 22	SA 5
ID 21	PF 6	9	ID 21	SA 4
ID 20	PF 5	10	ID 20	SA 3
ID 19	PF 4	11	ID 19	SA 2
ID 18	PF 3	12	ID 18	SA 1
SRR (r)	SRR*	13	RTR (x)	RTR (d)
IDE (r)	IDE*	14	IDE (d)	IDE*
ID 17	PF 2	15	FDF (d)	FDF*
ID 16	PF 1	16	DLC 4	DLC 4
ID 15	PS 8	17	DLC 3	DLC 3
ID 14	PS 7	18	DLC 2	DLC 2
ID 13	PS 6	19	DLC 1	DLC 1
ID 12	PS 5	20		
ID 11	PS 4	21		
ID 10	PS 3	22		
ID 9	PS 2	23		
ID 8	PS 1	24		
ID 7	SA 8	25		
ID 6	SA 7	26		
ID 5	SA 6	27		
ID 4	SA 5	28		
ID 3	SA 4	29		
ID 2	SA 3	30		
ID 1	SA 2	31		
ID 0	SA 1	32		
RTR (x)	RTR (d)	33		
FDF (d)	FDF*	34		
r0 (d)	r0*	35		
DLC 4	DLC 4	36		
DLC 3	DLC 3	37		
DLC 2	DLC 2	38		
DLC 1	DLC 1	39		

NOTES

SOF - Start of Frame Bit

ID ## - Identifier Bit #n

EDP - SAE J1939 Extended Data Page

SRR - Substitute Remote Request

RTR - Remote Transmission Request Bit

IDE - Identifier Extension Bit

r0 - CAN Reserved Bit #0

(r) - recessive bit

(d) - dominant bit

† Required format of proprietary 11-bit identifiers for compatibility with SAE J1939

P # - SAE J1939 Priority Bit #n

FDF - FD Format bit

DLC # - Data Length Code Bit #n

SA # - SAE J1939 Source Address Bit #n

DP - SAE J1939 Data Page

PF # - SAE J1939 PDU Format Bit #n

PS # - SAE J1939 PDU Specific Bit #n

(x) - bit state dependent on message

* ISO 11898-1 Defined Bit, Unchanged in SAE J1939

5.1.2 Parameter Group Number (PGN)

Whenever it is necessary to identify a Parameter Group Number (PGN) in the Data field of a CAN Data Frame, it will be expressed in 24 bits. The 24-bit value is sent LSB first, middle byte second, and MSB third, and has the following constituent components:

6 bits set to zero

EDP

DP

PF (8 bits)

PS (8 bits)

The procedure for converting the identifier fields to a PGN is as follows:

- a. The six most significant bits of the PGN are set to zero.
- b. EDP, DP, and PF are copied into the next 10 bits.
- c. If the PF value is less than 240 (F0h), then the least significant byte of the PGN is set to zero. Otherwise it is set to the value of the PS field.

See Table 2 for an illustration of the constituent component bit fields and their corresponding PGN. Note that not all 2^{17} (or 131072) combinations are available for assignment using the conventions specified in this document. The conventions specified yield 8672 PGNs (calculated as: 2 pages * [240 + (16*256)] = 8672 PGs). The Cumulative Number of PGNs column in Table 2 identifies the number of PGNs possible. Refer to SAE J1939 Digital Annex for the complete list of assigned PGNs.

Table 2 - Parameter group number examples (SAE USE EDP=0)

PGN Constituent Components	PGN Constituent Components	PGN Constituent Components	PGN Constituent Components	PGN Constituent Components					
PGN (MSB)	PGN (MSB)	PGN (MSB)	PGN	PGN (LSB)					
Byte 1	Byte 1	Byte 1	Byte 2	Byte 3					
Sent Third in CAN Data Frame			Sent Second in CAN Data Frame	Sent First in CAN Data Frame					
	EDP	DP	PF	PS	PGN	PGN	Number of Assignable PGNs	Cumulative Number of PGNs	SAE or Manufacturer Assigned
Bits 8 to 3	Bit 2	Bit 1	Bits 8 to 1	Bits 8 to 1	Dec	Hex _h			
0	0	0	0	0	0	000000 _h			SAE
							239	239	
0	0	0	238	0	60928	00EE00 _h			
0	0	0	239	0	61184	00EF00 _h	1	240	MF
0	0	0	240	0	61440	00F000 _h			SAE
							3840		
0	0	0	254	255	65279	00FEFF _h		4080	
0	0	0	255	0	65280	00FF00 _h			
							256		MF
0	0	0	255	255	65535	00FFFF _h		4336	
0	0	1	0	0	65536	010000 _h			
							239	4575	SAE
0	0	1	238	0	126464	01EE00 _h			
0	0	1	239	0	126720	01EF00 _h	1	4576	MF
0	0	1	240	0	126976	01F000 _h			
							3840		
0	0	1	254	255	130815	01FEFF _h		8416	SAE
0	0	1	255	0	130816	01FF00 _h			
							256		MF
0	0	1	255	255	131071	01FFFF _h		8672	
TOTALS							8672	8672	

5.1.3 Support of ISO 11898-1 CBFF Format Messages

It is recognized that controllers on the SAE J1939 network may support CBFF messages. Though these are not compatible with the SAE J1939 message structure, to accommodate the coexistence of the two formats, a minimum level of definition is given. This minimum definition allows devices that use this format to not interfere with other devices. CBFF messages are defined to be proprietary. Referencing Table 1, the 11-bit identifier field is parsed as follows: the three most significant bits are used as Priority bits; the eight least significant bits identify the Source Address (SA) of the PDU. Priority bits are described in 5.2.1. The SA is defined in the Source Address Table (refer to SAE J1939 Digital Annex).

NOTE: Incorrect bus arbitration could occur when two or more controllers, one of which is sending a CBFF message, attempt to access the bus at the same time. The Source Address has a higher relative priority in CBFF messages than in CEFF messages. The CBFF message could have an SA field indicating a higher priority than the EDP bit, DP bit, and PF of the SAE J1939 message. The three Priority bits should be used to achieve the correct message sequence.

SAE J1939 only defines a full strategy for standardized communications using the CEFF message format. Hardware that does not conform to ISO 11898-1, as well as hardware that uses only the FBFF or FEFF message formats, **MUST NOT** be used on an SAE J1939 network, to avoid disruption of network operation.

5.2 Protocol Data Unit (PDU)

The applications and/or network layer provide a string of information that is assimilated into a Protocol Data Unit (PDU). The PDU provides a framework for organizing the information that is key to each CAN Data Frame that is sent. The SAE J1939 PDU consists of seven fields: (1) P, (2) EDP, (3) DP, (4) PF, (5) PS (which can be a Destination Address or Group Extension), (6) SA, and (7) Data. The fields are packaged into one or more CAN Data Frames and sent over the physical media to other network devices. There is only one PDU per CAN Data Frame.

Some Parameter Group (PG) definitions require more than 8 data bytes and thus require more than one CAN Data Frame to send the corresponding data. Transport Protocol (TP) messages are used to transport PGs with more than 8 data bytes.

Some of the CAN Data Frame fields have been intentionally left out of the J1939 PDU definition because they are defined and controlled entirely by ISO 11898-1 and are invisible to all of the OSI layers above the data link layer. The fields that are controlled in this manner include the SOF, SRR, IDE, RTR, FDF, r0, CRC, ACK, and EOF fields. The seven PDU fields are illustrated in Figure 1. Each of the fields within the PDU is defined in the subsequent sections.

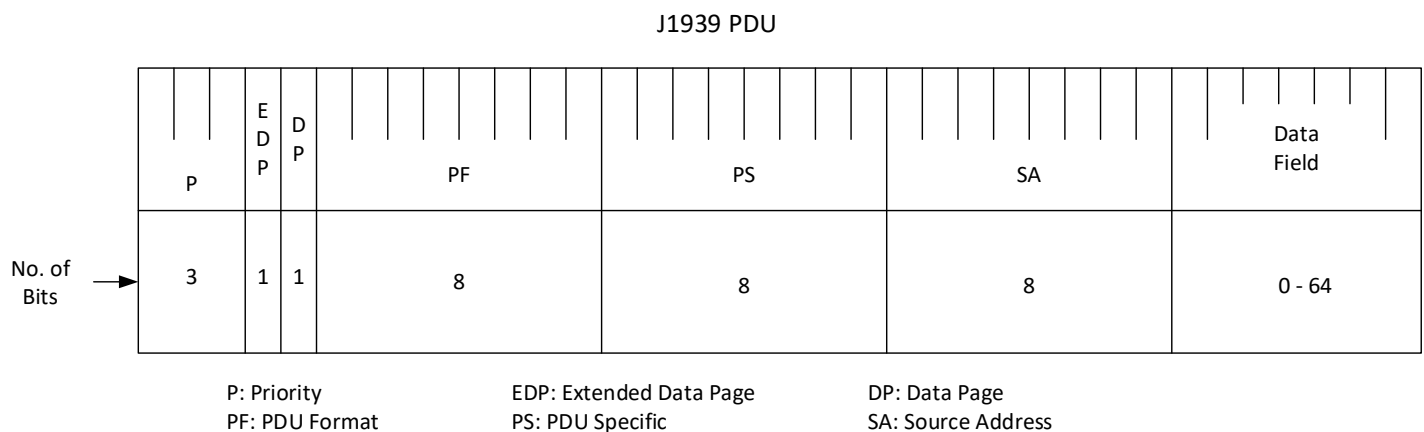


Figure 1 - Protocol data unit

5.2.1 Priority (P)

These three bits are used to optimize message latency for transmission onto the bus only. They should be globally masked off by the receiver (ignored). The priority of any message can be set from highest, 0 (000_b), to lowest, 7 (111_b). The default for all control oriented messages is 3 (011_b). The default for all other informational, proprietary, request, and ACK messages is 6 (110_b). This permits the priority to be raised or lowered in the future as new PGNs are assigned and bus traffic changes. A recommended value is assigned to each PGN when it is added to the application layer document. However, the Priority field should be reprogrammable to allow for network tuning by the OEM should the need arise.

5.2.2 Extended Data Page (EDP)

The EDP is used in conjunction with the DP to determine the structure of the CAN ID of the CAN Data Frame. All SAE J1939 messages shall set EDP to zero on transmit. See Table 3 to find the defined uses of the EDP and DP. Future definitions with EDP set to one could expand the PDU Format field, define new PDU formats, or increase the address space.

5.2.3 Data Page (DP)

The DP is used in conjunction with the EDP to determine the structure of the CAN ID of the CAN Data Frame. With the EDP set to zero, the DP selects between page 0 and page 1 of PGN descriptions. See Table 3. Also see Figure 2 to see the SAE J1939 Parameter Group Number template.

Table 3 - Definition of extended data page and data page use

Extended Data Page (bit 25) CAN ID (bit 25)	Data Page (bit 24) CAN ID (bit 24)	Description
0	0	SAE J1939 page 0 PGNs
0	1	SAE J1939 page 1 PGNs
1	0	SAE J1939 reserved
1	1	ISO 11992-4 defined

NOTE: When the EDP and DP of the CAN 29-bit ID are set to 11_b, the frame is identified as an ISO 11992-4:2014 diagnostic message. This means that the rest of the CAN ID is NOT set up the same as SAE J1939 specifies. CAN Data Frames following this format are not described in the SAE J1939 series of SAE recommended practices.

EDP	DP	PF	PS	Parameter Group Definition	Multipacket	PGN
0	0	0	DA	PDU1 Format – 100 ms or less	Not Allowed	0
0	0	1	DA		Not Allowed	256
Boundary X					↓	
					↑	
0	0	238	DA	PDU1 Format – greater than 100 ms	Allowed	60928
0	0	239	DA	PDU1 Format – Proprietary A	Allowed	61184
0	0	240	0	PDU2 Format – 100 ms or less	Not Allowed	61440
0	0	240	1		Not Allowed	61441
Boundary Y					↓	
					↑	
0	0	254	254		Not Allowed	65278
0	0	254	255	PDU2 Format – greater than 100 ms	Allowed	65279
0	0	255	0-255	PDU2 Format – Proprietary B	Allowed	65280-65535
0	1	0	DA	PDU1 Format – 100 ms or less	Not Allowed	65536
0	1	1	DA		Not Allowed	65792
Boundary X1					↓	
					↑	
0	1	238	DA	PDU1 Format – greater than 100 ms	Allowed	126464
0	1	239	DA	PDU1 Format – Proprietary A2	Allowed	126720
0	1	240	0	PDU2 Format – 100 ms or less	Not Allowed	126976
0	1	240	1		Not Allowed	126977
Boundary Y1					↓	
					↑	
0	1	254	254		Not Allowed	130814
0	1	254	255	PDU2 Format – Greater than 100 ms	Allowed	130815
0	1	254	0-255	PDU2 Format – Proprietary B	Allowed	130816-131071

LEGEND**EDP** – Extended Data Page**PF** – PDU Format**DA** – Destination Address**DP** – Data Page**PS** – PDU Specific**PGN** – Parameter Group Number**Figure 2 - SAE J1939 parameter group number template****5.2.4 PDU Format (PF)**

The PDU Format is an 8-bit field that defines whether a PGN has a PDU1 or PDU2 Format, and is one of the fields used to determine the PGN assigned to the Data field. PGNs are used to identify or label commands, data, some requests, acknowledgments, and negative-acknowledgments. PGNs identify or label information that may require one or more CAN Data Frames to communicate the information. If there is more information than fits in 8 data bytes, then a multipacket message needs to be sent (see 5.10). If there are 8 or fewer data bytes, then a single CAN Data Frame is used. A PGN can represent one or more parameters, where a parameter is a piece of data, such as engine rpm. Even though a PGN label can be used for one parameter, it is recommended that multiple parameters be grouped so that all 8 bytes of the Data field are used.

The definition of proprietary PGNs has been established allowing both PDU1 and PDU2 Formats to be used. The interpretation of the proprietary information varies by manufacturer. For example, even though two different engines may use the same source address, manufacturer “A’s” proprietary communications are likely to be different from manufacturer “B’s.”

5.2.5 PDU Specific (PS)

The PDU Specific field is an 8-bit field and its definition depends on the PF field. Depending on the PF field, it can be a Destination Address (DA) or a Group Extension (GE). If the value of the PF field is below 240, then the PS field is a DA. If the value of the PF field is 240 to 255, then the PS field contains a GE value. See Table 4. See Figure 2 for the range of PGNs.

Table 4 - PDU specific

	PDU Format Field	PDU Specific Field
PDU1 Format	0 to 239	Destination Address
PDU2 Format	240 to 255	Group Extension

5.2.5.1 Destination Address (DA)

This field defines the specific address to which the message is being sent. Note that any other device should ignore this message. The global DA (255) requires all devices to listen and respond accordingly as message recipients.

5.2.5.2 Group Extension (GE)

The GE field, in conjunction with the four least significant bits of the PF field (note that when the four most significant bits of the PF field are set, it indicates that the PS field is a GE), provides for 4096 PGNs per data page. These 4096 PGNs are only available using the PDU2 Format. In addition, 240 PGNs are provided in each data page for use only in the PDU1 Format. In total, 8672 PGNs are available to be defined using the two data pages currently available.

The total number of PGNs available can be calculated as follows in Equation 1:

$$(240 + (16 \times 256)) \times 2 = 8672 \quad (\text{Eq. 1})$$

where:

240 = number of PF field values available per data page (i.e., PDU1 Format, PS Field equals DA)

16 = PF values per GE value (i.e., PDU2 Format)

256 = number of possible GE values (i.e., PDU2 Format)

2 = number of defined DP values (both PDU Formats)

5.2.6 Source Address (SA)

The Source Address field is 8 bits long. There shall only be one device on the network with a given SA. Therefore, the SA field assures that the CAN ID is unique, as required by CAN. Address management and allocation is detailed in SAE J1939-81. Procedures are defined in SAE J1939-81 to prevent duplication of SAs. Refer to SAE J1939 Digital Annex for SA assignments.

5.2.7 Data Field

5.2.7.1 Data from 0 to 8 Bytes

When 8 bytes or fewer of data are required for expressing a given PG, then all 8 data bytes of the CAN Data Frame can be used. It is generally recommended that 8 data bytes be allocated or reserved for all PGN assignments which are likely to expand in the future. This provides a means to easily add parameters and not be incompatible with previous revisions that only defined part of the Data field. Once the number of data bytes associated with a PG is specified, the number of data bytes cannot be changed, and the PG cannot become multipacket unless originally defined as multipacket. The CAN Data Length Code (DLC) is set to the defined PG "Data Length" value when it is 8 bytes or less, and to 8 in each CAN Data Frame for PGs whose Data Length is 9 or more bytes. For example, the Request PGN 59904, has the PG Data Length as 3 so the CAN DLC is set to 3. It is important to note that an individual group function PG (see 5.4.5) must have the same

length Data field because the CAN ID will be identical while the Data field will be used to convey the specific group subfunctions, therefore requiring many different interpretations based on the Data field.

5.2.7.2 Data from 9 to 1785 Bytes

When a PG is defined with between 9 and 1785 bytes of data to be transmitted, the communication of this data is done in multiple CAN Data Frames. Thus, the term multipacket is used to describe this type of PG. A PG defined as multipacket capable, having fewer than 9 data bytes to transfer in a specific instance, shall be sent in a single CAN Data Frame with the DLC set to 8. When a particular PG has more than 8 data bytes to transfer, Transport Protocol (TP) is used. The Transport Protocol Connection Management (TP.CM) PGN is used to set up and close out the communication of the multipacket PGs. The Transport Protocol Data Transfer (TP.DT) PGN is used to communicate the data itself in a series of CAN Data Frames (packets) containing the packetized data. Additionally, Transport Protocol provides flow control and handshaking capabilities for destination-specific transfers using Request to Send (RTS) and Clear to Send (CTS) messages. See 5.10.

All CAN Data Frames associated with a particular multipacket response are required to have a DLC of 8. All unused data bytes are set to “not available” (refer to SAE J1939-71). The number of bytes per packet is fixed; however, SAE J1939 defines multipacket messages that have a variable and/or a fixed number of packets. The PG for active diagnostic codes (DM1) is an example of a multipacket message that has a “variable” number of packets. PGs that are defined as multipacket only use TP when the number of data bytes to send exceeds eight.

5.3 Protocol Data Unit (PDU) Formats

The available PDU formats are illustrated in Figure 3. Two PDU formats are defined: PDU1 Format (PS = DA) and PDU2 Format (PS = GE). PDU1 Format allows for direction of the CAN Data Frame to a specific DA (device). The PDU2 Format can only communicate CAN Data Frames that are not destination-specific. The creation of two separate PDU formats was established in order to provide more possible PGN combinations while still providing for destination-specific communications. Proprietary PG definitions have been assigned so that both PDU formats are available for proprietary communications. A standardized method was established for proprietary communications to prevent possible conflicts in identifier usage.

The definition of proprietary PGs has been established allowing both PDU1 and PDU2 Formats to be used. The interpretation of the proprietary information varies by manufacturer. For example engine manufacturer “A’s” proprietary communications are likely to be different than engine manufacturer “B’s” even though they both use the same source address.



NOTE: The global DA should not be used with Proprietary A and Proprietary A2 PGs.

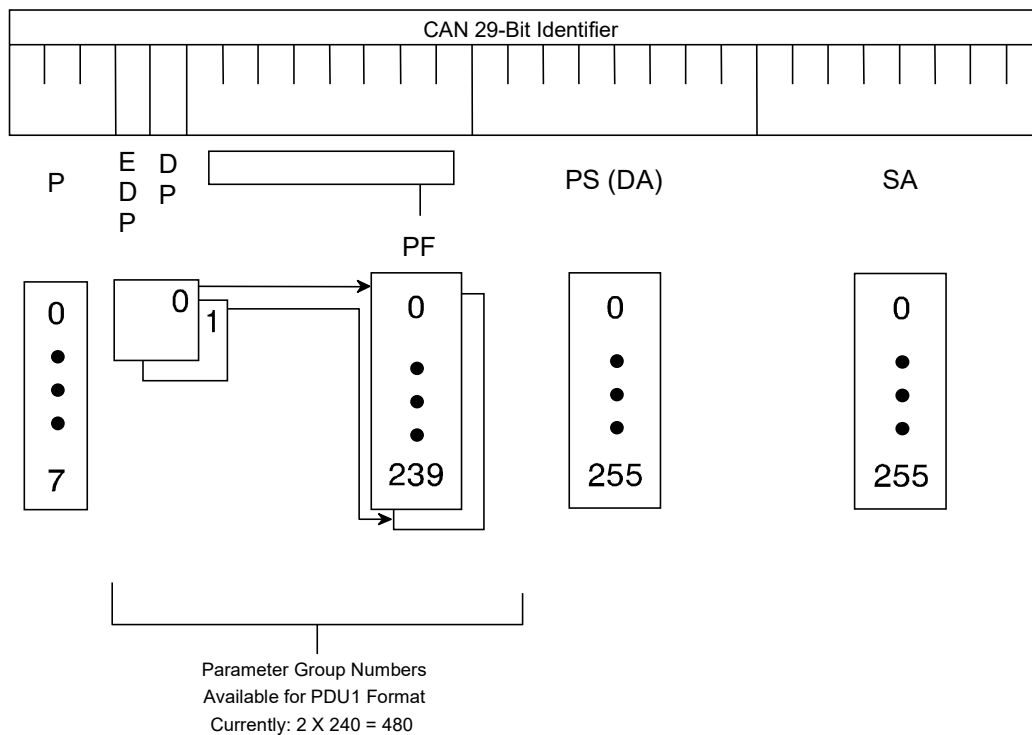


Figure 4 - PDU1 format

5.3.2 PDU2 Format

This format can only be used to communicate PGs to the global DA; the global DA is implied by the PDU2 Format and does not appear in the arbitration field. PDU2 Format messages can be requested or sent as unsolicited messages. Selection of PDU2 Format, at the time a PGN is assigned, prevents that PG from ever being able to be directed to a specific DA (unless multipacket and TP RTS/CTS protocol is used). The PS field contains a Group Extension.

PDU2 Format messages are defined to be those where the PF field is equal to 240 to 255 (see Figure 2). The formatting of the PDU2 Format message is illustrated in Figure 3. Also see Figure 5, PDU2 Format.

The PGNs of messages that are sent at fast update rates (generally less than 100 ms) start at PF = 240 and increment toward y (or y1). See Figure 2.

The PGNs of messages that are only requested, sent on change, or sent at slow update rates (generally greater than every 100 ms) start at PF = 254 and decrement toward y (or y1). See Figure 2.

512 PGNs with PF equal to 255, with EDP = 0 and DP = 0 or 1, are assigned for proprietary use. In this case the PDU Specific field is left to be defined and used by each manufacturer (see 5.4.5). The PGNs for Proprietary B with DP = 0 cover the range 65280 to 65535, while the PGNs for Proprietary B with DP = 1 cover the range 130816 to 131071. See 5.4.5 for a description of the Proprietary B message.