Dearborn Group Technology

VEHICLE SERIAL INTERFACE CLASS 2

USER'S MANUAL

Version 1.0

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The Vehicle Serial Interface-Class 2 is intended to be used as an evaluation tool only. Damage occurring to the board while it is misused is not covered under the seller's product warranty.

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CHAPTER 1

Introduction

The Vehicle Serial Interface - Class 2 (VSI-C2) is an instrument that enables communications with the General Motors implementation of the SAE J1850 (Class 2) serial data bus and UART bus using a personal computer. The VSI-C2 is compatible with any personal computer with a standard RS-232 serial communications port. The serial data buses are accessed via the Assembly Line Diagnostic Link (ALDL) connector on the vehicle.

The VSI-C2 was designed to allow development of Class 2 diagnostic and data acquisition instruments on commercially available personal computers. The VSI-C2 communicates to the host computer via an RS-232 serial port. Commands from the host include initialization, transmission of Class 2 messages, and grounding of diagnostic lines. When the VSI-C2 is configured, it can transmit and receive messages on the Class 2 bus. Power is supplied to the VSI-C2 from the SAE J1962 ALDL connector or from a cigarette lighter adapter.

Figure 1. Vehicle Serial Interface - Class 2

CHAPTER 2

System Description

The VSI-C2 consists of an interface module, RS-232 cable, an ALDL cable, ALDL connector adapters, and an optional analog channel breakout box.

2.1 Interface Module

The interface module contains a microprocessor circuit for processing commands, a Data Link Controller - Serial (DLC-S) chip for the Class 2 bus interface, a Serial Transmitter/Receiver (SXR) chip for the UART bus interface, diagnostic line control, and multiplexing circuits.

The module has four connectors: ALDL, RS-232, A/D Input and power. The ALDL connector is a 25-pin D shell connector. All Class 2 data, UART data, and diagnostic lines are available on this connector. Via this connector, 12 V DC power can also be supplied. The RS-232 connector is a 9-pin, D shell connector. This connector provides connection to a standard RS-232 serial port on any IBM-compatible personal computer. The A/D Input connector is a 15-pin, D shell connector. The 8 channels of the analog-to-digital converter are accessed via this connector. For external signal conditioning, 12V DC output is available from this connector. The power jack supplies 12V DC to the module if it is not supplied from the ALDL connector.

2.2 RS-232 Cable

The RS-232 cable supplied is a standard 9-pin to 9-pin cable. If the host computer has a 25-pin RS-232 port, an optional 9- to 25-pin converter is available.

2.3 ALDL Cable and ALDL Adapters

The ALDL cable and adapters supplied connect between the interface module and the vehicle ALDL connector. There are two ALDL adapters available: 12 pin and SAE J1926 16 pin. The adapters plug onto the ALDL cable and into the vehicle.

2.4 Analog Breakout Box

The Analog Breakout box provides a standard BNC connector interface to the A/D converter channels.

CHAPTER 3

Commands

The VSI-C2 accepts several commands from the host computer via an RS-232 port. When the VSI-C2 powers up, it defaults to 28.8K baud. All commands consist of at least two ASCII characters and are terminated with an ASCII carriage return. Some commands require additional binary data. All binary data is sent with a 2's compliment check sum value such that when all of the bytes transmitted are added, the result is zero.

The command protocol consists of a command from the host computer and a response from the VSI-C2. The following sections describe each command in detail.

3.1 Command Conventions

<..> refers to a binary encoded parameter occupying a single ASCII character
<CR> is carriage return.
[..] refers to an ASCII encoded parameter occupying more than one character.
'X' refers to an ASCII character

3.2 Transmit Class 2 Message

This command transmits a message on the Class 2 bus. This command consists of two parts: the command and the binary encoded message with checksum. The VSI-C2 will load the message into the DLC-S for transmission. The message will be transmitted on the bus as soon as it wins arbitration.

Command Format: T<len><CR><m0><m1>...<m#><cs>

<len>: length of the Class 2 message in hex ('1' to 'C').
<m#>: Class 2 message bytes
<cs>: 2's compliment checksum of the Class 2 message

Command Responses:

<CR>: Command received

?1: Command not understood
?2: Invalid message length
?5: Checksum error
?7: Transmitter shorted low
?8: Transmitter shorted high

3.3 Set Baud Rate of DLC

This command sends a new configuration byte to the DLC-S in the VSI-C2 to change the baud rate. The DLC-S has two communications baud rates: 10.4K baud and 41.6K baud.

Command Format: I<mode><CR>

<mode>: '0' for 10.4 K baud, '1' for 41.2 K baud

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Invalid mode

3.4 Connect the DLC to ALDL Pins

The DLC-S output can be connected to one or two different pins on the ALDL connector. The General Motors implementation of the SAE J1962 ALDL connector calls for the primary Class 2 bus to be on pin 2 and allows for a secondary Class 2 bus on pin 1. This command allows the user to select the communications pin for the vehicle without the need for adapters.

The bus loading circuit on the DLC-S can be configured to that of a main node or a secondary node. This feature allows the VSI-C2 to be used in development work where there is no main node on the Class 2 bus.

Command Format: C<mask><CR>

<mask>: '0' to disconnect DLC
'1' to connect DLC to primary Class 2 (pin 2 of J1962 connector)
'2' to connect DLC to secondary Class 2 (pin 1 of J1962 connector)
'4' to set up the DLC as a main node
Logically ORing these values will connect more than one line.

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Invalid mask

3.5 Send Block Transfer Message

The VSI-C2 is capable of transmitting up to 4K byte messages in block transfer mode on the Class 2 bus. Block transfer messages may be sent at either baud rate. This command consists of two parts: the command and the binary encoded block transfer message.

Command Format: XB[len]<CR><m0><m1>...<m#><cs>

[len]: 4 character length of the Class 2 message in hex (1000H maximum)
<m#>: block transfer message bytes
<cs>: 2's compliment checksum of the Class 2 message

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Length is out of range
?4: DLC is busy
?5: Checksum error

3.6 Monitor Mode Enable/Disable

On powerup, the VSI-C2 is configured not to send the host any Class 2 messages that are received. This command allows the host to enable and disable the transmission of Class 2 messages from the VSI-C2. There are two modes in the VSI-C2: monitor mode and block monitor mode. When monitor mode in enabled, the VSI-C2 will transmit all messages received from the Class 2 bus to the host. Only completion code from block transfer messages will be sent to the host. When block monitor mode is enabled, the entire block transfer messages received will be transmitted to the host.

Command Format: M<mode><CR>

<mode>: '0' to disable both monitor modes
'1' to enable monitor mode
'2' to enable block monitor mode
Logically ORing these values will enable both modes.

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Invalid mode

3.7 Filter Class 2 Messages

The VSI-C2 can relieve the host computer of some processing by selectively filtering out Class 2 messages that are received. When filtering is enabled, only messages that match one of the filter table entries will be sent to the host computer. Message filtering can be based on the message priority, type, target ID, source ID, and secondary ID. Don't care states are provided so that a range of messages can be filtered. The VSI-C2 will accept up to 20 filter table entries.

Command Format: F<len><CR><pr0><tp0><tg0><src0><id0>...<cs>

<len>: length of filter table (must be a multiple of 5, 0 disables message filtering)
<pr#>: message priority to filter (0 to FH, FFH = don't care)
<tp#>: message type to filter (0 to FH, FFH = don't care)
<tg#>: target id of message to filter (0 to FFH, FFH = don't care)
<src#>:source id of message to filter (0 to FFH, FFH = don't care)
<id#>: secondary id of message to filter (0 to FFH, FFH = don't care)
<cs>: 2's compliment checksum of the filter table

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Invalid length
?5: Checksum error

3.8 Connect SXR to ALDL Pins

The VSI-C2 is capable of supporting General Motors UART serial data links. This command allows the user to select the pin for UART communications. The pin letters referenced below are from the General Motors 12-pin ALDL connector. More than one pin may be connected at one time. This feature allows pins L and M to be tied together as is needed on some vehicles.

Command Format: U<mask><CR>

<mask>: '0' to disconnect all lines

'1' to connect to pin E
'2' to connect to pin L1
'4' to connect to pin L2
'8' to connect to pin M
Logically ORing these values will connect more than one line.

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Invalid mask

3.9 Ground Diagnostic Lines

The VSI-C2 can ground up to 5 different diagnostic lines. This command sets and clears the diagnostic lines.

Command Format: G<mask><CR>

<mask>: 80H to open all diagnostic lines
81H to ground diagnostic line 1
82H to ground diagnostic line 2
84H to ground diagnostic line 3
88H to ground diagnostic line 4
90H to ground diagnostic line 0 through a 10K resistor
A0H to ground diagnostic line 0 through a 3.9K resistor
C0H to ground diagnostic line 0
Logically ORing these values will ground more than one line.

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Invalid mask

3.10 Setup A/D Data Output

The VSI-C2 has an 8-channel, 8-bit analog-to-digital converter. These channels can be scanned periodically and sent to the host computer. The input range of the A/D converter is 0 to +5V.

Command Format: A<rate><CR>

<rate>: number of 25 msec periods between analog data packets offset by 80H (80H to FFH, a scan rate of 80H will return a single scan of the channels, a scan rate of FFH will disable the A/D converter)

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Invalid rate

3.11 Set RS232 Baud Rate

This command allows the user to change the communications baud rate between the host computer and the VSI-C2. Almost any baud rate is possible, the most common are listed below.

Command Format: B<baud><CR>

<rate>: Baud rate divisor
8DH = 38.4K baud
91H = 28.8K baud
9AH = 19.2K baud
BDH = 8192 baud

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Invalid rate

3.12 Latency Time Enable/Disable

When a message is loaded in the DLC-S for transmission, it may not be transmitted immediately. If the message loses arbitration, it may be several milliseconds before the message actually gets transmitted. The VSI-C2 can measure the latency of messages that it transmits. When the latency time is enabled, the VSI-C2 adds a two-byte latency value to each message sent to the host computer. This latency time has a 0.1 millisecond resolution.

Command Format: L<mode><CR>

<mode>: '0' disables latency time
'1' enables latency time

Command Responses:

<CR>: Command received
?1: Command not understood
?2: Invalid mode
?6: DLC is busy

3.13 Enter UART Mode

The VSI-C2 does not directly support General Motors UART serial data protocols, it simply provides an interface to the UART bus. This command connects the RS-232 port of the host computer to the UART bus. In this mode, the host computer must handle the entire UART protocol. To transmit a message on the UART bus, the host computer must assert the RTS line, transmit the messages, and release the RTS line. If the host computer transmits a command without asserting the RTS line, the VSI-C2 will exit UART mode and respond to the command.

Command Format: QM<CR>

Command Responses:

<CR>: Command received
?1: Command not understood

3.14 Send Current Time Stamp

The VSI-C2 handles time-stamping all Class 2 messages transmitted and received. This command is provided so that the host computer can access the current time according to the VSI-C2.

Command Format: ET<CR>

Command Responses:

<CR>: Command received

?1: Command not understood

3.15 Send Break Signal on Class 2 bus

This command causes the VSI-C2 to transmit a break signal on the Class 2 bus.

Command Format: KR<CR>

Command Responses:

<CR>: Command received
?1: Command not understood
?3: DLC is busy

3.16 Recover from RS-232 Error

This command causes the VSI-C2 to re-transmit messages to the host computer. If the host computer detects that it dropped a byte of a message, it should issue a break signal and then send this command within 25ms. The host must keep a counter to track the current message being sent to the host. The counter is modulo 64 based and must be reset to zero when the VSI-C2 is reset. A similar counter is kept in the VSI-C2. When a byte is lost from a message, the host should use the counter to determine the message number and use this number in the command.

Command Format: Z<msg><CR>

<msg>:number of message the VSI-C2 should start transmitting

Command Responses:

There are no responses to this command.

3.17 Clear VSI-C2 Buffers

This command causes the VSI-C2 to clear its internal communications buffers. After this command has been responded to, the host message counter should be set to one.

Command Format: CB<CR>

Command Responses:

?0: Command received
?1: Command not understood

CHAPTER 4

VSI-C2 Messages

The VSI-C2 will transmit messages and responses to commands to the host computer via the RS-232 link. The VSI-C2 will transmit messages to the host computer under the following conditions.

1) Messages sent with the 'T#' commands will be echoed back to the host computer for time-stamp purposes.

2) When block monitor mode is enabled, messages sent with the 'XB' command will be echoed back for time-stamp purposes.

3) When block monitor mode is disabled, completion codes of messages sent with the 'XB' command will be echoed back for time-stamp purposes.

4) Responses directed to the Source ID of the last message sent with either the 'T#' or the 'XB' commands will be sent to the host.

5) Messages received with a target ID of FEH will be sent to the host.

6) The host will be alerted if a Class 2 link break condition occurs.

7) When filtering is enabled, all messages that pass the filter table will be sent to the host.

8) When monitor mode is enabled, all messages received on the Class 2 bus will be sent to the host.

9) Analog data messages will be sent to the host at specific intervals when the A/D converter has been configured.

10) The current time-stamp value will be sent to the host when it has been requested.

The following sections describe in detail the message formats used by the VSI-C2.

4.1 Class 2 Messages

Class 2 messages and current time stamp values being sent to the host computer use the following format:

<hdr/len>[<blen1><blen2>]<m0><m1>...<m#><cc><tsmsb><tslsb>[<ltmsb><ltlsb>]<cs>

<hdr/len>: This is a binary encoded character. The high nibble will always be number of the message bytes and completion code (01H to 0EH). The bit combination F0H is used for returning the current time-stamp value to the host PC. The bit combination FFH is reserved for block transfer messages.
<blen1>: optional MSB of block transfer length
<blen2>: optional LSB of block transfer length
<m#>: Class 2 message bytes
<cc>: completion code appended to the Class 2 message by the DLC
<tsmsb>: MSB of message time stamp in ms
<tslsb>: LSB of message time stamp in ms
<ltmsb>: optional MSB bus latency of transmitted message in ms
<ltlsb>: optional LSB bus latency of transmitted message in ms
<cs>: 2's compliment checksum of the entire message

4.2 Analog Data

When the VSI-C2 is configured to send analog data to the host, the messages will use the following format:

<hdr/len><a0><a1>...<a#><tsmsb><tslsb><cs>

<hdr/len>: This is a binary encoded character. The high nibble will always be EH. The low nibble will contain the number of data bytes (01H to 08H, only 08H is used at this time).
<a#>: analog data byte
<tsmsb>: MSB of data time stamp in msec
<tslsb>: LSB of data time stamp in msec
<cs>: 2's compliment checksum of the entire message

CHAPTER 5

RS-232 Port Setup and UART Communications

The VSI-C2 uses two of the RS-232 control lines for special functions. The RS-232 port of the host computer must be set up for the VSI-C2 to communicate properly. The two control lines used are the Data Terminal Ready (DTR) and Ready to Send (RTS) lines. The DTR line can be used to reset the VSI-C2 if it is an unknown state. The RTS line is used to enable the transmitter of the SXR for transmitting on the UART link.

5.1 Data Terminal Ready Line

The DTR line must be in a low state (-10V to -12V) for normal operation of the VSI-C2. This corresponds to a 0 in bit 0 of the Modem Control Register (MCR) of the host computer. To reset the VSI-C2, write a 1 and then a 0 to bit 0 of the MCR.

5.2 Request to Send Line

The RTS line is normally in a high state (+10V to +12V) for normal operation of the VSI-C2. This corresponds to a 1 in bit 1 of the MCR. When the RTS line is high, the VSI-C2 can receive command, respond to commands, and receive messages from the UART link. When the Ready to Send (RTS) line is low, the VSI-C2 will not receive commands from the host computer and will enable the transmitter on the UART link.

5.3 UART Communications

To use the VSI-C2 for UART communications, use the following scenario:

1. Issue commands to the VSI-C2 to set up the diagnostic lines and the UART communications lines.

2. Issue the Enter UART Mode Command (Reference Section 4.13).

3. The host computer will now receive all UART communications.

4. To transmit on the UART link, set the RTS line low, send the UART message, and set the RTS line high after the last byte has been transmitted.

5. To change the UART communications line or diagnostic lines, keep the RTS line high and issue the correct command. The VSI-C2 will leave UART mode and acknowledge the command. To return to UART mode, issue the Enter UART Mode command.

APPENDIX A

Specifications

Microprocessor	Motorola MC68HC711K4FN 16 MHz Clock, 4 MHz Bus 24K On-Chip EPROM 640 Bytes On-Chip EEPROM 768 Byte On-Chip RAM Non-multiplexed Address and Data Bus 16-Bit Timer Serial Communication Interface Serial Peripheral Interface 8-Channel, 8-Bit A/D Converter 54 Bi-directional I/O pins
Memory	32K SRAM (no battery backup)
Serial Ports	1 RS-232 (8 data bits, no parity, 1 start bit 2 stop bits) 28.8K Baud Default 38.4K Baud Maximum
Vehicle Communications Links	General Motors SAE J1850 Multiplexed to one or two pins General Motors 8192/160 Baud UART Multiplexed to one or more of four pins
Diagnostic Line Control	5 Grounding Pins 1 Pin with 10K and 3.9K Resistor Grounding

Analog Inputs	8 Channels of 8-bit A/D 0 to +5V input 25 ms Scan Rate
Power	12 V DC @ 100 mA
Dimensions	4.5 in. x 4.5 in. x 1 in.
Operating Temperature	-40ºC to +85ºC

A.1 VSI-C2 Connector Pin Assignments

The VSI-C2 has four connectors, the pinouts for each connector are described in the following sections.

ALDL Connector

Pin	Assignment
1	Secondary J1850 bus or UART pin L1
2	Diagnostic Line 1
3 and 4	+12 VDC input
5	Diagnostic line 2
6	UART pin M
7	UART pin L2
8	Diagnostic line 0 (10K and 3.9K resistor capability)
9	No Connection
10	Diagnostic line 3
11	UART pin E
12	No Connection
13	12 V PWM Signal (Connected to Analog Input connector pin 12)
14	Primary J1850 bus
15 to 22	No Connection
23	Signal Ground
24	Chassis Ground
25	Diagnostic line 4

RS-232 Connector

Pin	Assignment
1	No Connection
2	RXD
3	TXD
4	DTR (low for normal operation, Pulsed high to reset VSI-C2)
5	Signal Ground

6	DSR
7	RTS (high for normal operation, low to enable SXR transmitter)
8	CTS
9	No Connection

A/D Input Connector

Pin	Assignment
1	Analog Channel 1
2	Analog Channel 2
3	Analog Channel 3
4	Analog Channel 4
5	Analog Channel 5
6	Analog Channel 6
7	Analog Channel 7
8	Analog Channel 8
9	J1850 bus
10	UART bus
11	No Connection
12	Connected to pin 13 of the ALDL connector
13 and 14	Signal Ground
15	+12 VDC filtered output, 500 mA maximum supply

Power Jack

Pin	Assignment
1	+12 V DC (inner contact)
2	Signal Ground (outer contact)

The VSI-C2 must be powered from the 12 volt input when power is not available from the 16 pin ALDL connector or when using the 12 pin adapter. Provided with the VSI-C2 is a Switchcraft power plug #760. Please follow the above pin assignments to connect the plug to an appropriate power source.

A.2 VSI-C2 ALDL Cable Wiring Diagram

The ALDL cable has two adapters: one for the 12-pin connector and one for the SAE J1962 16-pin connector. The following diagram gives the effective wiring for each adapter:

25 Pin Connector	12 Pin Adapter	16 Pin Adapter
1	F	1
2	C	3

3		16
4		16
5	G	8
6	M	9
7	L	7
8	B	6
9	J	14
10	H	12
11	E	10
12		15
13	D	11
14		2
15 to 22	No Connection	No Connection
23	A	5
24		4
25	K	13

A.3 VSI-C2 System Block Diagram

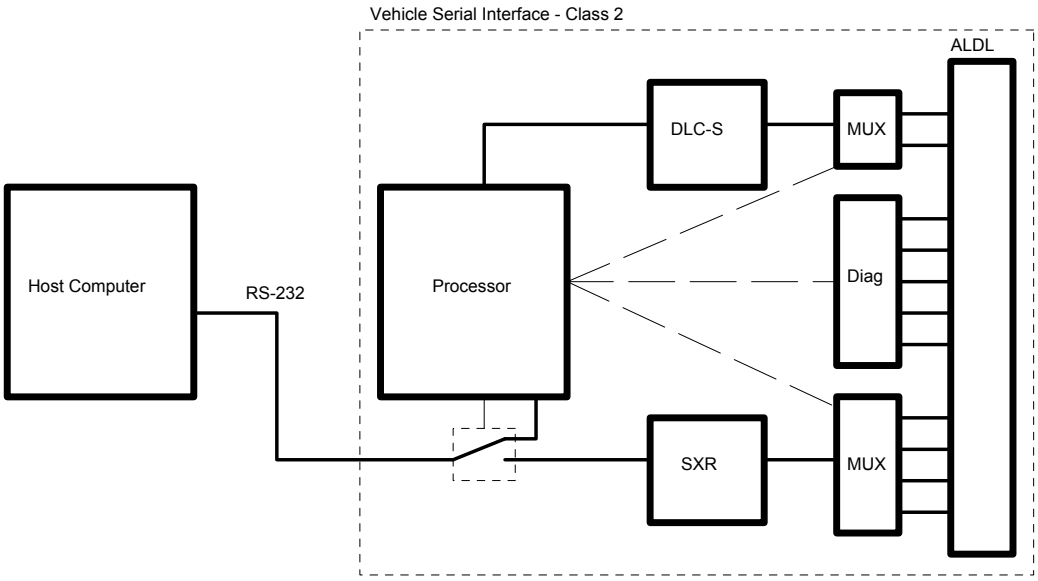

Figure 2. Vehicle Serial Interface - Class 2 System Block Diagram

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