



SURFACE VEHICLE RECOMMENDED PRACTICE

J1939™

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(R) Serial Control and Communications Heavy-Duty Vehicle Network -
Top-Level Document

RATIONALE

This document has been revised to synchronize terminology that is included in related SAE J1939 recommended practices and technical reports.

FOREWORD

The SAE J1939 communications network is defined using a collection of individual SAE J1939 documents. The SAE J1939 top-level document is the parent document for all other SAE J1939 documents.

The SAE J1939 communications network is a high-speed ISO 11898-1 CAN-based communications network that supports real-time closed loop control functions, simple information exchanges, and diagnostic data exchanges between electronic control units (ECUs) physically distributed throughout the vehicle.

The SAE J1939 communications network is developed for use in heavy-duty environments and suitable for horizontally integrated vehicle industries. The SAE J1939 communications network is applicable for light-duty, medium-duty, and heavy-duty vehicles used on-road or off-road, and for appropriate stationary applications which use vehicle derived components (e.g., generator sets). Vehicles of interest include, but are not limited to, on-highway and off-highway trucks and their trailers, construction equipment, and agricultural equipment and implements. The physical layer aspects of SAE J1939 reflect its design goal for use in heavy-duty environments. Horizontally integrated vehicles involve the integration of different combinations of loose package components, like as engine and transmissions, that are sourced from many different component suppliers. The SAE J1939 common communication architecture strives to offer an open interconnect system that allows the ECUs associated with different component manufacturers to communicate with each other.

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For more information on this standard, visit
https://www.sae.org/standards/content/J1939_202306/

Documents

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1. SCOPE

This top-level document provides a general overview of the SAE J1939 network and describes the subordinate document structure. This document includes definitions of terms and abbreviations which are used among the various SAE J1939 subordinate documents.

1.1 Degree of Openness

An SAE J1939 network is open to the degree that any two ECUs which conform to the same SAE J1939-0X document can be connected via the network and communicate with each other without functional interference. The SAE J1939-0X documents describe a specific type of application, typically representing a specific industry to which it pertains such as agricultural or heavy-duty trucks. It is possible that ECUs will be unable to communicate with one another if they conform to different SAE J1939-0X documents. It is possible that ECUs which conform to different SAE J1939-0X documents can cause degradation or complete disruption of the entire network.

1.2 Proof of Compliance

There is no procedure presently in place to test, validate, or provide formal approval for ECUs utilizing the SAE J1939 network. Each component developer is expected to design their products to the spirit of, as well as the specific content of, this recommended practice. Provisions are made in SAE J1939-11, SAE J1939-14, and SAE J1939-15 for self-certification to these documents. SAE J1939-82 provides methods for self-certifying compliance to several of the other SAE J1939 documents. In the future, additional procedures can be defined and implemented to test new products to ensure full compliance with all appropriate SAE J1939 documents. Until that time, compliance is determined by the manufacturer of the component. Should questions arise regarding the use or interpretation of any part of these recommended practices they should be directed to the SAE Truck and Bus Control and Communications Committee for resolution.

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 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 J1213	Glossary of Vehicle Networks for Multiplexing and Data Communications
SAE J1939DA	Digital Annex of Serial Control and Communications Heavy-Duty Vehicle Network Data
SAE J1939-1	On-Highway Equipment Control and Communication Network
SAE J1939-2	Agricultural and Forestry Off-Road Machinery Control and Communication Network
SAE J1939-3	On-Board Diagnostics Implementation Guide
SAE J1939-5	Marine Stern Drive and Inboard Spark-Ignition Engine On-Board Diagnostics Implementation Guide
SAE J1939-11	Physical Layer, 250 kbps, Twisted Shielded Pair
SAE J1939-13	Off-Board Diagnostic Connector
SAE J1939-14	Physical Layer, 500 kbps
SAE J1939-15	Physical Layer, 250 kbps, Un-Shielded Twisted Pair (UTP)

SAE J1939-16	Automatic Baud Rate Detection Process
SAE J1939-17	CAN FD Physical Layer, 500 kbps/2 Mbps
SAE J1939-21	Data Link Layer
SAE J1939-22	CAN FD Data Link Layer
SAE J1939-31	Network Layer
SAE J1939-71	Vehicle Application Layer
SAE J1939-73	Application Layer - Diagnostics
SAE J1939-74	Application - Configurable Messaging
SAE J1939-75	Application Layer - Generator Sets and Industrial
SAE J1939-76	SAE J1939 Functional Safety Communications Protocol
SAE J1939-81	Network Management
SAE J1939-82	Compliance
SAE J1939-84	OBD Communications Compliance Test Cases for Heavy-Duty Components and Vehicles
SAE J1939-90	OBD Traceability Matrix

2.1.2 ISO Publications

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

ISO 7498	Information Processing Systems - Open Systems Interconnection (OSI) - Basic Reference Model
ISO 11898-1:2015	Road Vehicles - Controller Area Network (CAN) - Part 1: Data Link Layer and Physical Signaling

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 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 J1587	Electronic Data Interchange Between Microcomputer Systems in Heavy-Duty Vehicle Applications
SAE J1708	Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications
SAE J1922	Powertrain Control Interface for Electronic Controls Used in Medium- and Heavy-Duty Diesel On-Highway Vehicle Applications

2.2.2 ASAM (Association for Standardisation of Automation and Measuring Systems) Publications

Available from ASAM, Altlaufstr. 40, 85635 Höhenkirchen, Germany, www.asam.net.

ASAM MCD-1 CCP CAN Calibration Protocol

ASAM MCD-1 XCP The Universal Measurement and Calibration Protocol Family

2.2.3 ISO Publications

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

ISO 11783 Tractors and Machinery for Agriculture and Forestry - Serial Control and Communications Data Network (Parts 1 through 14)

ISO 11992 Road Vehicles - Electrical Connections Between Towing and Towed Vehicles - Interchange of Digital Information (Parts 1, 2, and 3)

ISO 15765-3 Road Vehicles - Diagnostics on Controller Area Network (CAN) - Part 3: Implementation of Unified Diagnostic Services (UDS on CAN)

2.2.4 NMEA (National Marine Electronics Association) Publications

Available from National Electrical Manufacturers Association, 1300 North 17th Street, Suite 900, Arlington, VA 22209, Tel: 703-841-3200, www.nema.org.

NMEA 2000 NMEA 2000 Interface Standard

3. DEFINITIONS AND ABBREVIATIONS

Definitions provided herein supersede those contained in SAE J1213. SAE J1213 applies throughout otherwise.

3.1 Definitions

3.1.1 ACKNOWLEDGMENT

An SAE J1939 Parameter Group (message) used to indicate the positive or negative response to a received message or a requested action.

3.1.2 ADDRESS

The 8-bit numeric value used to identify a device communicating on an SAE J1939 network, also known as an SAE J1939 Address. SAE J1939 addresses are used with SAE J1939 data frames to identify the source of a message (source address), and sometimes the intended destination of a message (destination address).

3.1.3 ADDRESS ARBITRATION

The SAE J1939 process for multiple controller applications to resolve conflicts when attempting to acquire an address on an SAE J1939 network.

3.1.4 APPLICATION LAYER PROTOCOL DATA UNIT (A_PDU)

This SAE J1939 application layer protocol data unit contains the PG identity (PGN), the PG data, and supporting metadata necessary for use in a D_PDU.

3.1.5 BRIDGE

A network device used to transfer message frames between two network segments with the same data link protocol and network address space. A bridge permits communication between network segments that can have physical layer differences, such as the media, the electrical interface, and data rate. A bridge can filter message frames transferred between network segments.

3.1.6 BUS

See segment ([3.1.65](#)).

3.1.7 CAN DATA FRAME

Generic term referring to any of the ISO 11898-1 CBFF, CEFF, FBFF, and FEFF data frames.

3.1.8 CLASSICAL BASE FRAME FORMAT (CBFF)

An ISO 11898-1 CAN data frame with an 11-bit identifier, a single bit rate, and a maximum data field length of 8 bytes.

3.1.9 CLASSICAL EXTENDED FRAME FORMAT (CEFF)

An ISO 11898-1 CAN data frame with a 29-bit identifier, a single bit rate, and a maximum data field length of 8 bytes.

3.1.10 CONTROLLER APPLICATION (CA)

The software application that performs a system control function, such as controlling the transmission or engine, and communicates on the SAE J1939 network. The software in an ECU can consist of one or more controller applications for one or more system control functions.

3.1.11 CYCLIC REDUNDANCY CHECK (CRC)

An error control mechanism for detecting transmission errors.

3.1.12 DATA FIELD

The part of a CAN data frame that contains the data (payload). Data field is not equivalent to PG Data (see [3.1.49](#)). For CBFF and CEFF data frames, the longest data field is 8 bytes. For FBFF and FEFF data frames, the longest data field is 64 bytes.

3.1.13 DATA PAGE (DP)

- a. A 1-bit field in the 29-bit identifier in an SAE J1939 data frame that is used together with the EDP bit to classify and indicate how the 29-bit identifier is to be interpreted. Refer to SAE J1939-21 or SAE J1939-22 for the interpretations of the EDP and DP combinations.
- b. A 1-bit field of the four fields that comprise the Parameter Group Number (PGN) assigned to an SAE J1939 PG.

3.1.14 DATALINK LAYER PROTOCOL DATA UNIT (D_PDU)

The SAE J1939 datalink layer protocol data unit for transmitting A_PDUs by the CAN controller.

3.1.15 DESTINATION ADDRESS (DA)

- a. The use of an SAE J1939 Address to explicitly identify the intended receiver of an SAE J1939 message or SAE J1939 data frame.
- b. The interpretation of the PDU specific (PS) field in the 29-bit identifier of a D_PDU1 data frame.

3.1.16 DEVICE

A physical component with one or more network connections.

3.1.17 DIAGNOSTIC TROUBLE CODE (DTC)

A 4-byte data structure that describes a detected failure for a suspected parameter or system condition. The DTC consists of an SPN and an SAE J1939 Failure Mode Indicator (FMI), where the SPN identifies the parameter or condition being diagnosed and the FMI identifies the type of failure detected.

3.1.18 D_PDU1 DATA FRAME

The destination-specific form of the SAE J1939 data frame. The 29-bit identifier of the CEFF or FEFF data frame uses 8 bits as the SAE J1939 address of the destination of the data frame and 10 bits to identify the PGN of the SAE J1939 PG associated with the data frame data field. The SAE J1939 PG is identified by the EDP, DP and PF values of its PGN; the PS value of the PGN is always 0. A D_PDU1 SAE J1939 data frame has a PF field with a value less than 240.

3.1.19 D_PDU2 DATA FRAME

The broadcast-only form of the SAE J1939 data frame. The 29-bit identifier of the CEFF or FEFF data frame uses 18 bits to identify the PGN of the SAE J1939 PG associated with the data frame data field. The SAE J1939 PG is identified by the EDP, DP, PF, and PS values of its PGN. A D_PDU1 SAE J1939 data frame has a PF field with a value greater than or equal to 240.

3.1.20 ELECTRONIC CONTROL UNIT (ECU)

A computer based electronic assembly that can send or received SAE J1939 messages.

3.1.21 END OF FRAME (EOF)

A 7-bit field sequence specified by ISO 11898-1 for marking the ending of a CAN data frame.

3.1.22 EXTENDED DATA PAGE (EDP)

- a. A 1-bit field in the 29-bit identifier of an SAE J1939 data frame that is used together with the DP bit to classify and indicate how the 29-bit identifier is to be interpreted. Refer to SAE J1939-21 or SAE J1939-22 for the interpretations of the EDP and DP combinations.
- b. A 1-bit field of the four fields that comprise the Parameter Group Number (PGN) assigned to an SAE J1939 PG.

3.1.23 FD BASE FRAME FORMAT (FBFF)

An ISO 11898-1 CAN data frame with an 11-bit identifier, a flexible bit rate, and a maximum data field length of 64 bytes.

3.1.24 FD EXTENDED FRAME FORMAT (FEFF)

An ISO 11898-1 CAN data frame with a 29-bit identifier, a flexible bit rate, and a maximum data field length of 64 bytes.

3.1.25 FUNCTION

- a. An 8-bit field in the SAE J1939 NAME object that identifies the function performed by the controller application.
- b. A description of the basic purpose or activity of a controller application, relative to controlling or monitoring a particular system or subsystem. For example, "engine control" is an appropriate function description of the controller application controlling the engine operations.

3.1.26 GATEWAY

A network device which transfers messages between two dissimilar networks. A gateway repackages data into new message groups and performs address translation when transferring messages from one network segment to another.

3.1.27 GROUP EXTENSION (GE)

Describes the interpretation of the PDU specific (PS) field in the 29-bit identifier of a D_PDU2 format SAE J1939 data frame. The group extension is the PS value of the Parameter Group Number (PGN) assigned to an SAE J1939 PG.

3.1.28 IDENTIFIER

- a. The identifier field bits in the arbitration field of a CEFF, CBFF, FEFF, or FBFF data frame.
- b. General reference to an SAE J1939 numeric value used to identify a specific piece of information, such as an SAE J1939 PGN, SAE J1939 SPN, SAE J1939 NAME Function, or SAE J1939 Manufacturer code.

3.1.29 IDLE

A state on the CAN bus where no node is transmitting or attempting to transmit data.

3.1.30 IMPLEMENT

A tool or piece of equipment consisting of one or more ECUs which can be attached to or detached from the vehicle as a unit.

3.1.31 MEDIA

The physical entity which conveys the electrical transmission (or equivalent means of communication) between ECUs on the network. For SAE J1939-11, the media consists of shielded twisted pair copper wires. For SAE J1939-15, the media consists of un-shielded twisted pair copper wires.

3.1.32 MESSAGE

See SAE J1939 Message ([3.1.62](#)).

3.1.33 MESSAGE FRAME

See SAE J1939 Data Frame ([3.1.61](#)).

3.1.34 MULTIPACKET MESSAGE

An SAE J1939 PG that can have PG data longer than the data field of an SAE J1939 data frame. When the PG data is longer than the data field of an SAE J1939 data frame, multiple SAE J1939 data frames are used to transmit the PG data over a data link.

3.1.35 NAME

An 8-byte value describing the primary function of a CA and its instance on the network or system.

3.1.36 NEGATIVE ACKNOWLEDGE (NACK)

A form of the Acknowledgement PG that indicates a request message is not understood or a requested action was not performed.

3.1.37 NETWORK INTERCONNECTION ECU (NIECU)

An ECU that provides interconnection of messages between one or more network segments. The standard types of NIECUs are repeater, bridge, router, and gateway.

3.1.38 NETWORK SEGMENT

See segment ([3.1.65](#)).

3.1.39 NODE

A specific hardware connection of an ECU to the physical media. A node can have more than one SAE J1939 source address claimed on the network if its software consists of multiple controller applications for multiple system control functions.

3.1.40 NON-VOLATILE

Retention of changeable memory values even though power is turned off for any reason. This term is used with respect to data values, such as claimed source addresses or NAMES, that can change during use. Read only memory (ROM) is technically non-volatile, but is not changeable during use and thus not what is referred to by this term within these documents.

3.1.41 ORIGINATOR

A controller application that is the original communication endpoint for a transmitted SAE J1939 data frame or SAE J1939 message.

3.1.42 PACKET

See SAE J1939 data frame ([3.1.61](#)).

3.1.43 PARAMETER GROUP (PG)

An SAE J1939 standardized message for conveying data for zero or more data parameters. Parameter groups communicate application layer data and commands, such as engine speed or valve actuator position, application layer diagnostic information, such as active diagnostic trouble codes (DTC), as well as fundamental communication services, such as PG requests, transport protocol, and address claim.

A parameter group describes a PDU at the highest originating or consuming OSI layer. For SAE J1939, most PGs describe a PDU at the application layer; however, for some PGs, such as the Transport Protocol PGs, a PG can describe a PDU at OSI layers between the application layer and data link layer. Parameter groups are not defined specific to any source address thus allowing any source to send any PG.

Each SAE J1939 PG is assigned a unique Parameter Group Number (PGN). The PG data definition defines the collection of data parameters (SPs) and the placement of the parameter's data in the PG data.

3.1.44 PARAMETER GROUP NUMBER (PGN)

A numeric value assigned to each defined SAE J1939 PG and used to uniquely identify the parameter group. The PGN is a numeric representation of the Extended Data Page (EDP), Data Page (DP), PDU format (PF), and PDU specific (PS) values assigned to an SAE J1939 Parameter Group.

3.1.45 PDU FORMAT (PF)

- a. An 8-bit field of the four fields that comprise the Parameter Group Number (PGN) assigned to an SAE J1939 PG.
- b. An 8-bit field in the 29-bit identifier of an SAE J1939 data frame. The value of the PF field identifies the data frame as either a D_PDU1 or D_PDU2 data frame.

3.1.46 PDU SPECIFIC (PS)

- a. An 8-bit field of the four fields that comprise the Parameter Group Number (PGN) assigned to an SAE J1939 PG.
- b. An 8-bit field in the 29-bit identifier of an SAE J1939 data frame. The interpretation of the PS field differs between D_PDU1 and D_PDU2 data frames. For a D_PDU1 data frame, the PS field is interpreted as the destination address of the data frame. For a D_PDU2 data frame, the PS field is the group extension containing the PS value of the PGN of the PG.

3.1.47 PDU1 FORMAT

- a. The classification of an SAE J1939 Parameter Group that can be sent to a specific destination address (DA). The PGN's PF value is less than 240 and the PGN's PS value is always 0.
- b. The destination-specific form of the SAE J1939 data frame. See D_PDU1 Data Frame ([3.1.18](#)).

3.1.48 PDU2 FORMAT

- a. The classification of an SAE J1939 Parameter Group that can only be sent broadcast. The PGN's PF value is greater than or equal to 240.
- b. The broadcast-only form of the SAE J1939 data frame. See D_PDU2 Data Frame ([3.1.19](#)).

3.1.49 PG DATA

A structured data object containing the parameter data for an SAE J1939 Parameter Group. The contents and structure of the data is specified in the PG data definition. PG data is not be confused with the data field of a CAN data frame (see [3.1.12](#)).

3.1.50 PG DATA DEFINITION

Specifies the content and structure of the PG data; i.e., the data for an SAE J1939 parameter group. The definition specifies the parameter data content (by SP) and the position of the data for each parameter within the data object. Parameter data position is specified as either an absolute position (specific byte and bits placement) or relative position (subsequent placement following data for another parameter). The structured data object is defined with a fixed (non-variable) length or a variable length.

3.1.51 POSITIVE ACKNOWLEDGE (ACK)

A form of the Acknowledgment PG that indicates the requested action is understood and performed.

3.1.52 PREFERRED ADDRESS

A recommended address for a controller application to first attempt to claim during address claim. Preferred addresses are assigned by the SAE J1939 Committee for system functions that are fairly common across most industries. The SAE J1939 Committee has discontinued assignment of new industry group-specific preferred addresses.

3.1.53 PRIORITY

A 3-bit field in the 29-bit identifier of the SAE J1939 CEFF and FEFF data frames and the 11-bit identifier of the SAE J1939 CBFF data frame. The priority field is only used to influence which CBFF, CEFF or FEFF data frame gets transmitted when two or more nodes are contending to send CBFF, CEFF and/or FEFF data frames on the bus. The priority field is not used for filtering received SAE J1939 data frames. A default priority value is specified for each SAE J1939 Parameter Group. Applications are generally permitted to use a different priority value from the specified default priority, but this should be done only as required to resolve system issues, such as bus access problems with certain messages.