



SURFACE VEHICLE RECOMMENDED PRACTICE

J2534™-2/10_0500

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Pass-Thru Extended Feature - Analog Input

RATIONALE

Each of the features contained in the original SAE J2534-2 document (API version 04.04) is being published as a separate document for ease of maintenance and extensibility. At the same time, these features are being updated to be compatible with SAE J2534-1_0500 (API version 05.00) and to address feedback from the field.

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Documents

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1. SCOPE

This SAE Recommended Practice is part of the SAE J2534-2/X_0500 set of documents that extends the SAE J2534-1_0500 API (version 05.00) specification, and defines how to implement analog input within the SAE J2534 API framework. This document details only the changes from SAE J2534-1_0500 and items not specifically detailed in this document are assumed to have not changed.

An SAE J2534-2/10_0500 interface shall be compliant to the analog input feature only when all the required functionality in this SAE Recommended Practice is implemented. Any functionality not required for compliance will be specifically marked as “optional” in this document.

This document must be used in conjunction with the SAE J2534-2/BA_0500 and SAE J2534-2/RE_0500 documents.

2. REFERENCES

2.1 Applicable Documents

The following publications form 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 Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J2534-1_0500 Recommended Practice for Pass-Thru Vehicle Programming (API version 05.00)

SAE J2534-2/BA_0500 Pass-Thru Extended Features - Base Document (API version 05.00)

SAE J2534-2/RE_0500 Pass-Thru Extended Features - Resource Document (API version 05.00)

3. DEFINITIONS

IOCTLID: Identifier assigned to a specific IOCTL.

ACTIVE ANALOG SIGNAL: Refers to an analog signal that has been selected to have its input voltage measure and passed to the application via the PASSTHRU_MSG structure.

ANALOG CHANNEL: Refers to hardware in the pass-thru device that can measure the voltages of up to 32 analog signals.

ANALOG READING: Refers to the resultant voltage created by mathematically processing one or more samples of an analog signal.

ANALOG READING SET: Refers to a set of readings (with a common timestamp) that consists of one analog reading from each active analog signal.

ANALOG SIGNAL: Refers to a single analog input whose voltage can be measured by an analog channel.

PASS-THRU DEVICE: Refers only to the hardware portion of the SAE J2534 pass-thru interface.

PASS-THRU INTERFACE: Refers to all components of a SAE J2534 interface, including both physical hardware and software.

SAMPLE: Refers to a single voltage measurement of a single analog signal.

4. ACRONYMS

API Application Programming Interface

DLL Dynamic Link Library

IOCTL Input/Output Control

5. DOCUMENTATION CONVENTIONS

In the document body and in tables:

- All SAE J2534 API functions shall be in bold print (for example, **PassThruOpen**).
- All SAE J2534 API variables shall be enclosed in "<>" (for example, <DeviceID>).
- All SAE J2534 API DEFINES shall be in upper-case print (for example, STATUS_NOERROR).
- All number shall be in decimal unless otherwise indicated. (Hexadecimal values shall have a leading "0x"; for example, 0x7AF or 0x800 are hexadecimal values.)

6. PASS-THRU INTERFACE REQUIREMENTS

The analog input protocol shall be implemented as a physical communication channel and cannot be implemented on a logical communication channel.

The analog interface shall allow between 1 and 1024 analog signals. They shall be grouped into multiple analog channels, each containing up to 32 analog signals. Each analog channel shall have its own set of configurable parameters that apply to all analog signals in that analog channel. These configuration parameters define how analog signals will be sampled and how the samples will be processed.

There is no requirement that all analog channels have the same number of analog signals, voltage ranges, bandwidth, accuracy, input impedance, etc. Additionally, this API does not specify how the pass-thru interface collects analog samples, the timing between analog channels, or the physical connection to outside world. These details must be specified by the pass-thru interface manufacturer.

6.1 Specific Protocol Requirement

A pass-thru interface that supports the analog inputs shall:

- Contain one or more analog channels, where each analog channel is comprised of 1 to 32 analog signals. The number of analog signals may vary from channel to channel.
- Support a configuration parameter to identify which analog signals in an analog channel are to be sampled.
- Support a configuration parameter to define the period of time between samples of analog signals on an analog channel.
- Support a configuration parameter to define the number of samples of an analog signal that will be used to generate an analog reading.
- Support a configuration parameter to define the mathematical process to be used to generate an analog reading (e.g., simple average, min, max, or median).
- Support a configuration parameter to define the number of analog readings that will be placed in a single PASSTHRU_MSG.
- Use a common time-base when generating timestamps for all analog channels.
- Minimize the time it takes to sample the selected analog signals so that they are collected as close together as possible.

6.2 Pin Usage

The analog signals are hardwired to connector(s) on the SAE J2534 device. The mapping of the analog signals to analog channels as well as pin connections, input impedance, and voltage range shall be defined and documented by the SAE J2534 interface manufacturer.

Applications should query the interface using the discovery mechanism to determine if the analog input protocol is supported.

6.3 Data Buffering

6.3.1 Message Reception

An analog input channel shall provide a receive buffer as specified in [Table 1](#) and shall be capable of receiving and buffering messages while the receive buffer is not full. The number of messages buffered will depend on the analog channel's settings. This capability shall be available on each channel at all supported sample rates.

Table 1 - Minimum receive buffer size

Maximum Size of Each Message	Minimum Receive Buffer Size
4128	4128 bytes

6.3.2 Message Transmission

Message transmission does not apply to analog input.

6.4 Error Handling

6.4.1 Device Not Connected

As defined in SAE J2534-1_0500.

6.4.2 Receive Buffer Overflow

As defined in SAE J2534-1_0500.

6.4.3 Message Termination

Message termination does not apply to analog input protocol.

6.4.4 Network Errors

The pass-thru interface shall be capable of detecting receive errors. To deal with these errors, generic recovery strategies have been defined SAE J2534-1_0500. [Table 2](#) details the types of errors to be detected and the associated recovery strategy, as well as the required application notification mechanism that shall occur at the end of the designated recovery strategy.

Table 2 - Network errors

Error	User Notification	Recovery Strategy
Overflow error	Set BUFFER_OVERFLOW in RxStatus	Drop strategy as defined in SAE J2534-1_0500

7. WIN32 APPLICATION PROGRAMMING INTERFACE

7.1 API Changes

[Table 3](#) summarizes the changes to the SAE J2534-1_0500 API functions for this feature. The pass-thru API DLL must include entry points for all functions, regardless of whether or not the API function call is used for this feature.

Table 3 - SAE J2534 API functions

Function	Description
PassThruScanForDevices	Function implementation independent of this feature
PassThruGetNextDevice	Function implementation independent of this feature
PassThruOpen	As defined in SAE J2534-1_0500
PassThruClose	As defined in SAE J2534-1_0500
PassThruConnect	Added new <ProtocolID> values
PassThruDisconnect	As defined in SAE J2534-1_0500
PassThruLogicalConnect	This function shall always return an error (applicable error values defined in SAE J2534-1_0500)
PassThruLogicalDisconnect	As defined in SAE J2534-1_0500
PassThruSelect	As defined in SAE J2534-1_0500
PassThruReadMsgs	As defined in SAE J2534-1_0500
PassThruQueueMsgs	This function shall always return an error (applicable error values defined in SAE J2534-1_0500)
PassThruStartPeriodicMsg	This function shall always return an error (applicable error values defined in SAE J2534-1_0500)
PassThruStopPeriodicMsg	As defined in SAE J2534-1_0500
PassThruStartMsgFilter	This function shall always return an error (applicable error values defined in SAE J2534-1_0500)
PassThruStopMsgFilter	As defined in SAE J2534-1_0500
PassThruSetProgrammingVoltage	Function implementation independent of this feature
PassThruReadVersion	Function implementation independent of this feature
PassThruGetLastError	Function implementation independent of this feature
PassThruIoctl	Added discovery mechanism and configuration

To the application, each analog input channel appears like any other vehicle protocol channel. An analog input channel will periodically generate PASSTHRU_MSG structures which are placed in the receive queue where the application can read them using **PassThruReadMsgs**.

7.2 Message Structure

7.2.1 C/C++ Definition

The PASSTHRU_MSG structure, defined in SAE J2534-1_0500, shall be used for analog input messages.

```
typedef struct {
    unsigned long ProtocolID;
    unsigned long MsgHandle;
    unsigned long RxStatus;
    unsigned long TxFlags;
    unsigned long Timestamp;
    unsigned long DataLength;
    unsigned long ExtraDataIndex;
    unsigned char *DataBuffer;
    unsigned long DataBufferSize;
} PASSTHRU_MSG;
```

7.2.2 Description of Structure Elements

<ProtocolID>	ANALOG_IN.
<MsgHandle>	As defined by SAE J2534-1_0500.
<RxStatus>	The receive message status. See 7.2.2.1 for more details.
<TxFlags>	The transmit message flags. See 7.2.2.2 for more details.
<Timestamp>	As defined by SAE J2534-1_0500.
<DataLength>	As defined by SAE J2534-1_0500.
<ExtraDataIndex>	As defined by SAE J2534-1_0500.
<DataBuffer>	As defined by SAE J2534-1_0500.
<DataBufferSize>	As defined by SAE J2534-1_0500.

7.2.2.1 RxStatus

Analog Inputs shall support only the <RxStatus> bits defined in [Table 4](#). All unused bits shall be set to zero.

Table 4 - RxStatus bit definitions

Name	Description	Value
BUFFER_OVERFLOW	Indicated that the channel had a buffer overflow (refer to SAE J2534-1_0500 for more details)	0 = No buffer overflow 1 = Buffer overflow occurred prior to this message - data was lost

7.2.2.2 TxFlags

The analog input protocol does not use <TxFlags> bits. They shall all be set to zero.

7.2.2.3 ExtraDataIndex

The configuration parameter ACTIVE_SIGNALS shall be appended to the end of the analog readings and shall be treated as “extra data.” The <ExtraDataIndex> shall always be equal to (<DataLength> - 4) for network messages passed from the SAE J2534 API.

7.2.3 Protocol Specific Details

PassThruReadMsgs:

- Minimum message size is: 8.
- Maximum message size is: 4128.