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## Protocol Description

### 1. General

The protocol SAE J1939 is based on CAN.

The documents SAE J1939/1x describe its structure; Chapter 3 contains a general description.

The pressure transducers are of the ECU-type I. Thus, they do not include bus termination resistors.

### 2. Abbreviation index

CAN	Controller Area Network
DA	Destination Address
ECU	Electronic Control Unit
PDU	Protocol Data Unit
PGN	Parameter Group Number
SA	Source Address
SAE	Society of Automotive Engineers
SPN	Suspect Group Number

### 3. Can bus topology

The CAN bus is a linear structure (see 1).

All data are transferred in differential mode using two electrical lines (CAN high, CAN low).

On both of its ends, the bus requires a termination network (each resistor,) to provide a defined idle state.

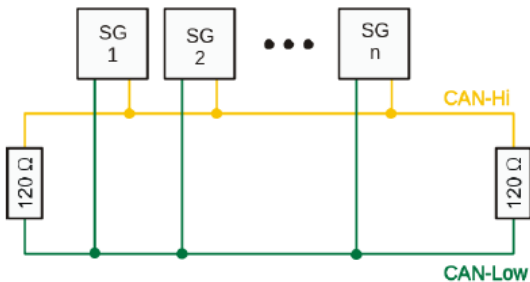


Figure 1:  
Linear CAN bus topology with terminating resistors [1]

For a limited extent, bus stubs may be used for realizing a star topology. Be aware that in this case, the terminating resistors have to be adjusted.

In combination with the protocol SAE J1939, the bus nodes are called ECUs.

### 4. Bit rate

The default bit rate is set to 125kBit/s. For special applications, different bit rates can be realized.

### 5. Network Management

The network management for SAE-J1939 is described in the document “J1939/81”. In default settings state, the pressure transducer fulfils the minimal requirements for “resolving address conflicts” and “checking for multiple device addresses”. Furthermore, it supports the automatic address alteration during runtime.

The fields for a clear determination of the devices’ functions may be assigned according to the customer’s needs.

### 6. CAN Message Format

2 depicts the CAN message format when using SAE J1939. The CAN-ID contains message priority, PGN and source address.

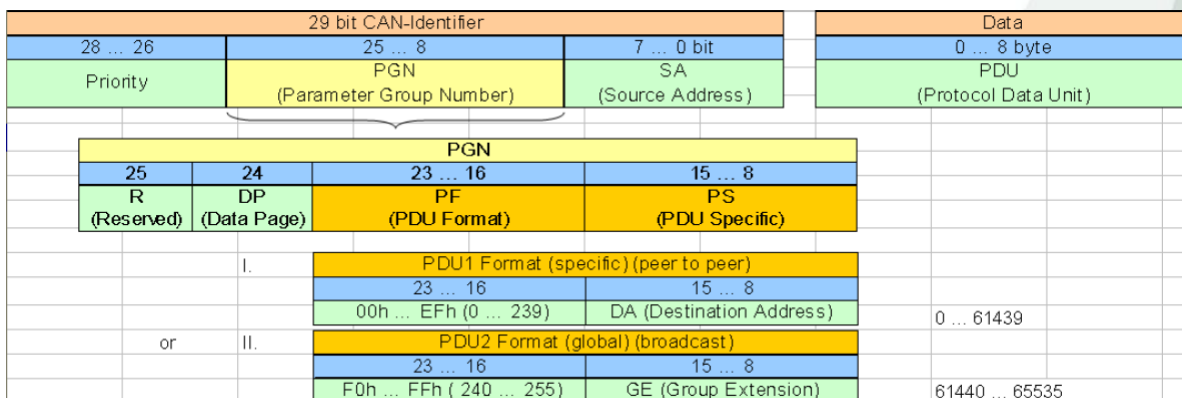


Figure 2: CAN Message Format with SAE J1939

### 6.1 Parameter Group Number (PGN)

The Parameter Group Number (PGN) consists of the fields “R” (*Reserved*), “DP” (*Data Page*), “PF” (*PDU Format*) and “PS” (*PDU Specific*). The first two fields (“R” and “DP”) are not used within the default parameter set and both do contain zeros. Document SAE J1939/71 defines various PGNs. Each of them has specifically structured payload and other parameters (e.g. repetition time).

The usage of proprietary data formats is possible, as long as the field “PF” is assigned the values 239 (*PGN Proprietary A*) or 255 (*PGN Proprietary B*).

#### 6.1.1 PGN proprietary a

This PGN is used when transferring data in a targeted manner. The field “PS” declares the destination address.

#### 6.2.2 PGN proprietary b

Broadcast messages use the PGN Proprietary B. In this case, the field “PS” declares supporting payload data formats.

## 7. Payload formats

The user data format must be interpreted according to the used PGN. A PGN may contain one or more SPNs (Suspect Parameter Numbers). The SPN data structure is described by SAE J1939/71. The pressure transducers by default do use a proprietary data format.

### 7.1 Interpreting the transmitted pressure values

Each message’s data field length is 8 bytes. The first two bytes contain the pressure value; the following bytes are assigned 255 (0xFF). The MSB (Most Significant Byte) will be sent at first (*known as Big Endian*).

Received data need to be multiplied with the Resolution. Subsequently, the Offset is subtracted. Both Resolution and Offset can be found in the pressure transducer’s datasheet.

Example:	■	Pressure transducer:	-1...10 bar
	■	Resolution:	0,01 bar / bit
	■	Offset:	1 bar
	■	Pressure:	9,00 bar
	■	Data bytes (HEX notation):	0x03 0xE8 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF
	■	Relevant data bytes:	0x03 E8 = 1000 <sub>decimal</sub>
	■	Calculation:	$\begin{aligned} \text{Pressure} &= \text{Pressure}_{\text{Digital}} \cdot \text{Resolution} - \text{Offset} \\ &= 1000 \cdot 0,01 \text{ bar} - 1 \text{ bar} \\ & \qquad \qquad \qquad \text{bit} \\ &= 9 \text{ bar} \end{aligned}$

### 8. The default settings set

The following table shows the pressure transducers' default settings set. They may vary with some articles' configurations. The valid parameters can be found in transducers datasheet.

Parameter	default value	Meaning
Transmission baud rate	125 kBit/s	Transmission speed
Start address	208 (0xD0)	Assigned address to boot up time
PGN	65330 (0xFF 32)	Parameter number of data
Priority	7	Message priority (0= highest)
Transmittion cycle time (also repetition time)	100 ms	Repetition time of the pressure messages
SPN	According to pressure range	Describes data interpretation
Manufacturer ID	455 (0 x 00 00 04 05)	Manufacturer ID of Variohm Eurosensor
ECU Instance	1	these fields hold the device's function within the system
Function Instance	3	
Function	4	
Industry Group	5	
Vehicle System	7	
Vehicle System Instance	1	
Arbitrary Address Capable	1	Automatic address obtaining enabled

### 9. Remarks

The behaviour described in this document corresponds to the internal standard of Variohm Eurosensor.

It is possible to alter the behaviour according to the customer's needs, so that the pressure transducer may be installed easily to the target application.

### 10. Bibliography

[1]

Stefan-Xp, "Wikimedia Commons (CC BY-SA 3.0)," 24 Nov. 2016. [Online]. Available: <https://commons.wikimedia.org/w/index.php?curid=3607670>.