Content

1 CAN SAE J1939

1.1 J1939 Interface Description

The J1939 interface uses the 29 bits CAN-ID according ISO 11898. The identifier contains the following general information:

Name	Priority	Extended data page	Data page	PDU format	PDU specific (Destination address)	Source address
Length	3 bits	1 bit	1 bit	8 bits	8 bits	8 bits
Description	Message latency for transmission, 0=high ... 7=low			To determine PGN (mid byte of PGN)	PDU Format < 240: destination address PDU Format ≥ 240: group extension	Unique address
Value	6	0	0			128

The entire frame format PDU contains the identifier (29 bits) and the data section (8 byte):

Identifier					Data Bytes (0 ...64 bits)							
Priority	PGN (18 bits)			Source address	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Data page	PDU format	Destination address									

1.2 Address Claiming (ACL)

Dynamic address claiming is supported. The sensor starts the claiming with the default source address 128.
If an address conflict with a higher prior source address occurs, the network management will increase the source address automatically by 1 until 247 is reached. If no free source address is available, the sensor will use address 255 and does not actively send data onto the bus, it can only be addressed using broadcast messages.

The new claimed address is used temporary only. After power on, the default source address is 128 again.

For use in networks with fixed address assignment, the dynamic address claiming can be deactivated and the start address can be changed by the user with the command "set start address" to the desired source address (128 ... 247, see chapter 1.5 Configuration Data).
The new start address remains even after power off if using the command "Store PGN Configuration".

1.3 Device Name / Name Field

Data in the Name field is not changeable by the user.

Name	Value	Description
Arbitrary address capable	1 / 0	1 = Yes, 0 = No
Industry Group	0	Global
Vehicle System Instance	0	
Vehicle System	127	Non specific
Reserved	0	
Function	255	Non specific
Function Instance	0	
ECU Instance	0	
Manufacturer	851	Manufacturer ID
Identity Number	> 0	Unique No.

1.4 PGN Default Definitions

1.4.1 Process Data - Message Content PGN 65450

After the sensor has claimed a source address, the measured position values will be sent automatically with a "Proprietary B" PGN message.
It is also possible to request the process data message (Configuration PGN and Reponse PGN see chapter 1.5 and 1.6) .
The process data message PGN 65450 contains the process data Rotary Position (P), Velocity (V), Revolution Counter (U) and Status.

	Byte 7		Byte 6		Byte 5		Byte 4		Byte 3		Byte 2		Byte 1		Byte 0	
Sensor Type Redundancy	Bit 7 ... 4	Bit 3 ... 0	Bit 7 ... 4	Bit 3 ... 0	Bit 7 ... 4	Bit 3 ... 0	Bit 7 ... 4	Bit 3 ... 0	Bit 7 ... 4	Bit 3 ... 0	Bit 7 ... 4	Bit 3 ... 0	Bit 7 ... 4	Bit 3 ... 0	Bit 7 ... 4	Bit 3 ... 0
Single PVU	Revolution Counter (Incremental, 32 bits)								Status (4 bits)	Velocity (12 bits)			Rotary Position (16 bits)			
Redundant PPVV	Velocity Ch. 2 (12 bits)			Velocity Ch. 1 (12 bits)			Status (8 bits)		Rotary Position Channel 2 (16 bits)				Rotary Position Channel 1 (16 bits)			
Redundant PPU	Revolution Counter (Incremental, 24 bits)						Status (8 bits)		Rotary Position Channel 2 (16 bits)				Rotary Position Channel 1 (16 bits)			

1.4.2 Definition of the Signals (SLOT)

Position values:

Data length	16 bits (unsigned value)
Resolution	Configurable: Range/Resolution (e.g. 360°/14 bits = 0,022° / bit)
Range	0 … 360°
Offset	0 °
Transfer Function	Position [°] = (Data * Resolution) - Offset

Velocity values:

Data length	12 bits (signed value)		
Resolution	Configurable: Range/Resolution/ms / bit		
	Min. 1 LSB = 0,055°/s	up to	1 LSB = 2,2°/s
Range	Min. -18,75 ... 18,75 rpm	up to	-750 ... 750 rpm
Transfer Function	Velocity [°/ms] = (Data * Resolution)		

Revolution counter values:

Data length	PVU: 32 bits (signed value), PPU: 24 bits (signed value)
Resolution	1 turn/bit
Range	PVU: -2.147.483.648 ... 2.147.483.648 turns, PPU: -8.388.608 ... 8.388.608 turns
Transfer Function	Number of turns = (Data * Resolution)

1.5 Configuration Data - Parameter Mode PGN 61184 + Source Address

The reading and writing of parameters and the triggering of defined actions is done by Configuration PGN 61184.
The PGN includes the sensor source address in the last byte for a peer-to-peer communication.
Each configuration operation is answered with a ACK response.

1. Index 1: Configuration

Name	Range	Default	Size	Read Write	Description
Preset [°]	0 ... (2^14)-1)	0	16 bits	rw	Position offset positive values, 1 bit = 0,022° A new written offset will be valid immediately.
Filter average	000 ... 111 (2^n, n = 0 ... 7)	0	3 bits	rw	Value count for average filter (moving average function for position and speed calculation) 0: moving average function off (2^0) 001 ... 111: moving average over 2^n values (n= 1 ... 7) A new written filter average will be valid immediately.
Counting direction	0, 1	0	1 bit	rw	Switch of counting direction. The counting direction clockwise (cw) or counterclockwise (ccw) defines whether the signal values are rising or falling when sensor shaft or position marker is rotated cw (view on the position marker or shaft). 0: CW 1: CCW A new written value will be valid immediately.
Resolution velocity [°/s]	00, 01, 10	00	2 bits	rw	Resolution velocity, independent of position resolution. For redundant outputs, it is effective at once for both channels. 00: fast, 1 LSB = 2,2°/s, max. speed 750 rpm 01: medium, 1 LSB = 0,22°/s, max. speed 75 rpm 10: slow, 1 LSB = 0,055°/s, max. speed 18.75 rpm A new written resolution will be valid immediately.
Resolution position [bits]	00, 01, 10	00	2 bits	rw	Measuring steps per turn. For redundant outputs, it is effective at once for both channels 00: 14 bits 01: 13 bits 10: 12 bits A new written resolution will be valid immediately.
Arbitrary address capable	0, 1	0	1 bit	rw	0: Dynamic address claiming 1: Dynamic address claiming deactivated, fixed source address has to be set (“set start address”) A new written value is not effective before reboot !
Baud rate [kBaud]	0, 1	0	1 bit	rw	Transmission rate 0: 250 kBaud 1: 500 kBaud A new written baud rate is not effective before reboot !
Transmit mode	0, 1	0 (Timer)	1 bit	rw	0 = Timer: process data is sent cyclically with the selected transmission repetiton mode 1 = Request: process data is only sent after a remote request Event triggered transmission of process data is not supported. A new written transmit mode will be valid immediately.
Transmit cycle	00, 01, 10, 11	10 (50 ms)	2 bits	rw	00 = 10 ms 01 = 25 ms 10 = 50 ms 11 = 100 ms A new written transmit cycle will be valid immediately.
Set start address	128 ... 247	-	8 bits	rw	Address claiming: desired start address can be set

To write parameters, the 8 data bytes must contain the complete configuration (Byte 0 to Byte 7).
Newly written parameters are stored non volatile with the defined action “Store Configuration” .

Programmable Parameters	**Index**	**Basic Configuration**										**empty**		**Interface Configuration**															
	Byte 0	Byte 1	Byte 2	Byte 3								Byte 4	Byte 5	Byte 6								Byte 7							
	-	Bit 0...7	Bit 0...7	0	1	2	3	4	5	6	7	Bit 0...7	Bit 0...7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
Preset position (Offset)	1	0 … (2^14)-1																											
Filter average	1			000 … 111																									
Counting direc-tion	1						0/1																						
Resolution velocity	1							00/01/ 10																					
Resolution position	1									00/01/10																			
Arbitrary address capable	1																	0/1											
Switch baudrate	1																0/1												
Transmit mode	1															0/1													
Transmit cycle	1													00,01, 10,11															
Set Start address	1																					128 ..247							

2. Index 0: Trigger flags
To trigger a defined action, the 8 data bytes have to contain the following trigger flags in index 1 byte 1:

Defined actions **0: no action 1: execute**	**Index**	**Trigger Flags**							**empty**
	Byte 0	Byte 1							Byte 2 ... 7
	-	0	1	2	3	4	5	6	7	Bit 0 ... 7
Store PGN Configuration	0	0/1								
Reset of Status Bits	0		0/1							
Sensor reboot (like Power OFF/ON, wait 200 ms until further actions)	0			0/1						
Reserved for internal use – do not address	0				0/1					
Zero Counter (reset counter, will be valid immediately)	0					0/1				
Store Counter (current revolution value will be stored non-volatile and is put out after reboot as start value)	0						0/1			
Read Configuration PGN	0								0/1	

Important Note:

- Only one trigger flag can be set in each operation! If more than one trigger flag is set, there is no action executed.
- If the trigger flag “Read Configuration PGN” is set, it is answered by the PGN Response “Configuration”

1.6 Response PGN 65452

Each configuration operation is answered with a ACK response or with the requested data (actual used configuration) by Response PGN 65452 (8 bytes).

	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Acknowledge ACK	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Configuration	Index	Basic Configuration			empty		Interface Configuration	

1.7 Request Commands

In the sensor, requests are implemented for Name Identification, Process Data Message, Software Identification (firmware version) and Component Identification (serial number).

SA: Sensor Source Address **MA**: Master Source Address

1.7.1 Name Identification PGN 60928 0x00EE00

Request

COB-ID	Read/ Transmit	Size	Data							
			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x00EA**SAMA**	Rx	3 Bytes	0x00	0xEE	0x00	-	-	-	-	-

Name Identifcation

COB-ID	Read/ Transmit	Size	Data							
			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x18EEFF**SA**	Tx	8 Bytes	Identity number (21 bits)	Identity number (21 bits)	Identity number (21 bits) / Manufacturer Code (11 bits)	Manufacturer Code (11 bits)	ECU Instance (3 bits) / Function Instance (5 bits)	Function (8 bits)	Reserved (1 bit) / Vehicle System (7 bits)	Vehicle System Instance (4 bits) / Industry Group (3 bits) / Arbitrary Address Capable (1 bit)

1.7.2 Process Data Message PGN 65450 0x00FFAA

Request

COB-ID	Read/ Transmit	Size	Data							
			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x00EA**SAMA**	Rx	3 Bytes	0xAA	0xFF	0x00	-	-	-	-	-

Process Data Message:

COB-ID	Read/ Transmit	Size	Data							
			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x18FFAA**SA**	Tx	8 Byte	see chapter 1.4.1							

1.7.3 Software Identification PGN 65242 0x00FEDA

Request

COB-ID	Read/ Transmit	Size	Data							
			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x00EA**SAMA**	Rx	3 Bytes	0xDA	0xFE	0x00	-	-	-	-	-

Software Identification

COB-ID	Read/ Transmit	Size	Data							
			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x18FEDA**SA**	Tx	8 Bytes	0x00	Major SW version	Minor SW version	Sensor process data configuration	Product code		0x00	0x00

Sensor process data configuration in byte 3 (see chapter 1.4.1):
0x00: PVU (1x position, 1x speed, 1x counter)
0x01: PPVV (2x position, 2x speed)
0x02: PPU (2x position, 1x counter)

Product code:
0x0C44: RFC-4800 series,
0x0C57: RSA-3200 series
0x0C21: RFE-3200 series

1.7.4 Component Identification PGN 65259 0xFEEB00

Request

COB-ID	Read/ Transmit	Size	Data							
			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x00EA**SAMA**	Rx	3 Bytes	0xEB	0xFE	0x00	-	-	-	-	-

Component Identification

COB-ID	Read/ Transmit	Size	Data							
			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x18FEEB**SA**	Tx	8 Bytes	Serial number (xxxxxx batch no. + yyy consecutive number, same B/N as on product label)				0x00	0x00	0x00	0x00

1.8 Diagnosis

1.8.1 Process Data in Error Case

Position value: HEX 0x7FF0
Velocity value: 0
Revolution counter: last value

1.8.2 Sensor Status

A flag is set if an error or warning has occurred since the last reboot or flag reset.
Caution: please be aware that the error flags are once set, they are not being reset automatically !

- **Single output (see 1.4.1: PVU):** the sensor status is flagged in last 4 bits of Byte 3.

Sensor Data	Byte 3			
	Bit 4	Bit 5	Bit 6	Bit 7
	Internal system error	Position marker missing or out of signal range	Revolution counter	Speed limit over-flow
Normal functionality, all values are valid	0	0	0	0
Error	1	1	1	1

- **Redundant output (see 1.4.1: PPVV, PPU):** the sensor status is flagged in 8 bits of Byte 4.

Sensor Data	Byte 4				
	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4 ... 7
	Internal system error	Position marker missing or out of signal range	Revolution counter	Speed limit over-flow	Not used
Normal functionality, all values are valid	0	0	0	0	
Error	1	1	1	1	

1.9 Network Termination

Optionally, models with internal 120 Ω network termination resistor inside the sensor are available.

1.10 Abbreviations

ACL	Address Claiming
CAN	Controller Area Network
Ch	Channel
MA	Master Address
P	Position
PD	Process Data
PDU	Process Data Unit
PG	Parameter Group
PGN	Parameter Group Number
rw	Read Write
ro	Read only
SLOT	**S**caling, **L**imit, **O**ffset and **T**ransfer Function
SA	Source address
V	Velocity

1.11 Document Changes

Revision	Changes	Date	Who
V00	First edition	23.04.19	VM/mm
V01	1.4.1 Process Data: more detailed presentation of bit format (sequence of bits rotated)	17.06.19	VM/mm