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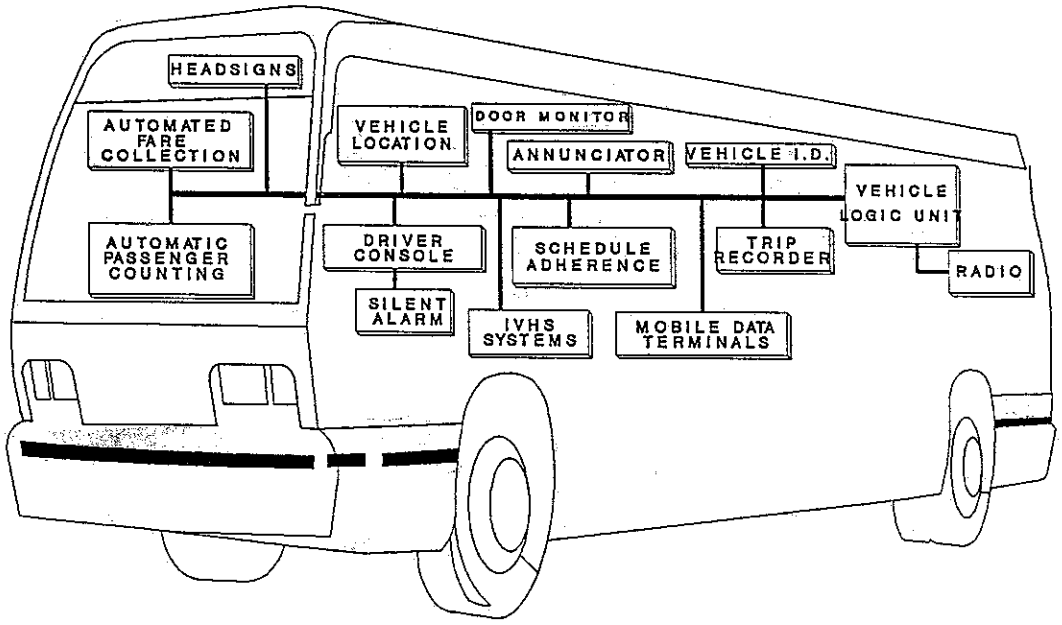
NOTE: This J1708 Standard has three sections:

Overview (1994), pdf pages 2 - 10
Standard (1990), pdf pages 11 - 26
Appendices (?), pdf pages 27-72

An OVERVIEW OF THE IVHS-FTA-SAE STANDARD FOR A VEHICLE AREA NETWORK



DRAFT - ISSUE A
(APRIL 1994)

An Overview of the IVHS/FTA/SAE Standard for a Vehicle Area Network

DRAFT RELEASE - APRIL, 1994

Transit vehicles and their Authorities of the nineties have progressed far beyond the needs of a basic vehicle with a coin box. The costs of vehicles, operations personnel, maintenance and Federal requirements have necessitated a number of electronic vehicle enhancements to efficiently and effectively manage and conduct business for all fleet sizes. As Agencies continues to move forward as an essential component of the Intelligent Vehicle and Highway Society of America's (IHVS) effort to better manage the limited resources of the roadways and streets, additional vehicle requirements are identified.

The challenge to past efforts to add electronic functions and devices to vehicles has not been the ability to specify and procure devices, but rather how to get an assortment of devices from different manufacturers to integrate and work together as a system on the vehicle. And further troublesome issues often developed around sole source procurements encountered when initial investments were made in proprietary systems and the initial provider is the only source who can furnish additional devices or enhancements.

In response to these challenges, the U.S. Department of Transportation's Federal Transit Administration, acting as a lead agency in the IVHS America's effort for an Advanced Public Transportation System (APTS), created a Vehicle Area Network (VAN) subcommittee to study and recommend a solution to the problem of integrating on-vehicle components, functions and communication interfaces. The VAN subcommittee is a component of the APTS Technical Standards Task Force and consists of representatives of Agencies, Academia, Integrators, Manufacturers, Industry Consultants and the Canadian Ministry of Transportation. The VAN subcommittee is also linked to the American Public Transportation Association's (APTA) corresponding Standards Committee.

VAN integration objective:

The assignment was to recommend a solution of with these guidelines:

a. Minimize hardware cost and overhead;

b. Provide interchangeable components and open standards on vehicles while permitting proprietary considerations;

c. Provide flexibility for expansion and technology advancements with minimum hardware and software impact on in-place assemblies;

d. Provide original equipment manufacturers, suppliers, and aftermarket suppliers the flexibility to customize for product individuality and for proprietary considerations.

The electronic functions and devices to be considered by the committee were:

Vehicle Control Head	Vehicle Logic Unit
Vehicle Signage	Vehicle Location Units
Door Status Units	Annunciators Automatic
Unit Inventory	Trip/Event Recorders
Fare Collection	Passenger Counters
Route Adherence Unit	Mobile Data Terminals
Vehicle Turntable	Vehicle Identification
Smart Card Unit	Silent Alarms
IVHS technologies	Vehicle Status Point Monitors

APTS VAN Committee Results

The VAN committee considered both existing, proposed and even proprietary standards in its effort to identify the most sufficient, reliable and cost effective solution. Ultimately, an existing standard was agreed upon as having identified itself as meeting all of the defined criteria:

Simple	Efficient
Sufficient	Cost Effective
Open architecture	Modular and Scaleable
Reliable in Environment	Field Experience in Environment
Product Infrastructure	Associated Environmental Standards

The VAN subcommittee's recommendation was the existing Society of Automotive Engineer's SAE-J-1708, "Serial Data Communications Between Microcomputer Systems in Heavy Duty Vehicle Applications." This standard had already seen many successful applications by Bus manufacturers. Transit product manufacturers found that no major product redesigns would be required to achieve a common interface. Only a few Transit-specific additions to the SAE standard would be required.

After approval by the IVHS/ APTS Technical Standards Task Force and IVHS, a request was formally transmitted to the SAE for inclusion of these additions into their existing SAE specifications. The January, 1994 release of the SAE J-1708 and J-1587 documents now includes all of these Transit-specific standards. The SAE is currently pursuing the entire SAE J-1708 standard to the International Standards Organization (ISO) level.

What does all this mean to my Authority?

Simply put, it means that an Agency can now specify and procure a given electronic device from multiple sources with the resulting devices able to ***interchangeably*** communicate with the rest of the vehicle's devices (See figures 1 and 2). Just by specifying SAE J-1708 standards in the procurement document. While the two devices may look different and have different electronic solutions inside, they are interchangeable because they understand and speak an identical electronic language. But the implications go much further.

Manufacturers now have the opportunity to market ***commodity*** building block devices while competing on pure performance issues (speed, accuracy, power demands, etc.). They no longer have to build, stock and support a stable of custom products uniquely developed and paid for by various Agencies procurements (figure 3).

Agencies now have the opportunity to "assemble" a system meeting their special needs and budgetary limits, by selecting the functions and performance requirements afforded by an ***open architecture*** marketplace. Because of the modular nature of the device standards, additional device and functional expansions could occur without discarding previous investments (figure 4).

Is there still something left to do?

Yes, there is. In 1994, the VAN subcommittee will undertake two tasks. The first task is to submit to the SAE the existing VAN consensus for a defacto vehicle cable and connector standards (figure 5). The SAE will then adopt the defacto standards as a SAE specification. This will insure the connector level compatibility of devices. The VAN effort would not be complete if an Agency is required to cut off "their special" connectors and put on "our special" connectors when procuring otherwise interchangeable devices.

One additional and very important issue will result from this SAE document. Through the standardization of the backbone connector, power, digital and audio wiring issues, the entire on-vehicle system becomes transparent to the vehicle on which it is installed (figure 6). This enables a single implementation solution to be transportable to bus, minibus, trolley, streetcar, paratransit van, truck and sedan types of vehicles without regard to the type of power train being used by the vehicle.

The second effort in 1994 will be a new issue for the VAN subcommittee. While commodity devices (functions) are now defined by the SAE 1708 documents, the VAN committee has been requested to investigate the possibility of defined and transportable functions between Vehicle Logic Units of different manufacturer ~~figure~~. Again, Agencies and Providers will be asked to identify a set of commonly acceptable standards (figure 7). This would be the final step in a complete IVHS open architecture definition for vehicular systems. Anyone interested in participating in the definition, discussion and consensus forming efforts is welcomed and encouraged to attend all VAN meetings.

Is there anything else?

One last thing. Under the IVHS initiative, Transit has the excellent position of benefiting from many industries and technologies not traditionally in the Transit business. Many of these devices could resolve problems which have challenged us for years. But the first question confronting the new provider is: "has your product ever been on, and survived in, a Transit vehicle". While there are numerous military standards which Transit may impose in an attempt to determine quality and durability, many of these tests require considerable time and expense outlays. Smaller providers cannot always afford these tests and their new solutions may never see Transit service. This could be Transit's loss, and discourage potential new providers and their solutions.

The VAN subcommittee offers this solution: devices claiming compliance to the SAE J-1708 standard imply conformance to all sub-documents below the top level J-1708 specification (figure 8). The SAE J-1455 document "Joint SAE/TMC Recommended Environmental Practices for Electronic Equipment Design" was specifically developed to technically describe the actual operating environments on Truck and Bus vehicles. It defines minimum standards for vibration, temperature, electrical system and other durability issues. Testing to these standards appears to be sufficient to protect the Agency from potentially faulty devices while being more time and cost effective for new technology providers. The VAN subcommittee would appreciate your review and comments this issue.

All comments, requests for mailing lists, and other matters should be directed to:

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Fax: 713-739-6824

REFERENCES:

SAE J1708, Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications

SAE J1455, Joint SAE/TMC Recommended Environmental Practices for Electronic Equipment Design.

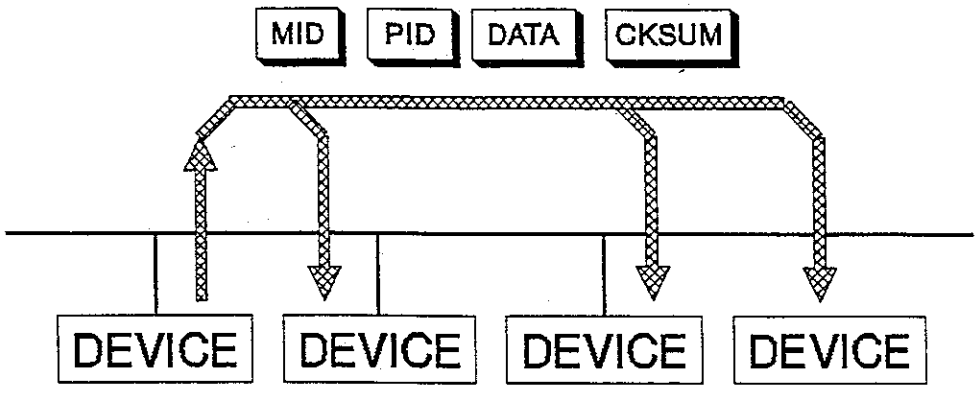
SAE J1587, Joint SAE/TMC Recommended Practice for Electronic Data Interchange Between Microcomputer Systems in Heavy Duty Vehicle Applications.

SAE J1922, Powertrain Control Interface for Electronic Controls Used in Medium and Heavy Duty Diesel on Highway Vehicle Applications.

Electronics Industries Association Standard RS-485 (EIA RS-485) "Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems," April 1983.

FIGURE 1: WHAT IS SAE J-1708?

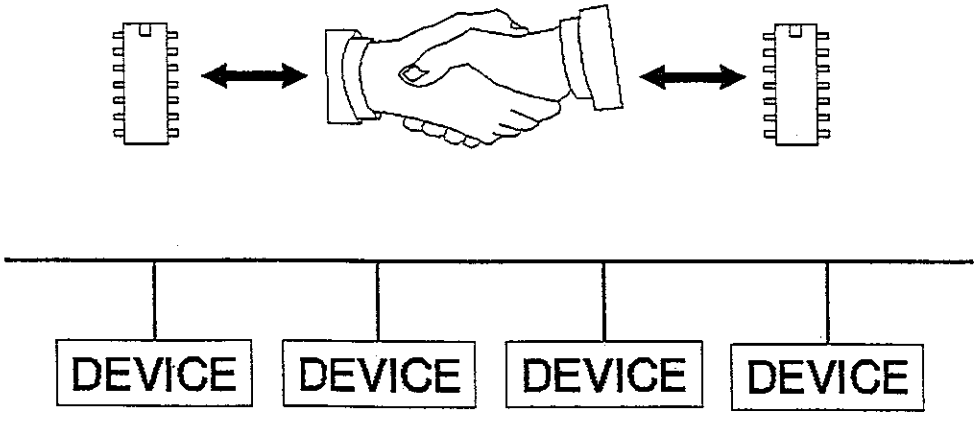
1ST: A NON-PROPRIETARY SAE COMMUNICATIONS PROTOCOL BASED ON INFORMATION SHARING EXPANDED BY IVHS/FTA TO COVER TRANSIT'S VEHICLE DEVICE AND COMMUNICATIONS NEEDS



(ALL DEVICES CAN UNDERSTAND AND BENEFIT FROM DATA)

FIGURE 2: WHAT IS SAE J-1708?

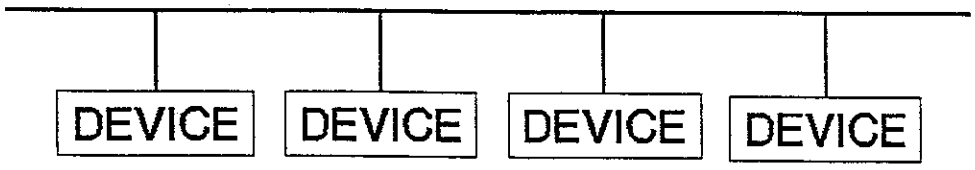
2ND: A DEFINED HARDWARE HANDSHAKE FOR ALL MANUFACTURER'S LOGIC BOARDS



(BASED ON ELECTRONIC INDUSTRIES ASSOCIATION RS-485)

FIGURE 3: BUILDING BLOCK CONCEPT

DEVICES FROM A VARIETY OF VENDORS CAN BE INTEGRATED INTO A SINGLE ON-VEHICLE SYSTEM TO PROVIDE UNIQUE AND CONBIMED FUNCTIONS



(PROVIDES FOR INTERCHANGABLE VENDOR DEVICES)

FIGURE 4: IVHS VAN OBJECTIVE

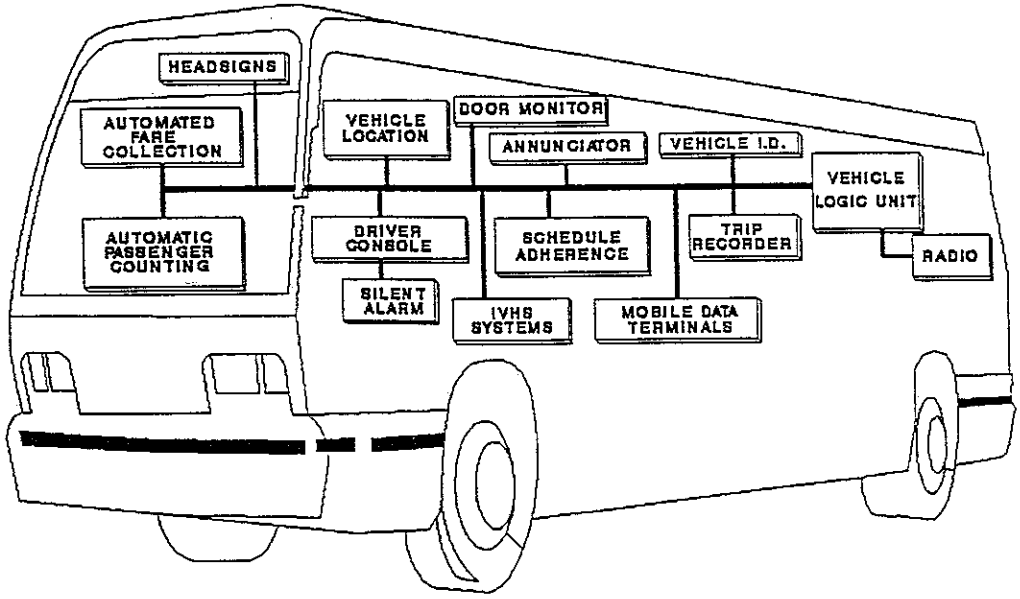
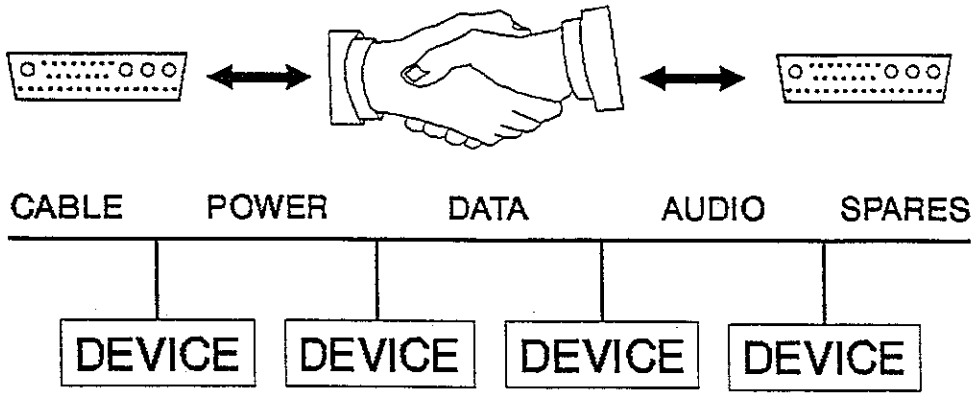


FIGURE 5: THE NEXT STEP FOR THE VAN

ADOPTION OF A DEFACTO CONNECTOR AND CABLE CONSENSUS DEVELOPED BY IVHS, FTA , AGENCIES AND MANUFACTURERS AS A STANDARD BY THE SAE



(RESOLVES CURRENT AND FUTURE WIRING NEEDS)

FIGURE 6: IMPLEMENTATION TRANSPARENCY

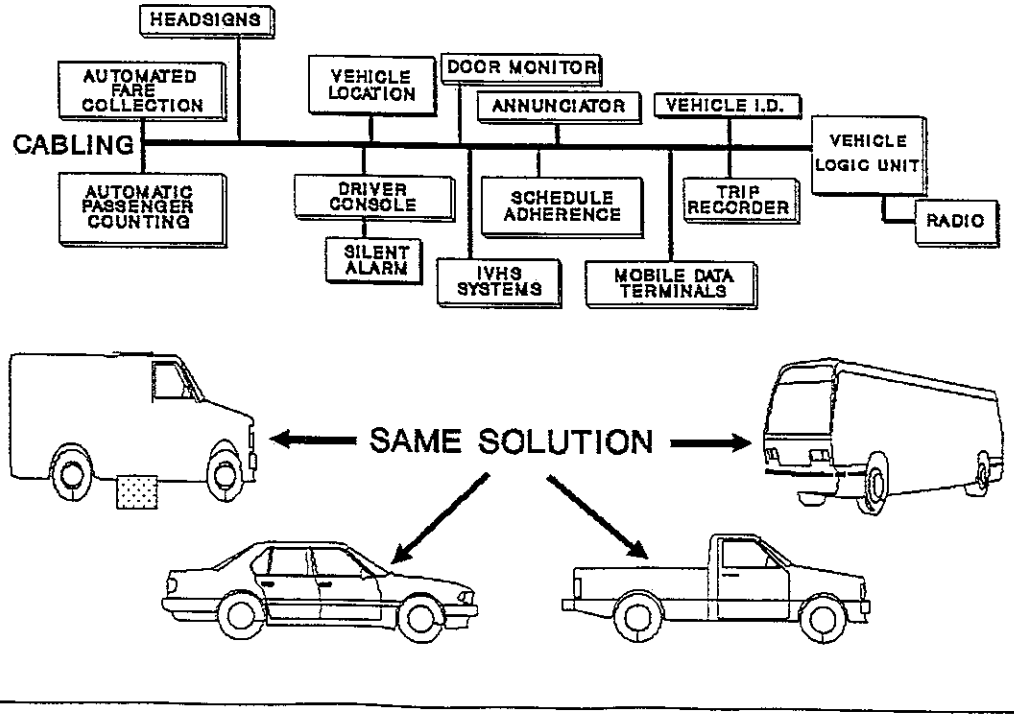


FIGURE 7: TRANSPORTABLE SOLUTIONS

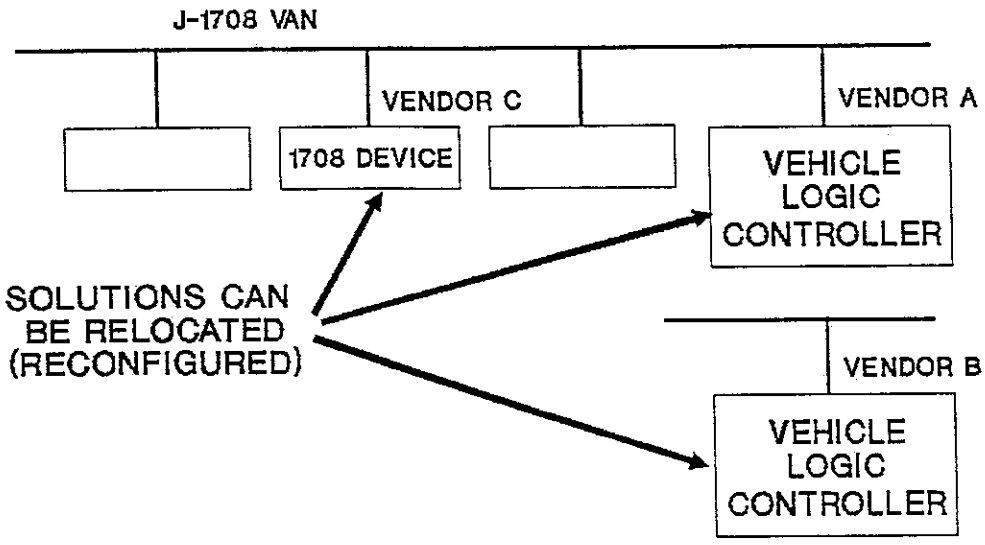
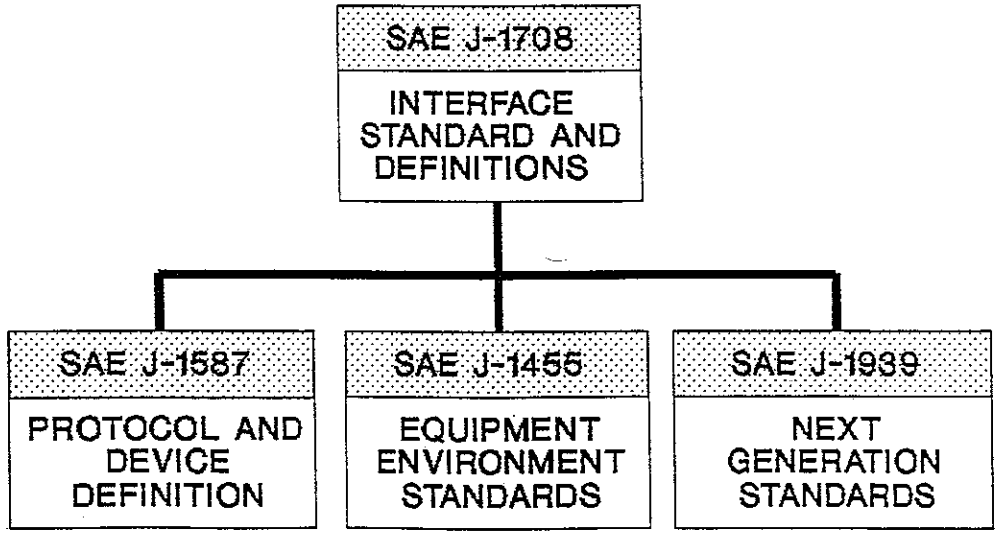


FIGURE 8: SAE J-1708 SPECIFICATIONS



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SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE J1708 | REV. OCT90

Issued 1986-01
Revised 1990-10-05

Superseding J1708 NOV89

(R) SERIAL DATA COMMUNICATIONS BETWEEN MICROCOMPUTER SYSTEMS IN HEAVY DUTY VEHICLE APPLICATIONS

FOREWORD

This SAE/TMC Joint Recommended Practice has been developed by the Truck and Bus Electronic Interface Subcommittee of the Truck and Bus Electrical Committee and by the S.1 Study Group of the Maintenance Council. The objectives of the subcommittee are to develop information reports, recommended practices, and standards concerned with the interface requirements and connecting devices required in the transmission of electronic signals and information among truck and bus components.

Objectives: Some of the goals of the subcommittee in developing this document were to:

a. Minimize hardware cost and overhead;

b. Provide flexibility for expansion and technology advancements with minimum hardware and software impact on in-place assemblies;

c. Utilize widely accepted electronics industry standard hardware and protocol to give designers flexibility in parts selection;

d. Provide a high degree of electromagnetic compatibility;

e. Provide original equipment manufacturers, suppliers, and aftermarket suppliers the flexibility to customize for product individuality and for proprietary considerations.

1. SCOPE:

This document defines a recommended practice for implementing a bidirectional, serial communication link among modules containing microcomputers. This document defines those parameters of the serial link that relate primarily to hardware and basic software compatibility such as interface requirements, system protocol, and message format. The actual data to be transmitted by particular modules, which is an important aspect of communications compatibility, is not specified in this document. These and other details of communication link implementation and use should be specified in the separate application documents referenced in Section 2.

1.1 Purpose:

The purpose of this document is to define a general-purpose serial data communication link that may be utilized in heavy duty vehicle applications. It is intended to serve as a guide toward standard practice to promote serial communication compatibility among microcomputer-based modules. The primary use of the general-purpose communications link is expected to be the sharing of data among stand-alone modules to cost effectively enhance their operation. Communication links used to implement functions that require a dedicated communication link between specific modules may deviate from this document.

2. REFERENCES:

It is recommended that a separate applications document be published by the manufacturer for each device using the serial link. These documents should define the data format, message I.D.'s, message priorities, error detection (and correction), maximum message length, percent bus utilization, and methods of physically adding/removing units to/from the line for the particular application.

2.1 Applicable Documents:

SAE J1455 Joint SAE/TMC Recommended Environmental Practices for Electronic Equipment Design (Heavy Duty Trucks)

SAE J1587 Joint SAE/TMC Recommended Practice for Electronic Data Interchange Between Microcomputer Systems in Heavy Duty Vehicle Applications

SAE J1992 Powertrain Control Interface for Electronic Controls Used in Medium and Heavy Duty Diesel on Highway Vehicle Applications

Electronics Industries Association Standard RS-485 (EIA RS-485) "Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems," April 1983

2.2 Definitions:

2.2.1 ACCESS TIME: Two bit times multiplied by the message priority (which ranges from 1 to 8) added to the idle line time.

2.2.2 BAUD: The maximum number of analog signal transitions per second that can occur on a channel. In this coding system, this is the reciprocal of the bit time.

2.2.3 BIT TIME: Duration or period of one unit of information.

2.2.4 CHARACTER TIME: The duration of one character. The character must start with a low logic bit, then 8 bits of data (least significant bit first) followed by a high logic level stop bit.

2.2.5 CONTENTION: A state of the bus in which two or more transmitters are turned on simultaneously to conflicting logic states.

2.2.6 DIFFERENTIAL SIGNAL: A two-wire process in which both lines are switches as opposed to a single-ended signal wherein one line is grounded and the signal line is switched between logic states.

2.2.7 IDLE STATE: The state that produces a high logic level on the input of the bus receiver when all transmitters on the network are turned off.

2.2.8 IDLE LINE: The condition that exists when the bus has remained in a continuous high logic state for at least 10 bit times after the end of the last stop bit.

NOTE: The idle line serves as the delimiter between messages on the bus. A receiver that cannot distinguish between a stop bit and any other high logic state may become synchronized with the bus by noting the receipt of 12 consecutive high logic bits. In the absence of errors, the first low logic bit (0) following 12 consecutive high logic bits (1) is the start bit of a message identification character (MID) (that is, the first character of a message).

2.2.9 MESSAGE PRIORITY: A measure of message criticality assigned on a scale of 1 to 8 by the appropriate applications document. The most critical message has a priority of one.

2.2.10 NODE: A receiver or transceiver circuit connected to the bus.

2.2.11 START BIT: Initial element of a character defined as a low logic level of 1 bit time duration as viewed at the output of the bus receiver.

2.2.12 STOP BIT: Final element of a character defined as a high logic level of 1 bit time duration as viewed at the output of the bus receiver.

3. ELECTRICAL PARAMETERS:

The electrical parameters of this serial data link are a modification of the EIA RS-485 standard. In some areas this document conflicts with RS-485. This document shall serve as the guiding document in such cases. Appendix A details a serial data bus standard node which defines the interface circuit parameters. Operation of this standard node is detailed in this section.

3.1 Logic State:

Positive true logic will be used when referring to the states of transmitted inputs and received outputs. Referring to Appendix A, the input of the transmitter (marked as point Tx) and the output of the receiver (marked as Rx) will be in logic 1 state when driven or passively pulled to +V, and will be at a logic 0 state when driven to ground.

3.2 Bus State:

The bus is in a logic 1 (high) state whenever Point A is at least 0.2 V more positive than Point B. The bus is in a logic 0 (low) state whenever Point A is at least 0.2 V more negative than Point B (Points A and B, refer to Figure A1). The bus state is indeterminate when the differential voltage is less than 0.2 V.

3.2.1 Logic High State: The bus will be in a logic 1 (high) state when all connected transmitters are idle or sending logic 1. An idle state is produced when all transmitters on the network are turned off. All nodes shall include means to pull the bus to a logic 1 (high) when all transmitters are off (see Appendix A).

3.2.2 Logic Low State: The bus will be in a logic 0 (low) state when one or more transmitters are sending logic 0, which guarantees that logic 0 (low) dominates when the bus is in contention.

3.3 Network Capacity:

The bus will support a minimum of 20 standard nodes where each node is comprised of the circuit defined in Appendix A. Deviations from this circuit must be carefully analyzed to determine impact on bus loading and noise margins over the common mode range.

3.4 Bus Termination:

Bus termination resistors as referenced in RS-485 are not required and shall not be used.

3.5 Ground:

All assemblies using the link must have common ground reference.

3.6 Wire:

A minimum of 18 gauge twisted pair wire, with a minimum of one twist (360 degrees) per inch (2.54 cm), is required. The twists shall be distributed evenly over the length of the wire.

3.7 Length:

This recommended practice is intended for, but not limited to, applications with a maximum length of 130 ft (40 m).

4. NETWORK PARAMETERS:

4.1 Network Topology:

The network interconnect shall use a common or global bus.

4.2 Network Access:

The method of access to the network is random.

4.2.1 Bus Access: A transmitter shall begin transmitting a message only after an idle state has continuously existed on the bus for at least a bus access time. The transmitter must verify that the idle state continues to exist immediately prior to initiating a transmission (that is, within one-half bit time).

4.2.1.1 Bus Access Time: Bus access time is a time duration equal to the minimum time of an idle line plus the product of 2 bit times and the message priority. This relationship can be expressed as follows:

$$T_a = T_i + \left[2 * T_b\right] * P \qquad \text{(Eq.1)}$$

(T_i = 10 * T_b; P_{1-8})

@9600 T_b = 104.17 ms (section 5.1)

where:

T_a = Bus access time
T_b = Bit time, or period of one unit of information
P = Message priority
T_i = Minimum time duration of an idle line

NOTE: The minimum time duration of an idle line is defined in 2.2.9. However, a transmitter that cannot distinguish between a stop bit and any other high logic state may not assume that Ti has elapsed until it has received 19 consecutive high logic bits.

4.2.1.2 Message Priority Assignment: All messages will be assigned a priority from 1 to 8 as indicated in Table 1:

1 - 8

TABLE 1

Priority	Message Assignment
1 and 2	Reserved for messages that require immediate access to the bus
3 and 4	Reserved for messages that require prompt access to the bus in order to prevent severe mechanical damage
5 and 6	Reserved for messages that directly affect the economical or efficient operation of the vehicle
7 and 8	All other messages not fitting into the previous priority categories should be assigned a priority 7 or 8

4.2.1.2 (Continued):

The applications document shall define the priority associated with each message. In the event that more than one priority could be assigned to a particular message, the application document shall define each priority and the circumstances in which the priority is assigned.

4.2.2 Bus Contention: All transmitters shall monitor the message identification portion of their message to determine if another transmitter has attempted to gain access to the bus at the same time. If a transmitter detects a collision, the transmitter shall relinquish control of the bus after completing the transmission of the current character or sooner if possible. After relinquishing control, it is recommended that the transmitter become a receiver, using the received MID as the beginning of the incoming message. The transmitter may attempt to regain access to the bus after a bus access time has elapsed. An example bus reaccess procedure is shown in Appendix B.

5. PROTOCOL:

5.1 Bit Time:

A bit time shall be 104.17 µs ± 0.5% (±500 ns). This is equivalent to a baud rate of 9600 bits per second.

5.2 Character Format:

A character shall consist of 10 bit times. The first bit shall always be a low logic level and is called the start bit. The last (tenth) bit shall always be a high logic level and is called the stop bit.

5.2 (Continued):

This convention is consistent with standard UART operation. The remaining eight center bits are data bits that are transmitted least significant bit (LSB) first.

5.3 Message Format:

5.3.1 Message Content: A message appearing on the communication bus shall consist of the following:

a. Message Identification Character (MID);
b. Data Characters;
c. Checksum.

As indicated in 4.2.1, a message shall always be preceded by an idle state of duration equal to or greater than the appropriate bus access time. The length of time between characters within a message shall not exceed 2 bit times.

5.3.2 Message Identification Character (MID): The first character of every message shall be a MID. The permitted range of MIDs shall include the numbers 0 to 255. The MIDs 0 to 68 shall be assigned to transmitter categories as identified in Table 2. These assignments have been made to accommodate existing systems, or systems that may presently be under development, and to avoid conflicts, which otherwise might arise if indiscriminate use of MIDs were permitted.

MIDs 69 to 86 have been set aside for use by the SAE J1922.

MIDs 87 to 110 shall be allocated as reserved MIDs for transmitter categories beyond those that are identified in Table 2. These MIDs shall be individually assigned by the SAE Electronics Interface Subcommittee of the SAE Truck and Bus Electrical Committee on petition by a manufacturer at the time a new transmitter category is identified, or when additional MIDs are required within a previously identified category. The content and format of the messages using the assigned MIDs (0 to 110) is the responsibility of the transmitter. Content of format of the data within these messages is not defined in this document but should be identified in an appropriate applications document as described in Section 2.

MID 111 shall be used exclusively for factory test of electronic modules. Since it is possible that during factory test the normal control software is bypassed, giving the tester direct control of module I/o, several precautions should be observed:

a. Entry into factory test should be granted by the module control software only after ensuring that it is safe to do so.

b. This MID should not be transmitted by any on-board module.

MIDs 112 to 127 are not assigned to any category and are not reserved for future assignment. These MIDs are available to any manufacturer or user for any message identification purpose outside the scope of this document.

TABLE 2 - Message Identification Character Allocation

Mid Range	Transmitter Category
00-07	ENGINE
08-09	BRAKES, TRACTOR
10-11	BRAKES, TRAILER
12-13	TIRES, TRACTOR
14-15	TIRES, TRAILER
16-17	SUSPENSION, TRACTOR
18-19	SUSPENSION, TRAILER
20-27	TRANSMISSION
28-29	ELECTRICAL CHARGING SYSTEM
30-32	ELECTRICAL
33-35	CARGO REFRIGERATION/HEATING
36-40	INSTRUMENT CLUSTER
41-45	DRIVER INFORMATION CENTER
46-47	CAB CLIMATE CONTROL
48-55	DIAGNOSTIC SYSTEMS
56-61	TRIP RECORDER
62-63	TURBOCHARGER
64-68	OFF-BOARD DIAGNOSTICS
69-86	SET ASIDE FOR SAE J1922
87-110	RESERVED - TO BE ASSIGNED BY ELECTRONIC INTERFACE SUB-COMMITTEE (see 5.3.2, Section 3).
111	RESERVED - FACTORY ELECTRONIC MODULE TESTER (OFF VEHICLE)
112-127	UNASSIGNED - AVAILABLE FOR USE
128-255	TO BE ASSIGNED BY DATA FORMAT SUBCOMMITTEE (see 5.3.2.)

5.3.2 (Continued):

MIDs in the 0 to 68 and 87 to 127 ranges shall be defined in the manufacturer's applications document. It shall be the responsibility of the systems integrator or user to ensure that a particular MID is not used by more than one device on the same vehicle.

MIDs in the range of 128 to 255 shall be reserved for applications using formatted data as set forth in a document issued by the SAE Truck and Bus Electrical Committee Data Format Subcommittee. These MIDs shall only be used when the data format set forth within that document is strictly followed. See SAE J1587.

5.3.3 Data Characters: Data characters shall be characters that convey the intelligence of the message and shall conform to the character format as defined in 5.2. The 8 bit data character may be given any value from 0 to 255. The data characters shall be defined in an appropriate applications document at the option of the supplier. The application document shall define parameters, parameter order, scaling and error detection/correction coding if applicable.

5.3.4 Checksum: The last character of each message shall be the two's complement of the sum of the MID and the data characters. Simple message error detection may be implemented by adding the checksum to the sum of all previous message characters (including the MID). The 8 bit sum will be zero, neglecting the CARRY, for a correctly received message.

5.3.5 Message Length: Total message length, including MID and checksum, shall not exceed 21 characters. Exceptions to this length limitation may be made when the engine is not running and the vehicle is not moving. Messages longer than 21 characters may also be broken up into several separate messages of 21 or fewer characters and may then be transmitted while the engine is running and/or the vehicle is moving by conforming to the 21 character message length limitation of SAE J1708.

APPENDIX A

Serial Data Bus Standard Node
(Unipolar Drive With Passive Termination in Each Module)

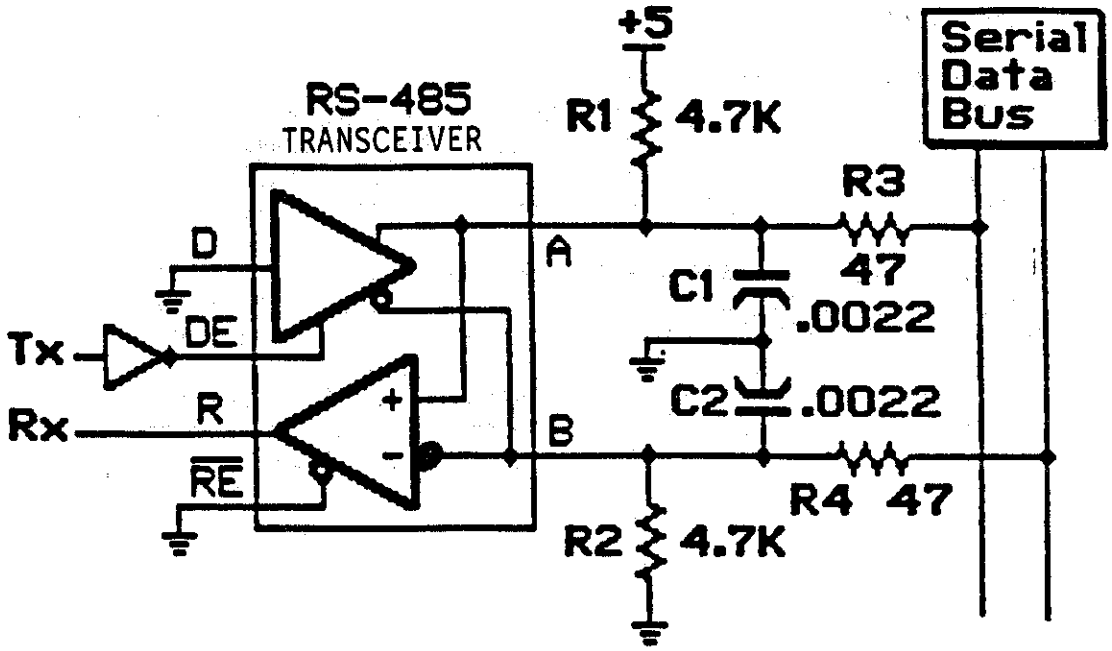

FIGURE A1 - Serial Data Bus Standard Node Diagram

A.1 This circuit utilizes standard RS-485 transceivers (less than or equal to one RS-485 unit load) connected to drive the differential data bus to the logic zero state only (unipolar drive). In the above circuit, a standard RS-485 receiver may be used in place of a transceiver in applications where data need not be placed on the bus (that is, receive only).

A.2 The logic one state (also idle state) is controlled by pull-up resistor R1 and pull-down resistor R2.

A.3 The transceiver output impedance, C1 and C2, form the transmit filter for transient and EMI suppression (approximately 6 MHz low pass).

A.4 R3, C1, R4, and C2 form the receive filter for EMI suppression (approximately 1.6 MHz low pass). These parts also form a pseudo line termination at high frequencies.

A.5 The active (high-to-low) transition delay is approximately 0.6 μs at the receiver with two nodes on the bus and 2.3 μs with 20 nodes on the bus.

A.6 The passive (low-to-high) transition delay at the receiver remains at 10 μs with any number of loads on the bus (up to 20).

A.7 The values shown were chosen for use with commercially available RS-485 drivers to provide maximum fan-out, EMI suppression, and bus termination. Remaining nodes may be in either the powered or unpowered state.

A.8 This method of unipolar drive prevents unresolved contention (logic zero always wins).

A.9 The resistors shown should be 5% parts to assure sufficient noise margin under worst case conditions. R3, R4, C1, and C2 should be balanced within 10% on each side of the data bus to minimize common mode electromagnetic radiation.

APPENDIX B

Example Bus Reaccess Procedure

B.1 A method for reaccessing the bus can be described by the following example:

B.1.1 Sequence of Events:

a. First crash occurs for the current attempt to access the bus.

b. Each device wishing to access the bus then waits their predefined bus access time (as described in 4.2.2).

c. Second crash occurs for the same attempt to access the bus.

d. Any device that has experienced two consecutive crashes in its attempt to transmit the same message shall follow the bus access procedure defined in 4.2.1 but with the bus access time calculated as follows:

$$T_a = T_i + 2 \times P_2 \times T_b \qquad \text{(Eq.B1)}$$

where:

T_i and T_b are defined as in 4.2.1.1.

P_2 = A three bit psuedo random number such as the three least significant bits of the stack pointer.

For example, if 18 is the location of stack pointer register, the contents of this register is the stack pointer. This value will be ANDED with 0007, which results in a number from 0 to 7. P_2 would, therefore, be a value from 0 to 7.

e. If any more consecutive crashes occur, the procedure described in d is repeated.

B.2 This example addresses the recognized possibility that two or more devices could continue to crash if their priorities were the same. The above method would greatly reduce the possibility of a third crash with the same device or devices.

The (R) symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

APPLICATION:

This document defines a recommended practice for implementing a bidirectional, serial communication link among modules containing microcomputers. This document defines those parameters of the serial link that relate primarily to hardware and basic software compatibility such as interface requirements, system protocol, and message format. The actual data to be transmitted by particular modules, which is an important aspect of communications compatibility, is not specified in this document. These and other details of communication link implementation and use should be specified in the separate application documents referenced in Section 2.

REFERENCE SECTION:

SAE J1455 Joint SAE/TMC Recommended Environmental Practices for Electronic Equipment Design (Heavy Duty Trucks)

SAE J1587 Joint SAE/TMC Recommended Practice for Electronic Data Interchange Between Microcomputer Systems in Heavy Duty Vehicle Applications

SAE J1992 Powertrain Control Interface for Electronic Controls Used in Medium and Heavy Duty Diesel on Highway Vehicle Applications

Electronics Industries Association Standard RS-485 (EIA RS-485) "Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems," April 1983

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Standards for Use on Transit Vehicle Systems

Appendix A:

Society of Automotive Engineers

SAE J1708

The J1708 family of specifications are now available directly from the Society of Automotive Engineers by contacting them at:

Society of Automotive Engineers
Customer Service
400 Commonwealth Drive
Warrendale PA 15096-0001
(412)-772-7100 (thru 7104)

The following documents make up the J1708 family of specifications:

Document:	Cost:	Description:
J-1708	$25	Serial Data Communications between Microcomputer Systems in Heavy Duty Vehicle Applications
J1587	$33	Joint SAE/TMC Recommended Practice for Electronic Data Interchange Between Microcomputer Systems in Heavy Duty Vehicle Applications
J1455	$33	Joint SAE/TMC Recommended Environmental Practices for Electronic Equipment Design
J1922	$17	Powertrain Control Interface for Electronic Controls Used in Medium and Heavy Duty Diesel on Highway Vehicle Applications
J1939	$17	(Draft, in Subcommittee) High Speed Truck and BUs Control and Communications Network

Non-SAE-member prices are shown. SAE members pay reduced pricing. Applications for Full Memberships in the SAE are available from the above address and cost $65.00 annually.

PROPOSED MIDS:

(Numbers to be assigned by SAE)

Vehicle Control Head Unit
Vehicle Logic Control Unit
Vehicle Head Signs
Vehicle Location Unit
Front Door Status Unit
Middle Door Status Unit
Rear Door Status Unit
Annunicator Unit
Fare Collection Unit
Passenger Counter Unit
Schedule Adherance Unit
Route Adherance Unit
Environment Monitor Unit
Vehicle Status Points Monitor Unit
High Speed Communications Unit
Mobile Data Terminal Unit
Vehicle Proximity, Right Side
Vehicle Proximity, Left Side
Base Unit (Radio Gateway to Fixed End)
Gateway from J1708 Drive Train Link
Maintenance Printer
Received AVL correction message
Vehicle Turntable
Bus chassis Identification Unit
Smart Card Terminal
Mobile Data Terminal
Vehicle Control Head Touch Screen
Silent Alarm Unit
Surveillance Microphone
Lighting control unit(s) and administrator

All above devices shall be capable of responding to PIDs:

(Proposed)

P01 Specific Device Cold Start/Status
P02 Specific Device Cold Start/Status
P03 Global Cold Start/Status Report

(Existing J1708)

194 Transmitter System Diagnostic Code
195 Diagnostic Data Request
196 Diagnostic Data/Count Clear
243 Component Identification Parameter

SUMMARY OF PROPOSED PARAMETER IDENTIFICATIONS (PID) TO EXISTING J1708 STANDARD

QUEST	TITLE OF PARAMETER	FUNCTION OF PID
P01	COLD RESTART OF SPECIFIC UNIT	Administrative cold reboot restart
P02	WARM RESTART OF SPECIFIC UNIT	Administrative warm reboot restart
P03	REQUEST COLD RESTART OF ALL UNITS	Administrative initialization of all units
P04	TRANSIT DOOR STATUS	Report Transit door opening and closing
P05	DRIVERS CONSOLE DISPLAY MESSAGE	Display message to driver's console
P06	DRIVERS CONSOLE KEYBOARD MESSAGE	Report key depression on driver's console
P07	MILEPOST READER	Milepost detection
P08	TRANSIT ASSIGNMENT IDENTIFICATION	Assigned Route, Run, and Block I.D.
P09	DRIVER ASSIGNMENT IDENTIFICATION	Driver's Identity
P10	SIGNAGE MESSAGES	Destination, Headsigns or Annunicator Signs
P11	ANNUNCIATOR VOICE MESSAGES	Annunciator
P12	VENDOR SPECIFIC LOCATION SENSOR	Position Sensor Device communications
P13	FARE COLLECTION SYSTEM	Report stop level detail and alarms
P14	TRANSIT SILENT ALARM STATUS	Report silent alarm push button status
P15	TRANSIT RUN SWITCH STATUS	Report run state of Transit vehicle
P16	ACCELERATION	Scalar acceleration from navigation device(s).
P17	VEHICLE UNAUTHORIZED USE	Report unauthorized operation of vehicle
P18	MESSAGE FROM MID TO FIXED END	Request for a radio transmission
P19	DIFFERENTIAL CORRECTION	GPS Differential Correction messages
P20	DELTA DIFFERENTIAL CORRECTION	Delta GPS Differential Correction messages
P21	ILLUMINATION CONTROL	Illumination of signage
P22	BUS TURNTABLE POSITION	Report the turntable position on the bus.
P23	PID REPORT PERIOD	Device reporting period assignment
P24	VEHICLE TRANSIT SERIAL NUMBER	Transit vehicle identification number
P25	RELAY DRIVE TRAIN LINK DATA	Pass selected data from Drive Train
P26	J1708 DRIVE LINK GATEWAY DEVICE	Frequency of Drive Train data
P27	PASSENGER COUNTER	Report passenger aliting/boarding or total count

PARTIAL SUMMARY OF EXISTING PARAMETER IDENTIFICATIONS

PID	P	DB	TITLE OF PID	FUNCTION
000	8	1	REQUEST PARAMETER	Used to request parameter data transmission from other components on the data link.
074	8	1	MAXIMUM ROAD SPEED LIMIT	Maximum vehicle velocity allowed
084	1	1	ROAD SPEED	Indicated vehicle velocity
128	8	2	COMPONENT SPECIFIC PARAMETER REQUEST	Used to request parameter data transmissions from a specified component on the data link.
165	6	2	COMPASS BEARING	Present compass bearing of vehicle
192	V	V	MULTISECTION PARAMETER	Used to transmit parameters that are longer than what is limited by SAE J1708. A specified parameter can be broken into sections.
194	8	V	TRANSMITTER SYSTEM DIAGNOSTIC CODE	Used to notify other components on the data link of the diagnostic condition of the transmitting electronic component.
195	8	3	DIAGNOSTIC DATA REQUEST/CLEAR COUNT	Used to request additional information about a given diagnostic code or clear its count.
196	8	V	DIAGNOSTIC DATA/COUNT CLEAR RESPONSE	Used to acknowledge the clearing of diagnostic codes or supply additional information about a diagnostic code as requested by PID 195.

Key:

PID = Existing Parameter Identification (PID) Assignment
P = Prioity
DB = Data Bytes
V = Variable number of bytes

PARTIAL SUMMARY OF EXISTING PARAMATER IDENTIFICATIONS
(Page 2)

237	8	V	VEHICLE IDENTIFICATION NUMBER	Vehicle Identification Number (VIN) as assigned by the vehicle manufacturer.
238	6	5	VELOCITY VECTOR	Any combination of the velocity, heading, and pitch, as calculated by the navigation device(s).
239	6	10	POSITION	Calculate the 3 dimensional location of the vehicle
240	8	4	CHANGE REFERENCE NUMBER	Used to indicate that a change has occurred in the calibration data
243	8	V	COMPONENT IDENTIFICATION	Used to identify the Make, Model and Serial Number of any component on the vehicle
251	8	3	CLOCK TIME	Report current system time
252	8	3	DATE	Determine system date
254	V	V	VENDOR SPECIFIC COMMUNICTIONS	This PID allows transmission of information on the data bus in a non-standard vendor proprietary fashion.

Key:

PID = Existing Parameter Identification (PID) Assignment
P = Prioity
DB = Data Bytes
V = Variable number of bytes

Proposed PID:	P01 - COLD RESTART OF SPECIFIC UNIT
Function:	Units with administrative authority may request the cold reboot (powerup) restart of selected units, usually to regain control of errant device.
Parameter Data Length:	1 Character
Data Type:	Unsigned Binary
Resolution:	Not applicable
Maximum Range:	1-255 (zero disallowed)
Update Period:	None
Message Priority:	3
Format:	PID (P01) Data a Where: a = MID of unit which is directed to perform a Cold Boot restart
Additional Information:	Unit identified by MID (a) performs cold reboot function upon receipt of command. Unit performs standard cold powerup communications functions after cold reboot and confirms by issuing a PID (P01) under its own mid with (a) = zero. Issuance of the Reset PID command is restricted to Units which have supervisory control over system devices. Devices which have become reset due to a loss of power and are returning to service should issue a PID (P01) with (a)=zero to notify the Transit Administrator of their resumed service status.

Proposed PID:	P02 - WARM RESTART OF SPECIFIC UNIT
Function:	Units with administrative authority may request the warm reboot restart of selected unit, usually to regain control of errant device.
Parameter Data Length:	1
Data Type:	Unsigned Binary
Resolution:	Not applicable
Maximum Range:	1-255 (zero is disallowed)
Update Period:	As needed
Message Priority:	3
Format:	PID (P02) Data a Where: a = MID of unit which needs Warm Boot
Additional Information:	Unit identified by MID (a) performs warm reboot function upon receipt of command and confirms by issuing a PID (P02) under its own mid with (a) = zero. Issuance of the Reset PID (P02) command is restricted to Units which have supervisory control over system devices.

Proposed PID:	P03 - REQUEST COLD RESTART OF ALL UNITS
Function:	Units with administrative authority may request the cold reboot (powerup) restart of all units, to initialize all units at start of engine operation or to regain control of errant system conditions.
Parameter Data Length:	1
Data Type:	Unsigned Binary
Resolution:	Not applicable
Maximum Range:	1 to 255 (zero is disallowed)
Update Period:	As required
Message Priority:	3
Format:	PID Data (P03) a Where: a = zero for command 255 for response
Additional Information:	All units of all MID designators perform cold reboot function upon receipt of command confirm by issuing a PID (P03) under its own mid with (a) = 255. Issuance of the Reset PID command is restricted to Units which have supervisory control over system devices.

Proposed PID:	P04 - TRANSIT DOOR STATUS
Function:	Report Transit door opening and closing
Parameter Data Length:	1
Data Type:	Binary
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	As door changes occur, and as requested
Message Priority:	7
Format:	PID Data (P04) a Where: a = (00) for door closures and (255) for door openings
Additional Information:	The MID identifies which door of several is encoutering a change of state.

Proposed PID:	P05 - DRIVERS CONSOLE DISPLAY MESSAGE
Function:	Display message to driver's console
Parameter Data Length:	Variable
Data Type:	Alphanumeric
Resolution:	ASCII (IBM-PC Character Set, 8 bits)
Maximum Range:	0-255 (each character)
Update Period:	As required
Message Priority:	7
Format:	PID Data (P05) n l1 l2 dddd....

Where:

n = Number of parameter data characters

l = screen location on drivers console

l1: Determine line for display of ASCII characters, and where line 0 is not allowed

l2: Determine the segment of the line for display of ASCII characters, where the horizontal display line is divided into multiples of 16 displayable characters, where segment 0 is not allowed.

d = Up to (15) ASCII characters as defined by IBM PCs, including the graphics values 128-255.

Additional Information: If the value of (L1) is zero the display shall interpret this as a clear screen command (all lines, all columns). In this case, there can be no (d) values included. If the display is equipped with a sound generating device, the receipt of an ASCII Bel character shall trigger the sound device.

If a manufacturer's design does not permit the console to be implemented using J1708 hardware interfaces, it is requested that the J1708 protocol be implemented on dedicated RS-233D lines to permit a level of vendor compatibility.

Proposed PID:	P06 - DRIVERS CONSOLE KEYBOARD MESSAGE
Function:	Report key depression on driver's console
Parameter Data Length:	Variable
Data Type:	Alphanumeric
Resolution:	ASCII (IBM 8 bit character set)
Maximum Range:	0-255 (each character)
Update Period:	Upon keyboard depression by driver
Message Priority:	7
Format:	PID Data (P06) n a b, ab ab ab ab ab

Where:

n = Number of parameter data characters

a = If nonzero, this byte will contain the ASCII value (1-255) of the key depressed and there will be no (b) byte.

If zero, this byte signifies the following (b) byte will contain the value of an IBM scan code for a function key depression

b = The value of a function key depression if byte (a) is zero in binary value.

Additional Information: After the driver's keyboard/display unit receives a cold/warm restart command, and if its internal self test logic determines no stuck keys or other problems, then the unit shall send a (00) value for (ab) as a operational status check message.

Function keys shall send (ab) when depressed, but other keystroke combinations shall require a "Enter" key depression for transmission, in which case (abababab....) sequence will be sent.

It is recommended that the console be capable of buffering a number of keystrokes.

If a manufacturer's design does not permit the console to be implemented using J1708 hardware interfaces, it is requested that the J1708 protocol be implemented on dedicated RS-233D lines to permit a level of vendor interchangeability.

Proposed PID:	P07 - MILEPOST READER
Function:	Used to identify the milepost detected by the onboard milepost sensor.
Parameter Data Length:	Variable
Data Type:	Alphanumeric
Resolution:	ASCII
Maximum Range:	0-255 (Each character)
Update Period:	Upon detection of milepost
Message Priority:	8
Format:	PID Data (P07) n ddddd....
	Where:
	n = Number of parameter data characters
	d = Characters specifying identification of the milepost
Additional Information:	None

Proposed PID:	P08 - TRANSIT ASSIGNMENT IDENTIFICATION
Function:	Used to identify the Assigned Route, Run, and Block
Parameter Data Length:	Variable
Data Type:	Alphanumeric
Resolution:	ASCII
Maximum Range:	0-255 (Each character)
Update Period:	On request
Message Priority:	8
Format:	PID Data (P08) n bbbbb * ccccc * ddddd Where: n = Number of parameter data characters b = Assigned Route c = Assigned Run d = Assigned Block
Additional Information:	All fields are five characters, right justified with preceding zeros. It is not necessary to include all three fields; however, the delimiter ("*") is always required. This information may be entered into different devices at different Authorities (Fare collection, radio, logic unit, control panels, etc.) In any case, the device which is assigned as the entry device shall make the identification available to all other devices on the Link with this PID.

Proposed PID:	P09 - DRIVER ASSIGNMENT IDENTIFICATION
Function:	Used to identify the Driver's Identity
Parameter Data Length:	Variable
Data Type:	Alphanumeric
Resolution:	ASCII
Maximum Range:	0-255 (Each character)
Update Period:	When entered or changed and on request
Message Priority:	8
Format:	PID Data (P09) n bbbbbbb * ccccc....
	Where:
	n = Number of parameter data characters
	b = Driver's Alphanumeric Identification
	c = Optional data on Driver
Additional Information:	It is not necessary to include both fields; however, the delimited ("*") is always required.
	The driver's identify may be entered into different devices at different Authorities (Fare collection, radio, logic unit, control panels, etc.) In any case, the device which is assigned as the entry device shall make the identification available to all other devices on the Link with this PID.

Proposed PID:	P10 - SIGNAGE MESSAGES
Function:	Used to identify the messages to be displayed on Destination, Headsigns or Annunicator Signs
Parameter Data Length:	Variable
Data Type:	ASCII
Resolution:	ASCII
Maximum Range:	0-255 (Each character)
Update Period:	When entered or changed and on request
Message Priority:	8
Format:	PID Data (P10) n t d0, d1, d2, d3...

Where:

n = Number of parameter data characters

t = Record Type (binary value)
- 0 = Poll Status of Signs
- 1 = Destination Code
- 2 = Public Ralations
- 3 = Next Stop
- 4 = Route Number
- 5 = Emergency Message enable/disable
- 6 = Direct Message Entry
- 7 = Direct Message Default Parms
- 8 = Direct Message Trigger (Update)
- 9 = Blanking

if:

t = 1 or 2 or 3 then d0, d1.... is the ASCII code and d1 is MSB

t = 4 then d0, d1... is the ASCII route number

t = 5 and if d0 = ff then Energency Message is enabled, other values for d0 = disable Emergency message

t = 6 then d0 = sign number (1-127 binary); d1 = Line Number (1-32 binary); d2 = Position (bit mapped) where bits 7-4 are Horizontal position and bits 3-0 are Verticle position; D1-D15 are ASCII direct message data

t = 7 then d0 is defined as:

1 = font type
2 = retention time in seconds
and where 00 = forever
3 = blanking time in seconds
4 = scoll rate
5 = Intensity (0 = lowest)
6 = Blink On Time in seconds
7 = Blink Off Time in seconds
8 = Color

d1 = parameter value (binary)

t = 8 then d0 is defined as the number of previous 6,7 records types since last trigger, for verification the sign has received all the records

t = 9 and d0 = FFhex, Blank the sign, other d0 values restore from blanking and displays previous message

Additional Information: Message clearance (blanking) should occur with the receipt of PIDs which request COLD reboot (restarts), however after responding, the sign shall restore the last message.

Maintenance should be performed by the use of standard diagnostic PIDs.

Administrative units shall issue this PID to set the sign(s).

According to individual Agency policies, (on/off) illumination control for signage may be controlled by a J1708 lighting PID or from a control and/or power source external to J1708. If J1708 power (on/off) control of illumination is elected, illumination power may be taken from the J1708 Transit Cable/Connector or from a external (to J1708) D.C. power feed.

Proposed PID:	P11 - ANNUNCIATOR VOICE MESSAGES
Function:	Used to identify the messages to be announced by Annunciator(s)
Parameter Data Length:	Variable
Data Type:	Binary
Resolution:	0-255
Maximum Range:	0-255 (Each character)
Update Period:	As needed
Message Priority:	6
Format:	PID Data (P11) n l dddd

Where:

n = Number of parameter data characters always (5)

l = Binary value of which annunciators are required to generate sound message (1 = generate sound, 0 = no sound)

Bit 8 = Front, interior

Bit 7 = Middle, interior

Bit 6 = Rear, interior

Bit 5 = External, front

Bits 4-1, Volume level, where (0 hex) = minimum level and (F hex) = maximum sound level available

d = binary value of audio message to be generated (65,536 preset messages)

Additional Information:	Message abort should occur with the receipt of PIDs which request COLD reboot (restarts). Maintenance should be performed by the use of standard diagnostic PIDs. Administrative units shall issue this PID to activate the annunicator.

Proposed PID:	P12 - VENDOR SPECIFIC LOCATION SENSOR
Function:	This PID allows transmission of information on the data bus in a nonstandard for a position sensor device (GPS, Loran, etc.) to its location calculator unit in a vendor's proprietary fashion. No other units on the data link should benefit for this communication message.
Parameter Data Length:	Variable
Data Type:	Variable
Resolution:	Variable
Maximum Range:	Variable
Update Period:	Variable up to 60 times per minute
Message Priority:	Parameter specific
Format:	PID Data (P12) n a d Where: n = Number of bytes following a = Receiving device's MID value d = data
Additional Information:	Contact manufacturer for details.

Proposed PID:	P13 - FARE COLLECTION SYSTEM
Function:	Report stop level detail and alarms
Parameter Data Length:	Variable
Data Type:	Binary
Resolution:	0-255
Maximum Range:	0-255
Update Period:	Upon occurrence
Message Priority:	6
Format:	PID Data (P13) n t v v b s h q d p

Where:

n = 9, the number of bytes to follow

t = type of transaction, where

Bit 8,7 are defined as:

(00) - cash transaction
(10) - token
(01) - pass
(11) - other (see notes)

Bits 6,5,4,3,2,1: identifiers of 64 fare types for each of cash, token, pass or "other" type transactions. (See also note)

vv = cash value of currency entering vault on this patron transaction in binary format (up to 65,636 cents)

b = 0-255 Dollars in Bills

s = 0-255 Dollar coins

h = 0-255 Half dollar coins

q = 0-255 Quarters

d = 0-255 Dimes

p = 0-254 Pennies. If more that 254 pennies are entered into the fare collection device, this byte shall be set to 255 and the number of pennies shall be derived by subtracting the other monitory values (bshqd) from the total value (v) to establish the number of physical pennies inserted.

Additional Information: "Other" transactions identified by (t) between 223 and 255 hex are reserved for 32 types of fare collection alarms, and are assigned by the fare collection systems manufacturers. Values for (vbshqdp) shall not be present, or set to zeros, in alarm reports.

Proposed PID:	P14 - TRANSIT SILENT ALARM STATUS
Function:	Report silent alarm push button status
Parameter Data Length:	1
Data Type:	Binary
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	On change of state
Message Priority:	3
Format:	PID Data (P14) a

Where:

a = (00) for button closures and
(255) for button openings

Proposed PID:	P15 - TRANSIT RUN SWITCH STATUS
Function:	Report run state of Transit vehicle
Parameter Data Length:	1
Data Type:	Binary
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	As changes occur
Message Priority:	7
Format:	PID Data (P15) a Where: a = (00) for RUN mode and (255) for RUN OFF mode

Proposed PID:	P16 - ACCELERATION
Function:	Scalar (not a vector) acceleration as calculated by the navigation device(s).
Parameter Data Length:	1
Data Type:	Signed integer
Resolution:	Not applicable
Maximum Range:	
Update Period:	On request
Message Priority:	6
Format:	PID Data (P16) a Where: a = 0.2 mph/sec/bit
Additional Information:	None

Proposed PID:	P17 - VEHICLE UNAUTHORIZED USE
Function:	Report unauthorized operation of vehicle (no valid driver logon)
Parameter Data Length:	1
Data Type:	Unsigned
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	60 seconds after unauthorized use starts
Message Priority:	8
Format:	PID (P16) Data a Where: a = (00) for normal operation and (255) for unauthorized operation
Additional Information:	The device providing this alarm may be the device for human input of authorization codes or the vehicle's Administrative controller device. It is suggested that such device be sensitive to the vehicle run mode PID and other locally defined criteria before the unauthorized use PID is generated (release of brakes, fixed time period, exit gate detection, etc.).

Proposed PID:	P18 - MESSAGE FROM MID TO FIXED END
Function:	Request for a message to be forwarded from a vehicle device to its fixed end component by radio.
Parameter Data Length:	1
Data Type:	Binary
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	As needed
Message Priority:	7
Format:	PID Data (P18) n a Where: n = byte count a = data
Additional Information:	None

Proposed PID:	P19 - DIFFERENTIAL CORRECTION
Function:	Transports differential correction to Geographical Position System (GPS) receivers on vehicle
Parameter Data Length:	V
Data Type:	Binary
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	As required
Message Priority:	6
Format:	PID Data (P19) variable
Additional Information:	See RTCM 104 version 2 for information

Proposed PID:	P20 - DELTA DIFFERENTIAL CORRECTION
Function:	Transports differential correction to Geographical Position System (GPS) receivers on vehicle
Parameter Data Length:	V
Data Type:	Binary
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	As required
Message Priority:	6
Format:	PID Data (P20) variable
Additional Information:	See RTCM 104 version 2 for information

Proposed PID:	P21 - ILLUMINATION CONTROL
Function:	Used to control illumination of signage and other illuminated Transit devices.
Parameter Data Length:	Variable
Data Type:	Binary
Resolution:	1-255
Maximum Range:	1-255
Update Period:	As needed
Message Priority:	3
Format:	PID Data (P21) n d1,d1,d1.... Where: n = Number of bytes d = Device address and illumination level Where LSB bits 5-0 are defined as: 00h = all illumination devices 01h = front sign 02h = side sign 03h = rear sign 04h = block sign 05h = annunciator sign 06h-32h = user defined Bits 7,6 are defined as: 11h = Maximum illumination 10h = Reduced illumination 01h = Dim illumination 00h = No illumination Bit 8 is defined as: 1 = Administrator 0 = Lighting controller
Additional Information:	The device charged with administering illumination shall issue the global (00h), a specific (1-32h) or group of devices (ddddd...) command(s) according to human or computer generated conditions defined by the Agencies design needs.

In any case, the illumination controllers receiving the their specific address, or the global address (00h), shall respond to the administering device with a data message using this PID with MSB=0 and Bits 7,6 as a confirmation of achieving the illumination level requested. Any failure to achieve the requested illumination level shall be indicated by setting bits 7,6 to 00h (no illumination level).

Illumination power may be taken from the J1708 cable/connector (a limited source of power) or from D.C. power sources external to the J1708 cable/connector.

Note that all devices use the same MID.

Proposed PID:	P22 - BUS TURNTABLE POSITION
Function:	Report the turntable position on the bus.
Parameter Data Length:	Variable
Data Type:	Binary
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	As required
Message Priority:	8
Format:	PID (P22) Data n b Where: n = Number of bytes b = Data
Additional Information:	None

Proposed PID:	P23 - PID REPORT PERIOD
Function:	Instructs the device reporting PID data unit to change the default reporting period.
Parameter Data Length:	Variable
Data Type:	Binary
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	As needed
Message Priority:	8
Format:	PID Data (P23) n ab ab ab.... Where: n = Number of bytes a = The PID value which needs to have a change in reporting interval b = Update interval seconds (1-255) and where (00) restores default
Additional Information:	None

Proposed PID:	P24 - VEHICLE TRANSIT SERIAL NUMBER
Function:	Identify vehicle identification number as assigned by the Transit owner (Similar to existing PID 236 bearing the VIN number)
Parameter Data Length:	Variable
Data Type:	Alphanumeric
Resolution:	ASCII
Maximum Range:	0-255 (each character)
Update Period:	On request
Message Priority:	8
Format:	PID Data (P24) n a a a a Where: n = Number of parameter data characters a = Character specifying VIN
Additional Information:	None

Proposed PID:	P25 - RELAY DRIVE TRAIN LINK DATA
Function:	Used by the device connected to both the Drive Train Link and the Transit Links to selectively pass requested data communications messages from the Drive Train Data Link to the Transit Data Link
Parameter Data Length:	Variable
Data Type:	Variable according to relayed message
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	As occurs on the Drive Train Data Link
Message Priority:	Same as Drive Train message being relayed
Format:	PID Data (P25) n o ddddddd.... Where: n = Number of bytes o = originating MID on Drive Train Data Link d = The original structure of the message including original MID, number of bytes, PID(s), data, but not the original Drive Train checksum.
Additional Information:	This PID shall have a valid checksum as do all other J1708 messages, generated according to protocol rules as the (repeated) message is assembled and transmitted to the Transit Data Link. Data messages occuring on the Drive Train Data Link which may have invalid check-sums are not to be repeated on the Transit Data Link. Repeated messages during normal vehicle run condition are limited by this PID to 18 bytes total due to the addition of MID, PID and checksum added to the Drive Train message by this device. Transit Data Link messages are never allowed to cross over into the Drive Train Data Link.

Proposed PID:	P26 - J1708 DRIVE LINK GATEWAY DEVICE
Function:	Instructs the device connected on to both the Drive Train Link and the Transit Link on which PIDs to repeat and how often.
Parameter Data Length:	Variable
Data Type:	Binary
Resolution:	Not applicable
Maximum Range:	1-255
Update Period:	As Needed
Message Priority:	8
Format:	PID Data (P26) n ab ab ab.... Where: n = Number of bytes a = The PID value which needs to be made available from the Drive Train Link to the Transit Link b = Update interval to made Drive Train PID available, where 00 indicates repeat all occurances of PID
Additional Information:	Drive Train repeaters shall be programmed to transfer no messages at powerup. They shall be programmed by the Transit Vehicle Administrative Computer for MIDs and PIDs to be transfered before any relay function(s) commence from the Drive Train Data Link to the Transit Data Link.

Proposed PID:	P27 - PASSENGER COUNTERS
Function:	Notifies the Transit Link devices of real-time boarding and aliting passengers, or, of the total number of passengers on vehicle referenced to the last transit stop
Parameter Data Length:	Variable
Data Type:	Binary
Resolution:	1-255
Maximum Range:	1-255
Update Period:	As Needed, following door closures or upon boarding event, depending on technology
Message Priority:	8
Format:	PID Data (P27) a b Where: a = Type of passenger count, where 00 hex - Absolute passenger count 01 hex - Boarding passenger 02 hex - Aliting Passenger b = The number of patrons currently on the vehicle after the door has closed in one-byte binary format.
Additional Information:	Some passenger counting systems indicate real-time boarding and aliting data for other devices to accumulate. Other types of passenger counters report a current on-board total relative to a (a) Door Closure PID, Fare collection PID, or other signal which can define the end of the boarding/aliting period and a stable underway totalized passenger count. In the case of the real-time counter systems, the format is PID+a. For total count systems the format is PID+a+b.

Standards for Use on Transit Vehicle Systems

Appendix B:

RECOMENDATIONS FOR

STANDARD CONNECTOR AND WIRING

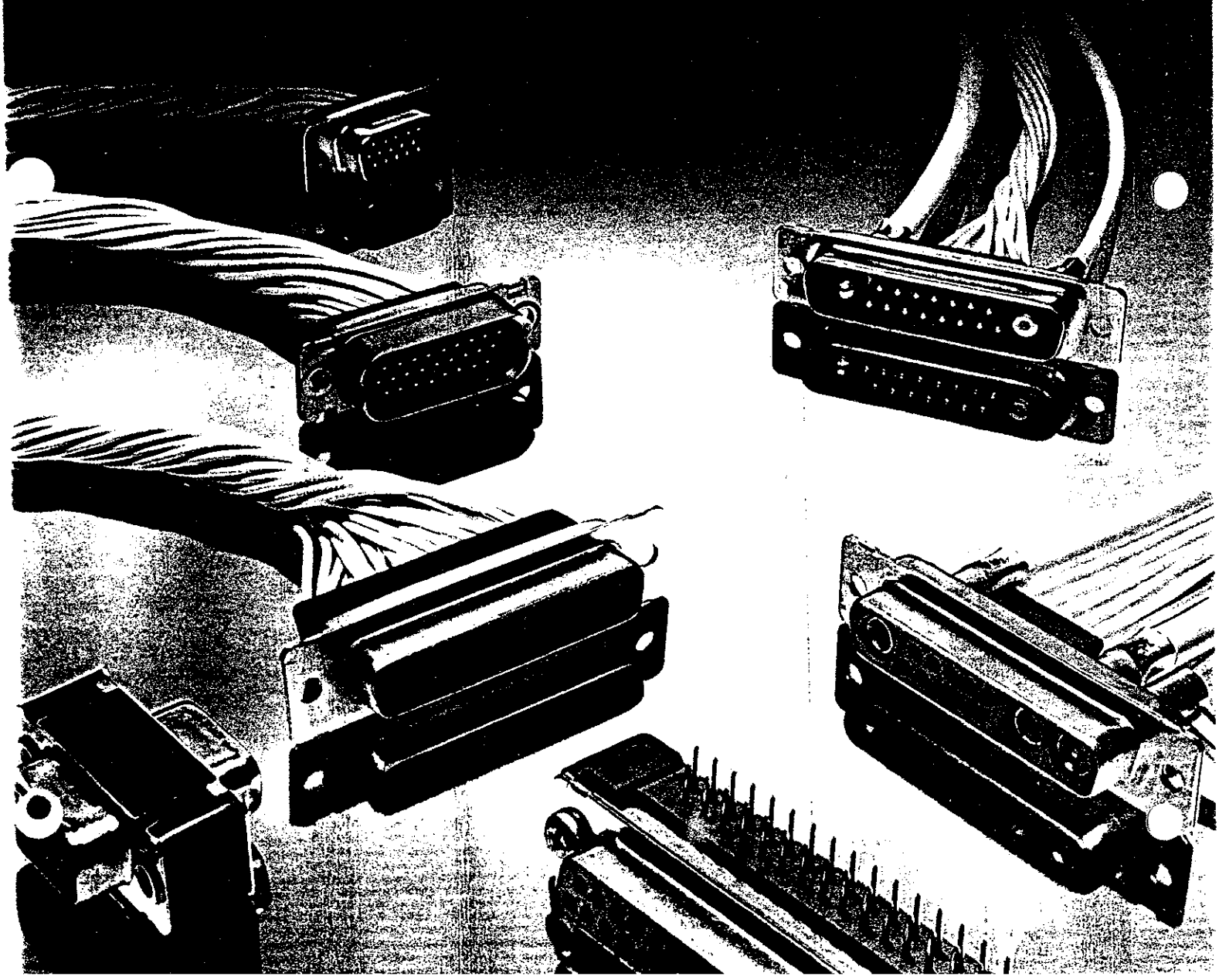
(DRAFT)

AMP

Subminiature D Pin and Socket Connectors per MIL-C-24308 (AMPLIMITE)

Catalog 79-547 • Streamlined 8-88

MIL-C-24308



STANDARDIZED CONNECTOR RECOMMENDATION:

DRAFT

While the Society of Automotive Engineers does not address the issue of standardized connectors within J-1708, the following recommendation has been made by the Manufacturers, Integrators and APTS representatives at the Houston workshop as a potential standardized connector for device interconnection:

MIL-C-24308 Subminiature D Pin and Socket Connectors

Multi-sourced MIL-rated connectors, having 45 amp ratings on power pins and 7.5 amp ratings on data/audio pins, all with 1000 VAC insulation resistance.

Reliability, stock availability and low costs are driving criteria, respectively.

Water-resistant or waterproof protective housings are available.

Female connectors are affixed to the vehicle.

Attaching devices may provide up to a six (6) foot (maximum) service cable terminated in a Male connector.

It should be noted that other connectors and conventions may be used and still have a fully compliant SAE J1708 system. However, non-standardized connectors and conventions may affect from-stock equipment delivery and interchangeability between manufacturers, integrators and users.

CONNECTOR INFORMATION:
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MIL-C-24308 Subminiature D Pin and Socket Connectors are comprised of:

Qty:	Part Number:	Description for one Female Connector:
1	208550-1,	Connector, for female pins
2	212008-1,	Female Pins, Crimp type, 12-14 awg
2	92-5064-17-1	(Special Female Pins for longer Male Pins)
32	1-66504,	Female Pins, Crimp type, 18 awg
1	1747098-1,	Hood with long Jackscrews

Qty:	Part Number:	Description for Male Connector:
1	208744-1,	Connector, for male pins
2	212007-1,	Male Pins, Std. Length, 12-14 awg
2	92-5064-16-1	Male Pins, Longer Length, 12-14 awg
32	1-66506,	Male Pins, Crimp type, 18 awg
1	1747098-1,	Hood with long Jackscrews

Qty:	Part Number:	Description for Hand-extraction tools:
1	580-95-1,	Tool, extraction of power pins
1	91067-2,	Tool, for extraction of small pins

The longer connector pins are to insure that a ground connection is completed before power or signal connections are make. Pins are also manufactured for 8-10 AWG power wiring if required.

While Amp, Inc. part number listed, the connectors are also available from Cinch Jones and others. The amp data sheets for purposes of specification content only.

PIN ASSIGNMENT RECOMMENDATION:

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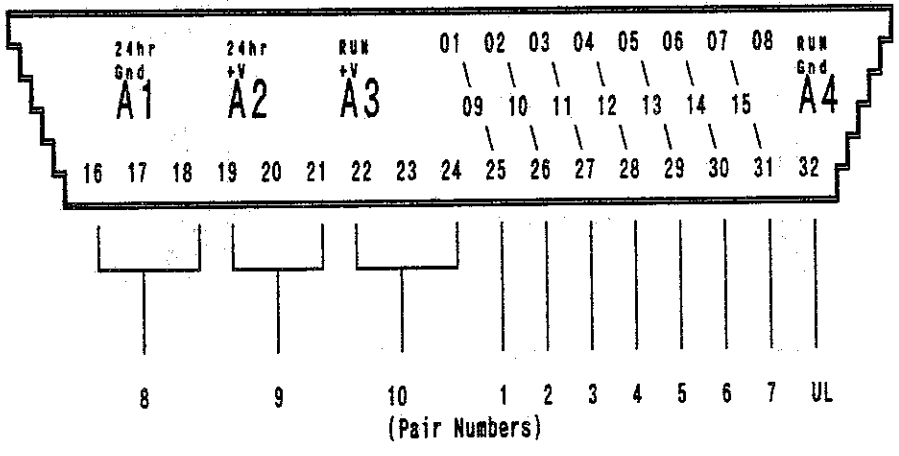
Pair Nbr:	Pin Nbr:	Assignment:	Mnemonic:
1	1	Transit J1708	Tip
	9		Ring
	25		Shield
2	2	Transit J1939	Tip
	10		Ring
	26		Shield
3	3	Spare Data #1	Tip
	11		Ring
	27		Shield
4	4	Spare Data #2	Tip
	12		Ring
	28		Shield
5	5	Spare Data #3	Tip
	13		Ring
	29		Shield
6	6	Reserved for	Tip
	14	Drive Train J1708	Ring
	30		Shield
7	7	Not assigned	Tip
	15	(may be used	Ring
	31	for pair 11)	Shield
8	16	Audio Pair #1	Tip
	17		Ring
	18		Shield
9	19	Audio Pair #1	Tip
	20		Ring
	21		Shield
10	22	Audio Pair #1	Tip
	23		Ring
	24		Shield
-	32	UL drain wire	---
-	8	Not assigned	---

PIN ASSIGNMENT RECOMMENDATION:

DRAFT
(Continued)

Pair Nbr:	Pin Nbr:	Assignment:	Mnemonic:
P1	A1	24 hour +12/+24 power return	Negative return (zero volts to chassis)
P2	A2	24 hour +12/+24 power source	Positive (to chassis)
P3	A3	ENGINE RUN only power +12/+24	Positive (to chassis)
P4	A4	ENGINE RUN only power return	Negative return (zero volts to chassis)

Pinout as viewed from REAR of Female connector:



STANDARDIZED CABLE FOR DISTRIBUTION

RECOMMENDATION:

DRAFT

An example of a cable for Data and Audio Service, selected to satisfy the cable definitions found in the SAE J1708 specifications, would be:

Belden #9775 Computer Cable

11 Pairs of 18 awg wires with constant twist

7x30 stranding

Each pair individually shielded with drain wire

Polyethylene Insulated

In this application, 10 pairs are assigned. The 11th pair may be reserved for bypassing a damaged pair between access points, or it may be used for an 11th pair assignment in the connector.

STANDARDIZED POWER DISTRIBUTION RECOMMENDATION:

DRAFT

The following recommendations are made by Manufacturers and Integrators and reflect the absolute total power consumption of all J1708-Transit Link components on the vehicle:

All equipment, excepting the Radio unit, shall be powered from two unregulated, unfiltered 24 volt DC power sources, each with a respective ground return wire. One power circuit is active during engine-on, and the second power circuit is available at all times.

If the vehicle provides only a 12 volt DC power source, then the distribution of unregulated, unfiltered 12 volt DC will replace the references to 24 volts below. Current ratings at 12 volts are not defined and subject to manufacturer's and Agency's mutual agreed upon design.

- RUN Power: Available only when the vehicle is in the engine "RUN" condition with a fuse rating of 20 amps at 24 volts.

- 24 Hour Power: Full time power for systems requiring 24 hour operation, memory retention voltage and/or other limited units defined as critical, with a fuse rating of 10 amps at 24 volts.