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SURFACE VEHICLE INFORMATION REPORT

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(R) CLASS A APPLICATION/DEFINITION

Foreword—The Vehicle Network for Multiplexing and Data Communication Subcommittee has defined three classes of communication networks. Perhaps, the least understood, with respect to function and implementation, is the Class A network. A clear understanding of Class A functions is necessary before any standards for protocol can be established.

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1. ***Scope—***This SAE Information Report will explain the differences between Class A, B, and C networks and clarify through examples, the differences in applications. Special attention will be given to a listing of functions that could be attached to a Class A communications network.

2. ***References***

2.1 **Applicable Publication—**The following publication forms a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

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

SAE J1213/1—Glossary of Automotive Electronic Terms.

3. ***Definitions—***SAE J1213/1 defines three classes of communication networks, Class A, Class B, and Class C.

3.1 **Class A—**The Class A network is defined as, “A potential multiplex system usage 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 to accomplish multiplexed body wiring typically did not exist in the same or similar form in a conventionally wired vehicle.”

3.2 **Class B—**The Class B network is defined as, “A potential multiplex system usage whereby data is transferred between nodes to eliminate redundant sensors and other system elements. The nodes of this form of a multiplex system typically already existed as stand-alone modules in a conventionally wired vehicle.”

3.3 **Class C—**The Class C network is defined as, “A potential multiplex system usage 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.”

4. ***Interrelationship of the Three Classes—***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.

4.1 System Speed versus Functional Speed—Most discussions on multiplexing focus on two issues; system speed and system complexity. Confusion arises from associating functional speed with system speed and complexity. As described in 3.3, Class C is defined as high speed and real time control. Intuitively, high function speed requires high system speeds and perhaps complexity. The Class B definition also makes no reference to the speed of the network or the function but places an emphasis on the type of function, "data communications". Class A defines the functions as being individually wired and not normally connected to intelligent nodes within the vehicle. Here again, no mention is made about the system speed or complexity required to achieve the function. Networks operating at high or medium speeds, therefore, must not be excluded from consideration as a Class A network.

5. Typical Applications of the Classes—Table 1 lists some characteristics of the three classes of multiplex networks. The real functional purpose is shown for each. In addition, the type of information and the timeliness of its distribution is noted.

TABLE 1—CHARACTERISTICS OF MULTIPLEX NETWORKS

	Class A	Class B	Class C
Purpose	Sensor/Actuator Control	Information Sharing	Real-Time Control
Information	Real TIme	Occasional	Real TIme
Latency Response Time	Wide Window	Varying Window	Narrow Window
System	Multiple Systems	Multiple Systems	System Specific
Information Lost or Corrupted	Nuisance	Nuisance or Failure	Failure

5.1 Class C Typical Applications—Systems that require real time, high speed control normally require a significant amount of information to function properly. This information must be available within a narrow time window that cannot vary. A delay of information longer than the specified time window may cause reduced operation or in extreme cases could result in the vehicle becoming inoperable. Figure 1 illustrates a Class C application.

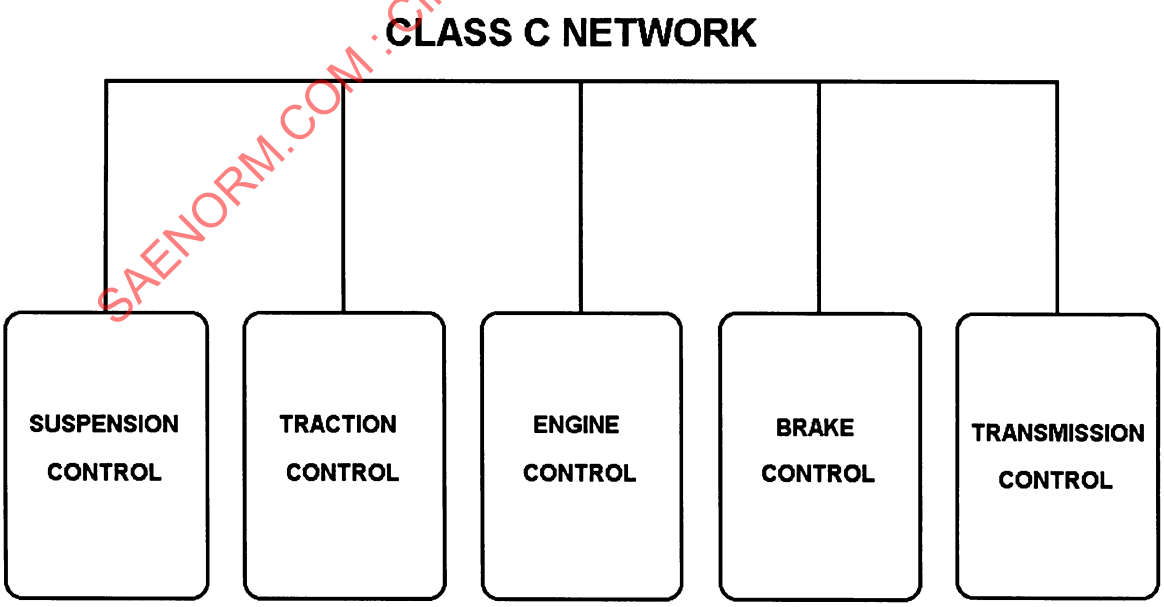

FIGURE 1—TYPICAL CLASS C APPLICATION

5.1.1 EXAMPLES OF CLASS C APPLICATIONS—Anti-Lock Brakes, Steer by Wire, Traction Control.

5.2 Class B Typical Applications—Many systems within the vehicle require information that is common to other systems. While redundant sensors and actuators as well as parallel circuitry, would support acceptable operation, multiplex data sharing of this information could result in simpler, more reliable systems. The shared information on a Class B network is not critical to the operation of all of the systems to which it is connected. The delay of a specific piece of information will not cause a critical failure in any of the systems. Therefore, the response window in the Class B network is not nearly as narrow as in the Class C. In fact, the response time may be variable, depending on the application. Another characteristic of Class B network is its interconnection of dissimilar systems. Figure 2 illustrates a Class B application.

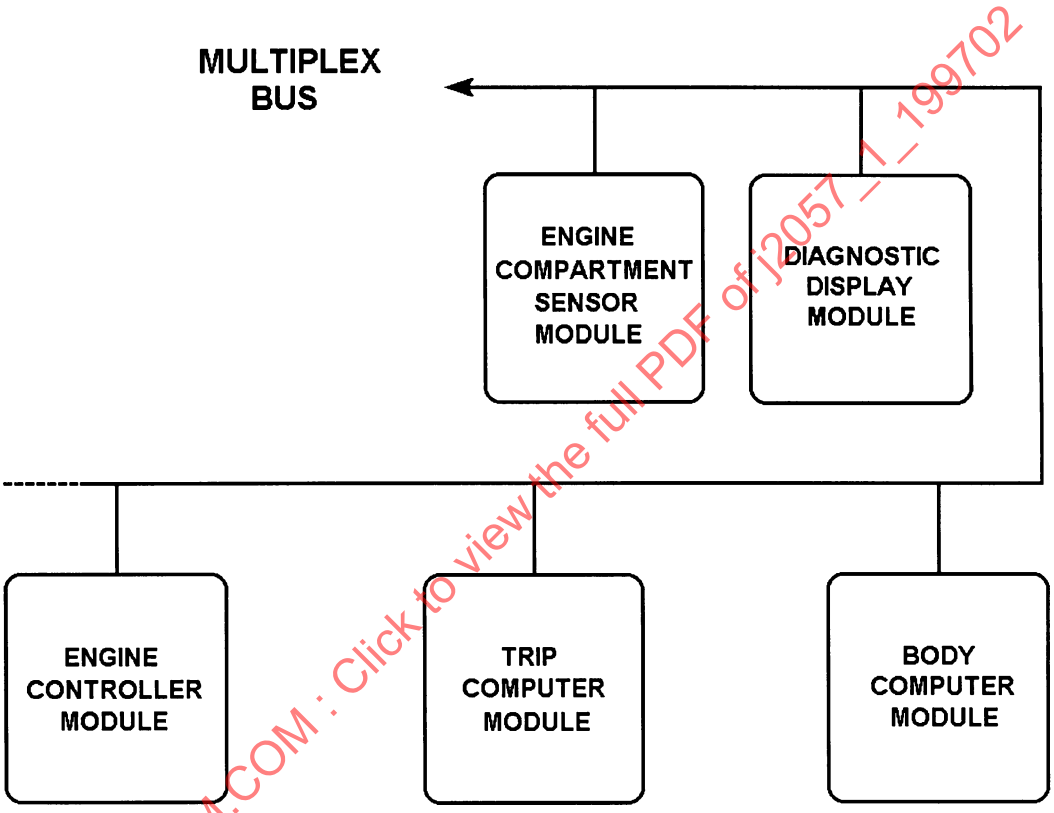

FIGURE 2—CLASS B MULTIPLEX APPLICATION

5.2.1 EXAMPLES OF CLASS B APPLICATIONS—A typical Class B network could connect Engine Control Modules, Body Computers, and System Diagnostic Modules.

5.3 Class A Typical Applications—Figure 3 illustrates the zone locations referenced in Tables 2A through 2D. Tables 2A through 2D list typical applications that could be considered for Class A networks. The chart is by no means complete, and will vary from application to application. It serves, however, to illustrate the numerous devices that can be serviced through a Class A network. It contains information on the device type, its anticipated latency requirements and the severity of damage, should the device fail.

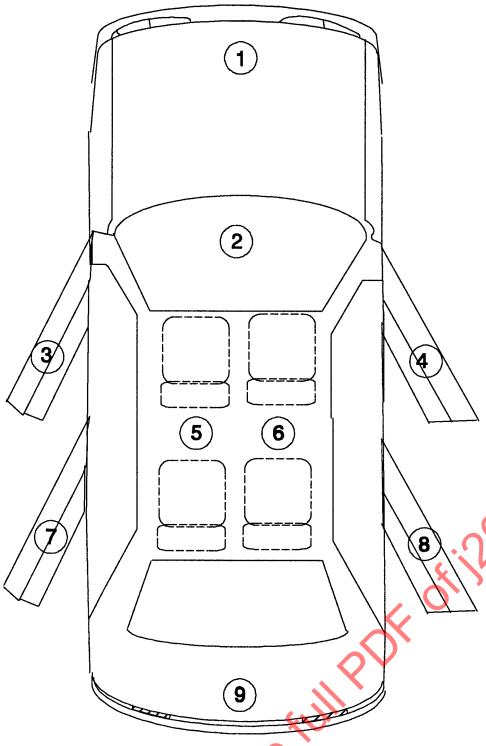

FIGURE 3—APPLICATION ZONES

TABLE 2A—TYPICAL CLASS A APPLICATIONS, OPERATOR INPUT SWITCHES

Zone	Description	Latency[1]	Typical[2] Number of Functions	Fault Category[3]
2	Headlights	B	2	A
2	Park Lamps	B	2	B
2	Turn Signal	B	3	A
2	Sunroof	C	3	C
2	Trunk Release	C	2	C
2	A/C with 4 Speed Fan	C	10	C
2	Seat Heater	C	2	C
2	Rear Defogger	C	2	C
2	Front Defogger	C	2	B
2	Windshield Wiper	C	2	B
2	Windshield Washer	C	2	B
2	Courtesy Lamps/Overhead	C	2	C
2	Radio Controls	B	12	C
2	Horn	B	2	A
2	Hazard	C	2	A
2	Fog Lamps	C	2	C
2	Fuel Door Opener	B	2	C
2	Illumination Control	C	2	A
2	Telephone Control	B	20	C
2	Cruise Control (Set. - Res.)	B	4	B
2	Convertible Top	C	2	C
3	Window with Lockout and Express	B	14	C
3	Mirror Left/Right	B	7	C
3	Seat with Memory	B	12	B
3, 4	Vent Window	B	3	C
3, 4, 7, 8	Door Lock	B	3	C
4	Seat without Memory	B	9	B
4, 7, 8	Window	B	3	C
5, 6	Recliner	B	3	C
5, 6	Lumbar	B	4	C
9	Wagon Rear Window	B	3	B

1. Latency, A: < 50 ms
   B: < 100 ms
   C: < 150 ms
2. Typical number of functions will vary with application
3. Fault Category, A: Severe problem interfering with reliable vehicle operation
   B: Problem that is inconvenient to operator but shall be corrected (limp home).
   C: Problem that is inconvenient to operator.

TABLE 2B—TYPICAL CLASS A APPLICATIONS, INPUT SENSORS

Zone	Description	Latency[1]	Typical[2] Number of Functions	Fault Category[3]
1	Hood Latch	C	2	C
1	Rain Sensor	C	2	C
1	Washer Level	C	2	C
1	Brake Fluid Level	C	2	A
1	Engine Oil Level	C	2	C
1	Battery Condition - Volts	C	2	C
1	Alternator Output - Amps	C	2	B
1	Refrigerant Flow	C	2	C
1	Radiator Water Flow	C	2	C
1	Transmission Fluid Level	C	2	C
1	Outside Temp. < Freezing	C	2	C
1	Coolant Temp. Limit	C	2	C
1	Headlight Light Output	C	8	C
1	Blend Door Position	C	4	C
1, 2	Auto Light Sensor	C	2	C
2	Park Brake Set	C	2	C
2	Brake Pedal Depressed	B	2	A
2	Clutch Pedal Depressed	C	2	C
3, 4, 7, 8	Door Lock	C	2	C
3, 4, 7, 8	Door Latch	C	2	A
3, 4, 7, 8	Door Handle	B	2	C
3, 4	Window Limit - Express	C	2	C
5, 6	Seat Temperature	C	2	C
9	Fuel Level	C	2	C
9	Axle Oil Level	C	2	C
9	Park Lamp Output	C	2	C
9	Stop Lamp Output	C	2	C
9	Auto Level	C	3	C
9	Fuel Door	C	2	C
9	License Lamp Output	C	2	C
9	Trunk Latched	C	2	B

1. Latency, A: < 50 ms
   B: < 100 ms
   C: < 150 ms
2. Typical number of functions will vary with application
3. Fault Category, A: Severe problem interfering with reliable vehicle operation
   B: Problem that is inconvenient to operator but shall be corrected (limp home).
   C: Problem that is inconvenient to operator.

TABLE 2C—TYPICAL CLASS A APPLICATIONS, OUTPUT CONTROL

Zone	Description	Latency[1]	Typical[2] Number of Functions	Fault Category[3]	Status Feedback Desired
1	Headlamp	B	2	A	Yes
1	Radiator Fan	C	2	B	Yes
1	Refrigerant Flow	C	2	C	Yes
1	Cruise Control On-Off	B	3	A	Yes
1	Wipers Hi-Lo	C	2	A	No
1	Horn	A	2	B	No
1	Windshield Washer	C	2	B	No
1, 9	Corner Lamps	B	2	B	
1, 9	Park Lamps	B	2	B	Yes
1, 9	Turn Signal	B	2	B	Yes
2	Defog Front Window	C	2	B	No
2	Sunroof Motor	C	2	C	No
2	Heater Blower	C	4	B	No
2	Heat Mode Doors	C	4	B	No
2, 3, 4, 7, 8	Courtesy Lamp	C	2	C	No
3	Defog Mirror	C	2	C	No
3	Mirror Motors	C	4	C	No
3, 4	Vent Window	C	2	C	No
3, 4, 7, 8	Window Motor	B	2	B	No
3, 4, 7, 8	Door Lock	B	2	C	Yes
5, 6	Seat Recline Motor	B	8	B	No
5, 6	Heated Seat	C	2	C	No
5, 6	Lumbar Valves 2 Bag	C	2	C	No
5, 6	Lumbar Compressor	C	2	C	Yes
6	Meter Illumination	B	2	B	Yes
9	Convertible Top Motor	C	2	B	No
9	Backup Lamp	C	2	B	
9	Level Control Compressor	B	2	B	No
9	Brake Light	A	2	B	Yes
9	Defog Rear	C	2	C	No
9	Trunk Release	B	2	C	No

1. Latency, A: < 50 ms
   B: < 100 ms
   C: < 150 ms
2. Typical number of functions will vary with application
3. Fault Category, A: Severe problem interfering with reliable vehicle operation
   B: Problem that is inconvenient to operator but shall be corrected (limp home).
   C: Problem that is inconvenient to operator.

TABLE 2D—TYPICAL CLASS A APPLICATIONS, ANALOG TO "B" BUS CONTROLLER

Zone	Description	Latency[1]	Typical[2] Number of Functions	Fault Category[3]
2	In Car Temperature	C	2	B
2	Wiper Delay	C	2	C
2	Panel Lamp Delay	C	2	C
2	Panel Lamp Dimmer	B	2	B
2	Seat Position	B	3	B

1. Latency, A: < 50 ms
   B: < 100 ms
   C: < 150 ms
2. Typical number of functions will vary with application
3. Fault Category, A: Severe problem interfering with reliable vehicle operation
   B: Problem that is inconvenient to operator but shall be corrected (limp home).
   C: Problem that is inconvenient to operator.

5.3.1 EXAMPLES OF CLASS A APPLICATIONS—Class A applications include the control of lights, power convenience features, and information diagnostics. Figure 4 illustrates an application of a Class A Network.

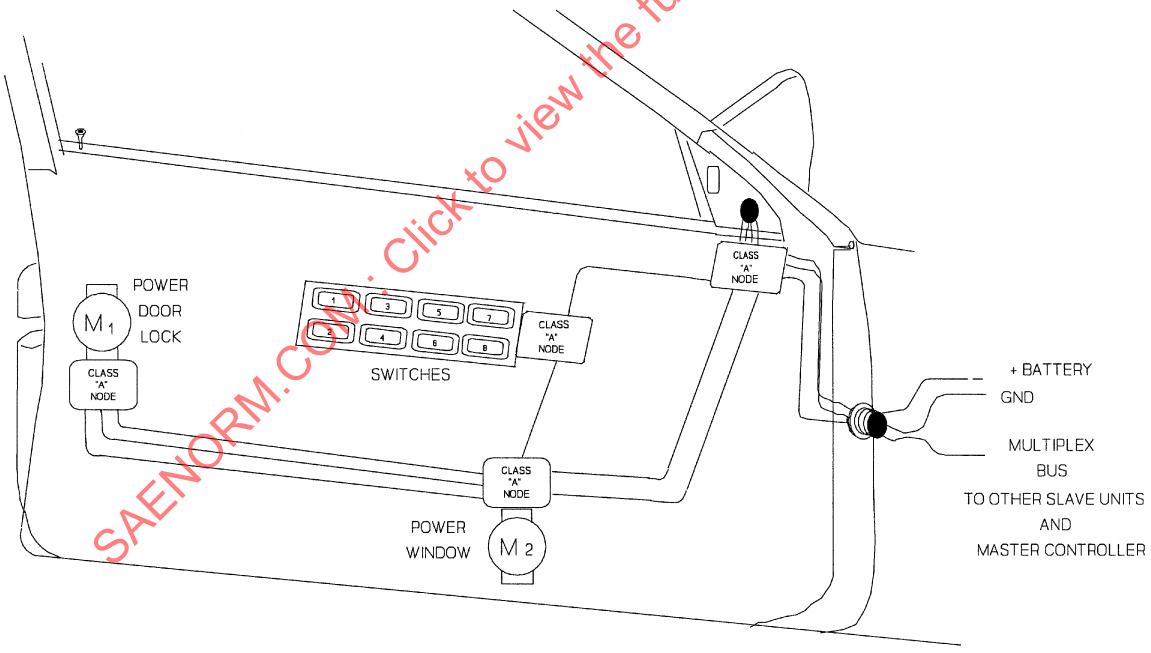

FIGURE 4—DOOR SUBSYSTEM IMPLEMENTED WITH CLASS A MULTIPLEXING