

(R) Glossary of Vehicle Networks for Multiplexing and Data Communications

- 1. Scope**—This document covers the general terms and corresponding definitions that support the design, development, implementation, testing, and application of vehicle networks.

The terminology also covers some terms and concepts of distributed embedded systems, network hardware, network software, physical layers, protocols, and other related areas.

- 1.1 Objective**—This document aims at being a common reference of terminology, fundamental concepts, abbreviations, and acronyms used to support vehicle networking technology.

2. References

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

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

SAE J1708—Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications
SAE J1850—Class B Data Communication Network Interface
SAE J1930—Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms
SAE J1939—Serial Control and Communications Vehicle Network
SAE J1939-71—Vehicle Application Layer
SAE J1962—Diagnostic Connector
SAE J1978—OBD II Scan Tool
SAE J1979—E/E Diagnostic Test Modes
SAE J2178—Class B Data Communication Network Messages
SAE J2178-1—Class B Data Communication Network Messages—Detailed Header Formats, and Physical Address Assignments
SAE J2178-3—Class B Data Communication Network Messages—Part 3—Frame IDS For Single-Byte Forms of Headers
SAE J2178-4—Class B Data Communication Network Messages—Message Definitions For Three Byte Headers
SAE J2190—Enhanced E/E Diagnostic Test Modes

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2.1.2 CALIFORNIA CODE OF REGULATIONS—Available from State of California.

California Code of Regulations, Title 13, 1968.1—Multifunction and Diagnostic System Requirements, 1994 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles with Feedback Fuel Control Systems

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

ISO 9141—Road vehicles—Diagnostic systems—Requirements for interchange of digital information

ISO 14229—Road vehicles—Diagnostic systems—Diagnostic services specification

ISO 14230-1—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 1: Physical layer

ISO 14230-2—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 2: Data link layer

ISO 14230-3—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 3: Application layer

ISO 15031-3—Diagnostic connector and related electrical circuits: specification and use

ISO/IEC 9646—Information technology—Open systems interconnection—Conformance testing methodology and framework

3. Definitions

3.1 **A Priori Knowledge**—Knowledge about future behavior of a system that is known or available ahead of time.

EXAMPLE 1—A node which knows that a missing periodic or repetitive message is expected can automatically invoke an alternate strategy, based on this "a priori knowledge."

EXAMPLE 2—In a Time-Triggered Architecture, the points in time when a node is supposed to send a message is known ahead of time.

3.2 **A/C**—Air Conditioning

3.3 **ABS**—Antilock Braking System

3.4 **ACK**—Acknowledgment

3.5 **Acknowledgment**—A type of response which is used to indicate whether a message has been received properly.

Acknowledgments can be positive, indicating the message was received, or negative, indicating the message was not received.

3.6 **Acknowledgment: Application**—A confirmation that the requested action has been understood and performed.

3.7 **ACP**—Audio Control Protocol, a Ford proprietary UART-based protocol

3.8 **Active State**—The electrical state of a bus wire which results when one or more nodes transmit the "dominant" bus condition by "turning on" their physical layer transmit circuit. Alternate names: Active, Dominant.

Refer to the designated physical layer specification for signal levels. For SAE J1850: This is Voh volts for bus + (PWM and VPW) and Vol volts for bus - (PWM only).

3.9 **Address**—A designated message field used to point at a network object, data variable, node, or module. A network address may be used to establish the source or destination of a message.

EXAMPLE—Network objects that may be assigned an address could include: an engine control module, a data variable "Engine RPM", a "Lock Door" command, etc.

3.10 Address Filtering—The ability to select a particular address or group of addresses based on user-established selection criteria or filtering technique.

3.11 Address Structure—The organization of network addressing that is used for a given protocol. The address structure is specific to a protocol.

EXAMPLE—SAE J2178 includes the address structure used for SAE J1850.

3.12 AM Band—The band of frequencies associated with the standard broadcast Amplitude Modulation Stations (i.e., 535 kHz to 1.605 MHz).

3.13 Analog Actuator—Class A analog actuators convert some continuously varying output characteristic such as a continuously varying output value or magnitude.

Although the communicated value may or may not be digitally encoded, the action taken is intended to provide a continuous range.

An example of this is the flapper position in the heat exchanger. The actuator has a continuum of positions between a maximum and minimum value.

3.14 Analog Resolution—Analog resolution requirement is the largest level change that cannot be perceived by an occupant or operator. The analog resolution of the system should not allow the occupant to perceive discrete change.

EXAMPLE—"Opera Dimming" is an analog function. It can be achieved with discrete drive level changes that appear to the occupant as continuous dimming.

The discrete drive resolution of this actuator should resolve to a level that is finer than required by the analog resolution of the function.

3.15 Analog Sensor—A sensor that converts some measured continuously varying input characteristic as a continuously varying output value or magnitude.

The sensor has a maximum and minimum measurable input range that corresponds to a maximum and minimum output represented value.

3.16 Application/Affiliation—The application section briefly identifies the applications for which the protocol was designed to serve (e.g., military, aircraft, industrial, land, vehicles, trucks).

The affiliation section identifies the organization(s) that originally developed or specified the protocol or which now endorse the protocol. If hardware is available, this section should detail the components and manufacturer.

3.17 Application-To-Application Delay Time—Delay time in a communication network, starting at the request for transmission and terminating at the presentation of the transferred information to the respective application(s).

3.18 Application Layer—Provides access to the OSI environment for users and also provides distributed information services.

3.19 Application Process—A specific grouped set of actions performed by a system, subsystem, module, or component to handle a designated task or set of tasks.

3.20 Application Software—A software implementation that supports all required module processing activities.

Refers to the microprocessor programming that controls the external equipment/scan tool hardware so as to perform required SAE J1978 OBD II Scan Tool functions.

3.21 Application Specific Network Requirements—A document of specific rules that applies to all implementations that use the designated network protocol for the named application.

3.22 Arbitration—If two or more senders start transmitting messages at the same time, the media access conflict is resolved either by a nondestructive bitwise collision avoidance algorithm or by a collision resolution method.

For SAE J1850: The process of resolving which frame, or In-Frame Response data, continues to be transmitted when two or more nodes begin transmitting frames, or In-Frame Response data, simultaneously.

3.23 Arbitration-Based Protocol—A form of contention-based protocol where contention is evaluated bit-by-bit.

Arbitration-based protocols typically require that the physical length of the signal bus be sufficiently short such that the propagation time for signal transmission is significantly less than one information bit time.

A form of contention-based protocol where contention is evaluated bit-by-bit.

3.24 Arbitration Field—Bits within the message frame attributed to each message for controlling the arbitration.

3.25 Architecture—The organizational structure of vehicle multiplex network, mainly referring to the application structure and communications protocol.

3.26 ASC—ASCII Encoded SLOT

3.27 ASCII—American Standard Code for Information Interchange

3.28 ASR—Acceleration Slip Regulation (Traction Control)

3.29 Asynchronous Communications—Asynchronous Communications is a method of moving serial data that uses a start bit and stop bit of a designated bit duration which synchronizes the transmitting and receiving stations.

3.30 Audio Control Protocol—A two-wire UART-based serial communication network solution that operates at 9.7K bits/second. ACP is Ford's Audio Control Protocol.

3.31 Availability—The decimal fraction of the time during which a system is capable of performing its required functions.

3.32 AWG—Arbitrary Waveform Generator, American Wire Gauge.

3.33 Bandwidth—Network bandwidth is a measurement of the utilized capacity of a network. Typically indicated as a percentage and measured over some designated period of time.

3.34 Base Vehicle Wiring—The wiring structure associated with a vehicle that contains a minimum number of electrical and electronic components, i.e., a vehicle without any optional features.

3.35 Baseband—The band of frequencies occupied by unmodulated signals. The ratio of the information bandwidth (upper limit minus the lower limit of the frequency band) to the center frequency is typically larger than unity.

- 3.36 Baseband Communications**—A communications method in which the transmitted signal is in its unmodulated form and not changed by modulation.
- 3.37 Baud Rate**—An information signal transfer rate, measured in baud which is signal transitions per second. Baud rate is slowly being replaced by the designation Bit Rate.
- 3.38 BCD**—Binary Coded Decimal
- 3.39 Binary Resolution**—Binary resolution is the number of bits, in base 2, required to represent the full scale value of a data variable.
- 3.40 Bipolar Data**—Data that is driven both positively and negatively from a common point such as a reference voltage or ground (0) potential.
- 3.41 Bit**—Binary Digit. A single unit of binary information which has only two states. A bit may be used to indicate Yes/No, On/Off, or True/False.
- 3.42 Bit Encoding**—A method in which the informational or logical bits, 1's and 0's, are translated into signals on the transmission medium by the physical interface (e.g., NRZ, PWM, VPW, Manchester).
- 3.43 Bit Rate**—Number of bits transferred per time period during a network transmission, independent of bit representation. The bit rate is usually expressed in BPS or Bits Per Second.
- 3.44 Bit Stuffing**—Technique used in bit-oriented protocols to provide edge transitions which are necessary to maintain synchronization when using a Non-Return-to-Zero bit encoding.

Whenever the transmitting logic encounters a certain number (stuff width) of consecutive bits of equal value in the data, it automatically stuffs a bit of complementary value—a stuff bit—into the outgoing bit stream.

Receivers destuff the frame by using an inverse procedure. For CAN: A method used to assure the transmitted and received messages maintain a minimum number of dominant to recessive edges, and vice versa, to maintain the proper resynchronization within the string of bits in a CAN Data Frame.

- 3.45 Bit Synchronized**—Transmission of a frame in which the data bits are transmitted with the transmitter and receiver bit transitions aligned in time (synchronized).
- 3.46 Bit Time**—The time duration of a single bit period for a given protocol. Depending on the protocol, a bit time may be of fixed duration or variable. Some protocols allow the bit timing to be adjustable (e.g., CAN).

Refer to the specific vehicle network's Physical Layer specification for a specific protocol bit time.

- 3.47 Bit Time Segment**—A sub-division of a bit time.

EXAMPLE—The CAN protocol defines multiple bit time segments that are adjustable and used for bit sampling and re-synchronization.

- 3.48 Bitwise Arbitration**—An arbitration method, whereby the individual bit collisions created by simultaneous access of multiple nodes on the network is resolved on a bit-by-bit basis.

Using media states of dominant and passive, the dominant bit transmitter will override all passive bit transmitters which are subsequently required to cease sending.

- 3.49 BMM**—Bit Mapped with Mask (See SAE J2178.)

3.50 BMP—Bit Mapped without Mask (See SAE J2178.)

3.51 Bridge—For network-based systems, a device or node which moves messages between two physically separate networks that both use the same protocol.

3.52 BRK—Break

3.53 Broadband Communications—A communications method in which the transmitted signal is the original signal modulated onto a carrier. The form of modulation may be amplitude, frequency, or phase.

3.54 Broadcast Message—The transmission of information to more than one receiver as differentiated from node-to-node communications.

3.55 Broadcast Message—Any number of nodes can receive and simultaneously act upon the same broadcast message.

A type of message based only on the functional address of some system or subsystem entity.

3.56 Build-In Diagnostic Capability—An electronic device feature that requires the build-in test capabilities for the module, the module sensors, and module actuators.

3.57 Built-In Test—Test capabilities that are part of or internal to the device design.

3.58 Burst Noise—Unwanted electromagnetic disturbances that are manifested as relatively short period barrages (bursts) at random or repetitive rates.

3.59 Bus—A physical conductor used to transfer either power or data between two locations within an electrical system.

Topology of a communication network, where all nodes are reached by links, which allow transmission in both directions.

A network bus may be identified as a segment. See Segment (See SAE J1939.)

3.60 Bus –—A designated bus signal name used to identify a network wire. The minus "–" implies that the signal is negative, at ground, or more negative relative to the Bus+ signal in the "dominant" bus state.

3.61 Bus +—A designated bus signal name used to identify a network wire. The plus "+" implies that the signal is positive, at the power supply level, or more positive relative to the Bus– signal in the "dominant" bus state.

3.62 Bus Load: Maximum—The maximum allowable electrical impedance or load for a designated vehicle network.

3.63 Bus Signal: Names—A Bus Signal Name is the designated name assigned to a signal or wire of a network implemented using an electrical media. Multiple bus signal names usually have the "dominant" bus state as an attachment (e.g., Bus+ and Bus–, CAN_L and CAN_H).

3.64 Bus State—The logical or electrical state of the bus or transfer medium. For typical vehicle networks, one of two complementary states: "dominant" or "recessive".

3.65 Bus: Data—One or more physical conductors used to transfer data or information between two locations.

3.66 Bus: Power—One or more physical conductors used to transfer power between two locations.

- 3.67 Bus: Topology**—A type of physical topology of a communication network, where all nodes are reached by passive links which allow transmission in both directions.
- 3.68 Busbar**—A single conductor used to transfer power between two locations of an electrical system usually employed to deliver large current to electrical loads.
- 3.69 Bytewise Arbitration**—An arbitration method, whereby the individual byte collisions created by simultaneous access of multiple nodes on the network are resolved on a byte-by-byte basis.
- 3.70 CAN**—Controller Area Network. A protocol licensed by Bosch.
- 3.71 CARB**—California Air Resources Board
- 3.72 Carrier**—A wave suitable for modulation by an information bearing signal to be transmitted over a communications medium.
- For a waveform to be considered to include a carrier, it shall have a separate carrier, as in amplitude and frequency modulation, rather than an inherent carrier, as in pulse width modulation.
- 3.73 Carrier Sense**—Required for arbitration, the ability of a receiver to sense if another node is transmitting (providing a listen before talking capability) or to sense if any node is transmitting (adding a listening while talking capability).
- 3.74 Carrier Sense Multiple Access**—An access method in which a node on a multiple node signal bus waits for an idle bus before attempting to transmit.
- 3.75 Carrier Sense Multiple Access with Collision Detection**—A type of CSMA method in which a node that attempts to transmit and detects that another node is also transmitting will stop and delay a subsequent transmission for a time determined by a predefined arbitration algorithm.
- 3.76 CCD**—Chrysler's Class B serial data communications protocol.
- 3.77 Centralized Control**—An organization of a control system whereby a central control element exercises control over the remainder of the system (see also Master/Slave).
- 3.78 Certification**—The act of certifying or the state of being certified; usually accompanied with an authoritative, written statement attesting that something has met a set of requirements.
- 3.79 Check Byte**—An additional message field, usually a CRC or Checksum, that is used to increase the message transfer reliability. The CRC is statistically more robust and usually requires a hardware implementation.
- 3.80 Checksum**—A simple computational algorithm applied to a data sequence that results in a value, the Checksum, which is included in a message to improve the transfer reliability. CRC is better.
- A simple 8-bit summation of a series of bytes within a designated area of a message that are to be transmitted and subsequently checked by a receiver.
- 3.81 Class 2**—The OEM specific name for General Motor's SAE J1850 protocol.

3.82 Class A Data Communication—A system whereby vehicle wiring is reduced by the transmission and reception of multiple signals over the same signal bus between nodes that would have been accomplished by individual wires in a conventionally wired vehicle.

The nodes used to accomplish multiplexed body wiring typically did not exist in the same or similar form in a conventionally wired vehicle.

3.83 Class A Function—A distributed vehicle resident process or activity whose timing characteristic is governed by the expected response of a human.

Class A Functions are typically slow with response times that range in the 60 to 100 ms region with extended times to near 150 ms being acceptable on an infrequent basis.

3.84 Class A Network—A vehicle based multiplexing solution that handles the data transfers for a collection of Class A functions.

An example of a Class A Network may include both silicon-based multiplexed solutions and software-based protocols such as ISO 9141.

3.85 Class A Sensors—A sensing, measuring, or input device usually classified into the areas of operator convenience, vehicle status, and vehicle message information for a monitored function.

They are characterized by moderate to slow times of being read and are non-time critical.

3.86 Class A System—A multiplex system whereby vehicle wiring is reduced by the transmission and reception of multiple signals over the same signal bus between nodes that would have been accomplished by individual wires in a conventionally wired vehicle.

The nodes used to accomplish multiplexed body wiring typically did not exist in the same or similar form in a totally conventional wired vehicle.

3.87 Class B Data Communications—A communication system in which data variables are transferred between nodes to eliminate redundant sensors and other system elements.

The nodes in this form a multiplex system typically already existed as stand-alone modules in a conventionally wired vehicle. A Class B network may also be capable of performing Class A functions.

3.88 Class B Function—A distributed vehicle resident process or activity whose timing characteristic is governed either by a required moderate speed data transfer or by the expected response of a human.

Class B Functions have response times that depend upon the volume of network traffic, the expected human response time, and the amount of moderate speed data transfers.

3.89 Class B Network—A vehicle-based multiplexing solution that handles the data transfers for a collection of Class B functions.

Class B Network examples include all three SAE J1850 forms.

3.90 Class B System—A multiplexed system where data, (e.g., parametric data values) is transferred between nodes to eliminate redundant sensors and other system elements.

The nodes in this form of a multiplex system typically already existed as stand-alone modules in a conventionally wired vehicle.

3.91 Class C Data Communications—A system whereby high data rate signals typically associated with real time control systems, such as engine controls and anti-lock brakes, are sent over the signal bus to facilitate distributed control and to further reduce vehicle wiring.

A Class C network may also be capable of performing Class A and Class B functions.

3.92 Class C Function—A distributed vehicle resident process or activity whose timing characteristic is governed by the response requirement of a high-speed control function (typically motion control).

Class C Functions are typically fast with response times that are dictated by the distributed high-speed control algorithm.

3.93 Class C Network—A vehicle-based multiplexing solution that handles the data transfers for a collection of Class C functions.

An example of a Class C Network solution is the SAE J1939 CAN protocol.

3.94 Class C System—A multiplex system whereby high data rate signals typically associated with real-time control systems, such as engine controls and anti-lock brakes, are sent over the signal bus to facilitate distributed control and to further reduce vehicle wiring.

3.95 Class: Network—A hierarchical relationship exists between the classes of networks. By definition, Class C is a superset of Class B. Also, Class B is a superset of Class A.

It should be noted that this is a functional relationship only. Therefore, it is important to distinguish between the function and the application of the multiplex network.

3.96 Closed System—A system, consisting of nodes interconnected by a common communications medium (signal bus), which does not permit the easy addition of modules developed by another manufacturer and temporary connection to other networks, as in an open system.

3.97 Coaxial Cable—A communications medium (signal bus) with two concentric conductors separated by dielectric material(s) resulting in low losses and a relatively constant specific impedance over a wide range of frequencies.

3.98 Collision—For a protocol, the state-of-the-bus in which two or more active transmitters have simultaneously placed the bus into a conflicting state relative to the expected receive state.

3.99 Collision Detection—For a protocol, the ability to sense the state-of-the-bus during the transmission of data such that a comparison may be made to determine if a collision has occurred.

All arbitration-based protocols use collision detection as a portion of the arbitration algorithm.

3.100 Command Mode—A mode of operation of a master slave system where the Master Node takes prompt control of the network to achieve the input and/or output function.

3.101 Common Mode Bus Voltage Range—For CAN: Boundary voltage levels of VCAN_L and VCAN_H, for which proper operation is guaranteed if up to the maximum number of ECUs are connected to the bus line.

3.102 Common Mode Rejection Ratio—The ratio of the common mode input voltage to output voltage commonly expressed in dBV, i.e., the extent to which a differential amplifier rejects an output when the same signal is applied to both inputs.

- 3.103 Compliance**—The act or process of complying with a wish, request, or demand to meet an official or authoritative requirement.
- 3.104 Complimentary Addressing**—A mode of operation where an address provides one state of operation and the compliment address provides another state of operation.
- 3.105 Configuration Flexibility**—Nodes may be added without requiring any change in the software or hardware of any existing node or application layer.
- 3.106 Contention**—The action of contending for access rights to the network bus. A network state in which two or more transmitters are turned on simultaneously to conflicting states.
- 3.107 Contention-Based Protocol**—A protocol in which nodes that seek the use of the transfer medium will contend for access rights to the bus by following the rules of a predefined arbitration algorithm.
- 3.108 Contention Process**—A state-of-the-bus in which data from two or more transmitters are simultaneously attempting to use a single shared network medium.
- A collision detection or arbitration process can be used to resolve the conflict.
- 3.109 Contiguous Bits**—A sequential series or string of data bits that are continuous and without dead time between bits.
- 3.110 Control**—An architectural system element which contains the algorithm for translating input mechanism abstractions into output mechanism abstractions and implements the desired customer and system behaviors for a given function or feature.
- 3.111 Control Architecture**—An architecture (or structural organization) that supports the traditional functional processes of input, control, and output.
- 3.112 Control Architecture: Types**—Control Architectures may include: Independent, Centralized, Master/Slave, Peer-to-Peer, or combination of these.
- 3.113 Control Field**—A field in a frame which designates command information.
- 3.114 Control Mode**—Control Mode and Command Mode are used interchangeably and refer to a mode of operation of a master slave system where the Master Node takes prompt control of the network to perform the input and/or output function.
- 3.115 Control Process**—A function or series of actions performed to handle a class of activity that exercises authoritative or dominating influence upon information contained with a system, subsystem, or component.
- 3.116 Conventionally Wired Vehicle**—The wiring structure associated with a vehicle that contains only conventional wiring without any type of multiplex or vehicle network.
- 3.117 Conversation**—The network dialog or interchange of network messages used to support distributed system activity. The terms conversation and dialog are interchangeable.
- The organization of dialog or conversation structure (session layer) establishes the conversation rules for a given network implementation.
- 3.118 CRC**—Cyclic Redundancy Check

- 3.119 Crunch Points**—The points of constriction within a vehicle where a large number of wires must cross such as the door pillar, engine compartment, or steering column.
- 3.120 CS**—Checksum (See SAE J2178-4.)
- 3.121 CSMA**—Carrier Sense Multiple Access
- 3.122 CSMA/CD**—Carrier Sense Multiple Access with Collision Detection
- 3.123 Cyclic Redundancy Check**—A computational algorithm applied to a data sequence that results in a value, the CRC, which is included in a message to improve the transfer reliability.
- 3.124 DA**—Destination Address (See SAE J1939.)
- 3.125 Data**—For a protocol, data is the fundamental information unit that moves across a network.
- Data is located in a designated message or frame data field. Some protocols, like SAE J1939 and the 3-byte header implementation of SAE J1850 provide some additional locations.
- For each network implementation, data is organized into a documented data structure (presentation layer) that establishes the data by name, the assigned network address, the data encoding, and the data definition.
- 3.126 Data Communications**—The interchange of parametric data from one point to another over a medium.
- 3.127 Data Consistency**—A feature of communications in some multiplex wiring systems whereby it is determined and ensured that all required recipients of a message have received the message accurately before acting upon it simultaneously.
- This feature is desirable in, for example, ensuring that all four lamps are turned on at once or that all four brakes are energized simultaneously.
- Assures that a message is simultaneously accepted either by all nodes or by no node.
- 3.128 Data Field**—A portion of a message that is designated to hold data rather than a message type, a command, address, checksum or CRC, acknowledge, or other in-frame response.
- The data and data field are sometimes used interchangeably and both refer to a field within a message or frame.
- For SAE J1850 protocols, the data field resides between header bytes and error detection byte. May include extended addresses and test modes.
- For the CAN protocol, a zero to 64-bit field that contains the data as defined in the Application Layer. (See SAE J1939-71.)
- 3.129 Data Filtering**—The ability to select a network data variable or group of network data variables based on user-established selection criteria or filtering technique.
- 3.130 Data Length Code**—For CAN, the Data Length Code (DLC) defines the number of data bytes in a Data Frame. It is a 4-bit field and may contain a byte count of 0 to 8.

3.131 Data Link Layer—As one of the seven OSI layers, the data link layer defines the data transfer structure. Establishes the data encoding method, bit timing and synchronization, the message sequence, and handles interface to the physical layer.

The data link layer is between the physical layer and the network layer.

3.132 Data Page—For SAE J1939: One bit in the Identifier portion of the CAN Arbitration Field is used to select one of two pages of Parameter Group descriptions and to provide for future data content definitions.

3.133 Data Rate—Data rate and bit rate are sometimes used interchangeably and they both refer to the bits per time during transmission, independent of bit representation.

3.134 Data Size—The amount of data, usually measured in bytes, that is transferred by a message.

Most small area networks limit the maximum data size for a single message in order to maximize dialog and minimize bandwidth hogging.

3.135 Decibel Volts (dbV)—A measure of the relative strength of two signals where the value is 20 times the log of the ratio of the voltage of the two signals.

3.136 Decoding—For a physical layer, the process of retrieving a signal on the transmission medium that was encoded (e.g., NRZ, PWM, VPW, Manchester) back into the original logical, 1's and 0's bits.

3.137 Delay Time—The amount of time a signal or event is behind a reference point in time.

3.138 Destination Address—For SAE J1939: The Destination Address (DA) is a Protocol Data Unit (PDU) specific field in the 29-bit CAN identifier used to indicate the address of the intended receiver of the CAN message.

3.139 Destination Specific PDU Format—For SAE J1939: A designated PDU format that is used for messages to be sent to a particular destination address (DA).

3.140 Deterministic—A signal is said to be deterministic when the future behavior of the signal can be predicted precisely.

3.141 Diagnostic Message—A specific type of network message that supports a system or module diagnostic activity.

3.142 Diagnostics—The ability of a system to determine if failures are present in the system and relay this information for appropriate action.

3.143 Dialog—The network conversation or interchange of network messages used to support distributed system activity. The terms dialog and conversation are interchangeable.

The organization of dialog or conversation structure (session layer) establishes the conversation rules for a given network implementation.

3.144 Dialog Filtering—The ability to select a particular network dialog or group of dialogs based on user-established selection criteria or filtering technique.

3.145 Differential Internal Capacitance—For CAN: Capacitance, Cdiff, or an ECU seen between CAN_L and CAN_H during the recessive state when the ECU is disconnected from the bus line.

3.146 Differential Internal Resistance—For CAN: Resistance, R_{diff} , of an ECU which is seen between CAN_L and CAN_H during the recessive state when the ECU is disconnected from the bus line.

3.147 Differential Receiver—A node receiver that contains a differential input.

3.148 Differential Twisted Pair—A transmission line consisting of two similar conductors that are insulated from each other and are twisted around each other.

The terms differential twisted pair and twisted pair are interchangeable.

3.149 Differential Voltage—For a two-wire physical layer that utilizes a differential transmit signal, the voltage measured across the two network wires.

For CAN: $V_{diff} = V_{CAN\ H} - V_{CAN\ L}$, with the voltages V_{CAN_L} and V_{CAN_H} denoting the voltages of CAN_L and CAN_H relative to ground of each individual ECU.

3.150 Digital Actuator—A device which converts some system or module output characteristic into discrete output states.

The digital actuator has a maximum and minimum measurable range that corresponds to a fixed number of discrete output states.

EXAMPLE 1—Outputs that can have two states are the interior lights and parking lights.

EXAMPLE 2—The blower fan is a digital actuator with possibly four or more states: off, low, medium, and high.

3.151 Digital Sensor—An input-sensing device that converts a measured input characteristic into useful discrete digital states.

A digital sensor has a maximum and minimum measurable input range that corresponds to a fixed number of discrete output states.

3.152 Direct Addressing Mode—A mode of operation of a master/slave system in which the Master Node takes prompt control of the network to perform the input or output function.

The terms Direct Addressing, Control Mode, and Command Mode are used interchangeably.

3.153 Distributed Control—A control method spread across a distributed system which is usually based on either the Master/Slave or Peer-to-Peer control architecture.

3.154 Distributed Control System—An organization of a control system whereby control logic elements are physically located in several different places, as differentiated from a centralized organization of control.

3.155 Distributed Function—A function (or customer feature) that is distributed across multiple physical boundaries and is dependent upon the data transfer characteristics of a network to establish the distributed function's interconnectivity.

3.156 DLC—For CAN: Data Length Code

For SAE J1850: The OEM specific acronym for GM's Data Link Controller, another internal name for General Motor's SAE J1850 protocol IC implementation.

- 3.157 DLCS**—For SAE J1850-GM: Data Link Controller Serial refers to the integrated circuit family developed by General Motors that supports SAE J1850 10.4 Kbps communication.
- 3.158 Dominant Bit**—A bit which wins arbitration when contending for the bus.
- For SAE J1850: a logic "0" is the dominant bit.
For SAE J1939: a logic "0" is the dominant bit.
- 3.159 Dominant State**—The electrical state of the bus or media being in the Active State. The dominant state is the opposite of the recessive state.
- 3.160 DP**—Data Page (See SAE J1939.)
- 3.161 Driver**—An electrical circuit used to transfer information or electrical power to another system or module element.
- EXAMPLE—An electrical load or power driver, solenoid driver, motor driver, actuator driver, a line driver, a display driver, etc.
- 3.162 DTC**—Diagnostic Trouble Code (See SAE J2178.)
- 3.163 Dual Wire**—A two-wire network connection that is routed adjacently throughout the network and can be either a twisted pair or a parallel pair of wires.
- 3.164 Duplex Bus**—A multiplex bus where both transmission and reception occurs simultaneously on the same network media. Also referred to as Full Duplex.
- 3.165 DUT**—Device Under Test
- 3.166 Dynamic Priority**—Priority which may be altered during system operation.
- 3.167 Dynamic Range**—The difference between the overload level and the minimum acceptable signal level in a multiplex system, sometimes expressed in dBV.
- 3.168 Electromagnetic Interference**—The degradation of performance as a result of unintentional electromagnetic radiation (interference).
- 3.169 Electromagnetic Susceptibility**—The sensitivity (susceptibility) to degradation of performance as a result of unintentional electromagnetic radiation or EMI.
- 3.170 EMI**—Electromagnetic Interference
- 3.171 EMS**—Electromagnetic Susceptibility
- 3.172 Encoding**—For a physical layer, the process or method in which the logical information bits, 1's and 0's, are translated into signals on the transmission medium by the physical interface (e.g., NRZ, PWM, VPW, Manchester).
- A method of representing information bits in data processing or communication system.
- 3.173 End of Frame**—For CAN: The End-of-Frame (EOF) is a 7-bit field marking the ending of a CAN data frame.
- 3.174 End of Message**—A character or set of characters used to signify the end of a message.