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General Motors UART Serial Data Communications

RATIONALE

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1. Scope

This Technical Information Report defines the General Motors UART Serial Data Communications Bus, commonly referred to as GM UART. This document should be used in conjunction with SAE J2534-2 in order to enhance an SAE J2534 interface to also provide the capability to program ECUs with GM UART.

SAE J2534-1 includes requirements for an interface that can be used to program certain emission-related Electronic Control Units (ECUs) as required by U.S. regulations, and SAE J2534-2 defines enhanced functionality required to program additional ECUs not mandated by current U.S. regulations. The purpose of this document is to specify the requirements necessary to implement GM UART in an enhanced SAE J2534 interface intended for use by independent automotive service facilities to program GM UART ECUs in General Motors vehicles.

1.1 Rationale

Not applicable.

2. References

2.1 Applicable Publications

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

2.1.1 SAE PUBLICATIONS

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

SAE J2534-1—Recommended Practice for Pass-Thru Vehicle Programming

SAE J2534-2—Recommended Practice for Optional Pass-Thru Features

3. Definitions

3.1 Master ECU

An ECU that can send and receive messages on the serial data bus, and that controls the flow of messages on the data bus

3.2 Serial Data Bus

A physical connection between devices that comprise a vehicle system used to send and receive message bytes sequentially

3.3 Slave ECU

An ECU on the serial data bus that receives requests from the Master ECU and performs the requested functions, and sends messages only when requested by a Master ECU or Tester

3.4 Tester

A device, external to the vehicle, that has the capability to connect to the serial data bus through a data link connector (DLC) and assume the role of a Master ECU, primarily for the purpose of diagnostics or reprogramming

4. Acronyms

ALDL – Assembly Line Diagnostic Link
DLC – Data Link Connector
ECU – Electronic Control Unit
LSB – Least Significant Bit
MIB – Message Identification Byte
MSB – Most Significant Bit
NRZ – Non-Return to Zero
UART – Universal Asynchronous Receiver/Transmitter

5. System Elements

The elements of a GM UART serial data bus system are shown in Figure 1. A vehicle system is composed of a Master ECU, the Serial Data Bus, a group of optional Slave ECUs, and a Data Link Connector which permits access to the Serial Data Bus by external test devices. External test devices, called Testers, can be a Service Tester (often called a Scan Tool), an Assembly Line Tester, or an SAE J2534 pass-thru programming interface.

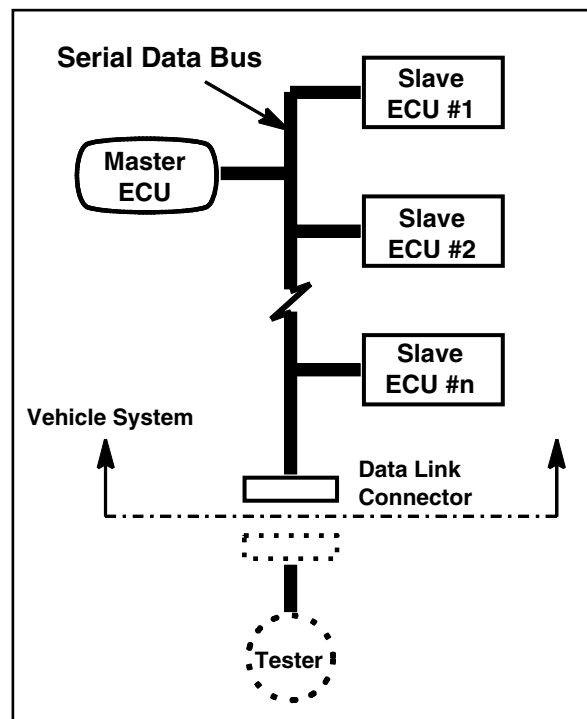


FIGURE 1—SYSTEM ELEMENTS

The functionality of these elements are contained in the following paragraphs.

5.1 Master ECU

A Master ECU is an ECU or Tester that is in control of the bus. The Master ECU shall perform transmit and receive functions. The major characteristic which distinguishes the Master ECU from a Slave ECU is that it controls the traffic on the serial bus.

The Master ECU shall control which device has control of the bus via a cyclic transmission of polling messages. Normal operation is for the Master ECU to transmit a message and then receive a valid response message transmitted by the proper Slave ECU. The Master ECU will transmit the next message at the scheduled time. The sequence of messages may vary from application to application and from model year to model year.

The Master ECU may also periodically transmit an ALDL polling message to determine if there is a Tester connected to the serial data bus that needs to take control of the serial data bus. If a Tester responds to this ALDL polling message, the Master ECU relinquishes control of the serial data bus to the Tester and becomes a Slave ECU.

When the system does not contain any Slave ECUs, the Master ECU may not execute a scheduled polling sequence. In this case, the only possible communications would be between the Master ECU and a Tester. The Master ECU would then be in a listening mode and respond only when interrogated by the Tester. Its function is then equivalent to a Slave ECU.

The Master ECU may "Broadcast" information per a schedule, with no response from any other device (except an ALDL Tester) on the link.

A Master ECU in control of the bus can be moded into an ALDL Mode by a Tester when it responds to the appropriate polling message issued by the Master ECU. That response shall typically be a command to disable normal communications via a "Mode 8" function mode number in the response message. The actual response message required by an interface to become Master ECU is defined by the programming application using the PassThruIoctl function specified in SAE J2534-2. The Master ECU will then discontinue executing its normal polling sequence, relinquish control to the Tester, and the Tester then becomes the Master ECU.

5.2 Slave ECU

A Slave ECU is an ECU on the serial bus that performs the receiver functions. If a Slave ECU is also designed to transmit on the serial bus, it shall only perform the transmit functions when requested by the Master ECU. The major feature which distinguishes a Slave ECU from the Master ECU is that it does not perform the bus traffic control function. A Slave ECU shall only transmit its preassigned message(s) after the receipt of a valid request message. A given Slave ECU can be programmed to respond to more than one request. Once a Slave ECU has received the end of a valid message instructing it to transmit, it must respond within the timing defined in the *Communication Protocol and Timing* section.

A Slave ECU which performs the transmit function can be moded into the ALDL Mode, similar to the Master ECU. This requires that if a Master ECU is present in the system, it must be idled and the Tester assumes the role of the Master ECU.

5.3 Tester

A Tester is external to the vehicle and is not part of the normal vehicle operating configuration. A Tester is defined to have the capability to connect to the serial data bus through a data link connector (DLC), receive and transmit information on the serial data bus, and to assume the role of the Master ECU.

The Tester is normally used to request data from the system devices on the vehicle and control these devices for the purpose of verifying system operation and diagnosing malfunction conditions, or for purposes of reprogramming the ECU.

5.4 Data Link Connector

All GM vehicles built since the 1996 model year, and a few built during the 1995 model year, have been equipped with an SAE J1962 connector. GM UART uses either Pin 9 or Pin 1 of this connector. Most GM vehicles with serial data links built prior to the 1996 model year are equipped with a GM specific 12 pin connector.

SAE J2534-2 includes GM UART pin usage for both of these connectors.

6. System Element Moding

Each device of the system shall contain all, or some subset of, the following operating modes:

Normal	All normal control or display functions are being performed. If a scheduled polling sequence is a part of the system design, it is being executed in the Normal Mode. It is entered upon power-up or from exiting the ALDL Mode.
ALDL	This mode is entered from the Normal Mode. It is entered upon receipt of a Tester command message requesting that the device enter an ALDL Mode.
Transmit	This mode is entered when a message is to be sent from either the Normal Mode or the ALDL Mode.
Receive	This mode is entered when a message is being received for either the Normal Mode or the ALDL Mode.

7. Communication Protocol and Timing

The serial data bus is normally implemented as an 8192 baud (bit per second), half duplex, Non-Return to Zero (NRZ), Universal Asynchronous Receiver/Transmitter (UART) type. Different baud rates are used for some vehicles, but that will be controlled and set in the interface by the programming application using SAE J2534-2 functions. The following paragraphs specify the protocol and timing details.