

AUDIO SYSTEMS
DELPHI AUTOMOTIVE SYSTEMS CORPORATION

E&C to RS-232 Gateway
Systems Analysis INterface Tool (SAINT)
Users Guide

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Corrected title of 4.4.2.

Added section 4.4.5 “Example E&C Message”

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1 Introduction

1.1 Scope

This document describes the use and operation of SAINT Gateway with E&C firmware. This document is proprietary to Delphi Automotive Systems Corporation and cannot be copied in whole or in part without the express written consent of Delphi Automotive Systems Corporation.

1.2 Precedence

This document shall have precedence over any information in any other document. Between reference documents, the document with the later revision date shall have precedence.

1.3 Definitions and Nomenclature

Gateway - abbreviation for E&C to RS-232 Gateway.

SAINT - common nickname for the gateway (Systems Analysis Interface Tool).

Host - The computer which communicates to the gateway via RS-232 or USB.

USB - Universal Serial Bus

2 Overview

This document describes the operation of the E&C to RS-232 Gateway. The gateway is often referred to as the “SAINT gateway” or simply “SAINT”.

The following is synopsis of gateway features:

- Allows host system to communicate on E&C bus.
- Performs timing, access, arbitration, serialization, and error control.
- Configuration via host to gateway messages.
- LED status indicator array:
 1. Power LED (flashing LED)
 2. Bus Message LED (toggles upon receiving a valid bus message)
 3. Message Trigger LED (toggles upon receiving a specified byte pattern)
- Gateway to host status / error messages.
- Software is easily updated via a flash connector. Will eventually be done through the USB bus.

The following is a synopsis of requirements for use of the gateway:

Connection to power, ground, and busses to be monitored
RS-232 connection to host

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3 RS-232 Setup

The gateway uses the following RS-232 parameters:

- 8 Data Bits
- 1 Stop Bit
- No Parity

The gateway supported baud rate: 57600.

Baud Rate
57600

The supported baud rate is sufficient for communicating with the Class2, Keyword, ACP, BEAN, E&C and slower CAN bus's. However, USB connection is recommended for high speed CAN communications.

3.1 Buffering and Flow Control

Whenever the gateway receives a new message from the host, it will set the CTS line until the message can be processed. The host should not send data to the gateway while the CTS line is set. Due to the speed of the gateway processor, it is unlikely that the host will ever see the CTS line set.

The gateway buffers 64 bytes to send to the host. The gateway polls the RS-232 transmitter in the main loop to send data to the host. In some cases, the RS-232 transmit buffer will overflow. This should occur only when receiving CAN or IIC messages at a very fast rate. This will cause an ERc_RSFull error to be generated and the data to be lost.

4 Message Format

To minimize latency with the RS-232 link, all data is sent in binary form. The same data format is used to send and receive messages. The gateway supports bi-directional asynchronous communications.

4.1 Data Stream

The host data stream is broken into messages. A message consists of a Message ID and one or more data bytes.

The character FFh is used as an ESCAPE character to indicate the end of messages. There are three cases when an ESCAPE character is received.

If the ESCAPE character is followed immediately by a second ESCAPE character, the following are true:

- The message is not yet complete.
- The pair of ESCAPE characters represents a single byte of message data of value FFh.

If the ESCAPE character is followed immediately by a byte of value 00h, the following are true.

- The message is complete.
- Neither the FFh nor the 00h are part of the message.
- No more messages are ready to be sent.

If the ESCAPE character is followed immediately by of any value other than FFh or 00h, the following are true:

- The message is complete.
- Neither the ESCAPE character nor the character following the ESCAPE character are part of the message.
- The value following the ESCAPE character is the message ID for a new message.

This data stream format was chosen to allow arbitrary long messages (i.e. 4K Class 2 data blocks), to minimize the overhead to two bytes per message during peak traffic, and to immediately recognize the end of a message without having to wait for the next message to start.

After a gateway reset, the gateway will ignore all data until it sees an ESCAPE character. Once it has received a valid EOM, it will recognize the following message.

4.2 Messages IDs

Message IDs are one byte long and have the following general format:

Type (CAN, BEAN, ACP, Class 2, IIC, etc)	Command (Cmd=1)	Tx (1) / Rx (0)	Time Stamp (TS)
Bits 3 - 7	bit 2	bit 1	bit 0

The upper nibble indicates the type of message. The following types are defined:

- Gateway (08)
- Keyword 82 (10h)
- Keyword 71 (18h)
- IIC (20h)
- Keyword 2000 (28h)
- IDB (30)
- ACP (38h)
- E&C (40h)
- J1708 (48h)
- CAN (50h)
- Class2 (60h)
- Class2 Block (68h)
- SPI (70h)
- BEAN1 (90h)
- BEAN2 (98h)

Bits 3 to 7 identify the specific communication bus (i.e., Class 2, CAN bus, etc.). Bit 2 is used to designate a command or setup message when set to 1. Bit 1 is the transmit or receive bit with 1 designating transmit and 0 designating receive. Bit 0 is used to designate the Time Stamp. In general, report messages from the gateway use the same identifiers as commands to the gateway.

4.3 Gateway Messages

4.3.1 Gateway Commands

The SAINT Gateway supports the following commands:

Header	ID	Data	Description
08h	80h	None	Perform Reset
08h	86h	None	Turn Time Stamp Information OFF
08h	87h	None	Turn Time Stamp Information ON
08h	88h	None	Turn Transmit Echo ON
08h	89h	None	Turn Transmit Echo OFF
08h	92	None	Request Software Version
08h	F0h	D1-D12	Enable Gateway Trigger
08h	F1h	None	Disable Gateway Trigger

4.3.1.1 Reset

This command will cause the gateway to do a complete cold start. The gateway will ignore the next message.

4.3.1.2 Time Stamp

This command controls whether a 16 bit time stamp is appended to the end of the bus message reports.

4.3.1.3 Transmit Echo

This command controls whether transmitted messages are echoed back to the host when they are sent. *Echoed back messages will have their transmit bit set.*

4.3.1.4 Software Version Request

This command requests the gateway software version (ASCII).

4.3.1.5 Trigger

This command will cause the gateway to toggle the trigger LED upon receiving the specified byte pattern. Up to 12 data bytes may be used. This feature is helpful for triggering an oscilloscope. (Not available with IDB firmware)

4.3.2 Gateway Reports

The gateway will report a Reset whenever one occurs. Most likely causes of reset are power on reset, host commanded reset, or gateway micro watchdog error. The gateway does a cold start on all resets (all information is

lost). The gateway will also report error conditions with the Report Error message below. See section 4.3.2.1 for error code definitions.

The gateway will also echo back all system commands.

Header	ID	Description	Data Bytes
08h	80h	Reset Occurred	None
08h	82h	Report Error	1 byte Error Code
08h	86h	Report Time Stamp Information OFF	None
08h	87h	Report Time Stamp Information ON	None
08h	88h	Report Transmit Echo ON	None
08h	F0h	Report Gateway Trigger ON	1-12 bytes of Trigger Data
08h	F1h	Report Gateway Trigger OFF	None

4.3.2.1 Gateway Error Codes

Most error codes are related to sending data at the wrong rate (usually too fast).

Code	Description
80h	System - Invalid message ID
81h	System - RS-232 Transmit Buffer Full
82h	System - UART Error (Overrun, etc.)
83h	System – Received message is too long.
84h	System - Have not read previous message

4.4 E&C Messages

4.4.1 E&C Commands

There are no E&C commands at this time.

4.4.2 Transmitted E&C Messages

The following is the format for sending an E&C message:

40h	E&C 1	E&C 2	E&C 3	E&C 4	EOM 1	EOM 2
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	FFh	00h

For the example message of “ABCDEFGH IJKLMNOP QRSTUVWX YZabcdef” the bytes sent for E&C 1-4 are sent out as: “1GFEDCBA PONMLKJI XWVUTSRQ fedcbaZY” (where H is always a “1”)

The maximum accepted E&C message length is 4 bytes.

4.4.3 Received E&C Messages

The following is the format of a received E&C message without time stamp information:

40h	E&C 1	E&C 2	E&C 3	E&C 4	EOM 1	EOM 2
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	FFh	00h

The following is the format of a received E&C message with time stamp information:

41h	E&C 1	E&C 2	E&C 3	E&C 4	Time MSB	Time LSB	EOM 1	EOM 2
Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	8+N	9+N	FFh	00h

4.4.4 Length and Parity Bits

The last bit sent on the E&C bus is one’s parity (odd) and a zero bit may be added before the last bit to make the total number of bits even. This is handled by the SAINT firmware. All transmitted messages have these bits added and all received messages have these bits removed.

4.4.5 Example E&C Message

The following is an example of how to send an E&C Message and how it will look when echoed back from the SAINT Gateway.

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Suppose you want to read Address 1234

Request Data at Address (page 34 of E&C Diagnostic and Manufacturing Test Messages):

1pp 101j00 1101 aaaaaaaA bbbbbbbB S

The actual message would look like:

111 101000 1101 00101100 01001000 1 (according to the above, where pp=11; j=0; S=1)

Break this down in bytes:

11110100 01101001 01100010 01000100

F2 69 64 22 - Read each byte lsb (left) to msb (right)

However to send this out to the SAINT send:

2F 96 46 22 (msb is sent first onto the bus, also don't forget to send a 40h header byte)

Now the SAINT takes this message and REMOVES the first bit!

So you will see on your screen (echoed back from SAINT)

11101000 11010010 11000100 10001000 (same as above but everything shifted since first bit is removed)

71 B4 32 11

You will see on the SAINT Monitor:

17 4B 23 11

5 Connectors

The gateway uses two connectors. One connector is for the RS-232 link and is DB9F. The second connector is a DB9M for the CAN bus (low speed, medium speed, and high speed), Class 2 bus, Keyword, power, and ground. The following pin outs are used:

5.1 RS-232 Connector (J3-DB9F)

A straight pass cable should be used to connect the gateway to the host computer.

DE-9s Pin #	Use
2	TX to Host
3	RX from Host
8	CTS
6	DSR
5	GND

5.2 Bus and Power Connector for ACP Daughter Board 1.0 (J4-DB9M)

DE-9p Pin #	Use
1	Ground
2	ACP B
3	ACP A
4	NC
5	NC
6	NC
7	NC
8	NC
9	12 volt

5.3 Flash programming connector

Note: the long term goal is to Flash using the USB connector.

Connector J2 is used with an external connector – the intended application of this port is the flash programming of a product. The pin out of the connector J2 – flash programming connector - is as follows:

Pin #	Mnemonic	Use / description
Line up the connector label with the board pin label.	Osc1	External (to SAINT) oscillator
	Osc2	External (to SAINT) oscillator
	Vdd	Already connected to +5V on SAINT board
	Vss	Already grounded

6 LEDs

Four LEDs are used by the gateway. These LEDs are:

LED #	Purpose
4	NC (No Connection)
3	Trig (Toggled on specified message)
2	Pow (SAINT powered up)
1	Bus (Toggles on receiving an E&C message)

7 Switches

7.1 SW1 Transceiver Switches:

The following is a summary of the dip switches .

SWITCH #	Mnemonic	Purpose
1	NA	NA
2	NA	NA
3	NA	NA
4	NA	NA
5	NA	NA
6	NA	NA
7	NU	Not currently being used
8	NU	Not currently being used

7.2 SW2 Manual Reset:

SW2 is the manual reset switch. Pressing this switch will change an input to the SAINT microprocessor, causing it to start executing the embedded code from some predetermined start state.

