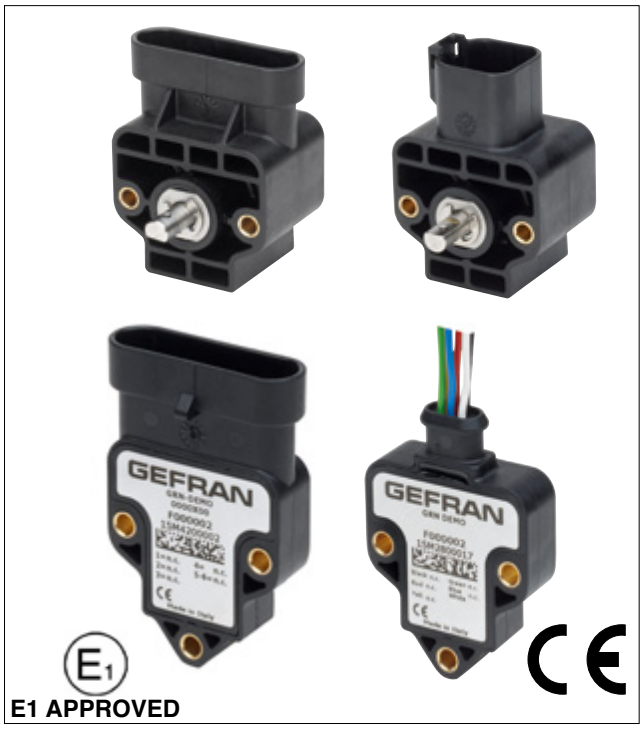
GEFRAN

# SAE J1939 GRA-GRN

## digital output




**E1 APPROVED**

**Code** 80526B **Edition** 03-2019

## SUMMARY

## 1. SCOPE

This document represents a Gefran SAE J1939 definition for Hall-effect single turn rotary sensors.

## 2. ABBREVIATIONS AND TERMS

*Table 1. Abbreviations and terms.*

| Abbreviation / Term | Definition or Meaning |
|---|---|
| SAE | Society of Automotive Engineers |
| ECU | Electronic Control Unit |
| CA | Controller Application |
| PDU | Protocol Data Unit |
| NMT | Network Management |
| PGN | Parameter Group Number |
| AC | Address Claiming |
| MSB | Most Significant Byte |
| LSB | Least Significant Byte |
| SOF | Start Of Frame |
| RTR | Remote Transmission Request |
| CRC | Cyclic Redundancy Check |
| ACK | Acknowledgment |
| EOF | End Of Frame |
| SRR | Substitute Remote Request |
| IDE | Identifier Extension |
| POST | Power On Self Test |
| CW | Clockwise |
| CCW | Counterclockwise |

## 3. REFERENCE DOCUMENTS

*Table 2. J1939 sub standards.*

| Document | Contents |
|---|---|
| J1939 – Recommended Practice for a Serial Control & Communications Vehicle Network | |
| J1939/11 – Physical Layer – 250k bits/s, Shielded Twisted Pair | Bus physical properties. |
| J1939/13 – Off-Board Diagnostic Connector | Standard connector for diagnostic purpose. |
| J1939/21 – Data Link Layer | CAN frame (29-bit identifier, PGN etc.), transport protocol functions, and 5 types of message types: Commands, Requests, Broadcasts/Responses, Acknowledgment, and Group Functions. |
| J1939/31 – Network Layer | Services and functions needed for intercommunication between different segments of a J1939 network. |
| J1939/71 – Vehicle Application Layer | Standard parameters which are grouped together in a message frame and given a PGN. |
| J1939/73 – Application Layer – Diagnostics | Functions and messages for accessing diagnostic and calibration data. |
| J1939/81 – Network Management | Information about the content of an ECU Name and how the ECU claims an addressing using that Name. |

## 4. ELECTRICAL CONNECTIONS AND BLOCK DIAGRAM

*Table 3. DEUTSCH version with shaft: connections.*

| DEUTSCH DT04-6P | Meaning |
|---|---|
| 1 | OV (GND) |
| 2 | +Vs (+9 … +36 Vdc) |
| 3 | NC |
| 4 | NC |
| 5 | CAN-L |
| 6 | CAN-H |

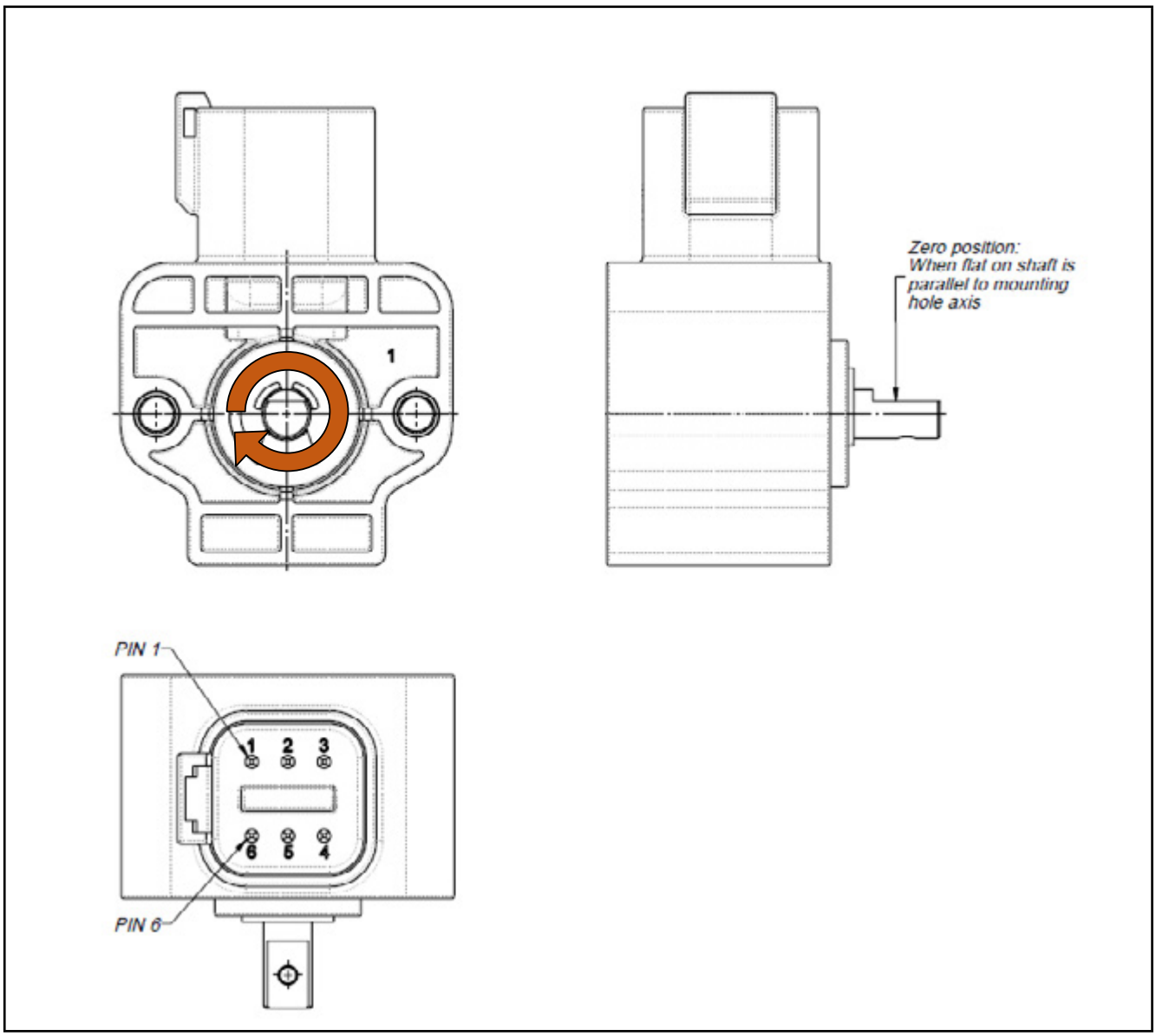



*Figure 1. Mechanical drawings of Gefran Hall-effect rotary sensor: DEUTSCH version with shaft.*

*Table 4. AMP version with shaft: connections.*

| AMP Superseal 6 P 282108-1 | Meaning |
|---|---|
| 1 | OV (GND) |
| 2 | +Vs (+9 … +36 Vdc) |
| 3 | NC |
| 4 | NC |
| 5 | CAN-L |
| 6 | CAN-H |

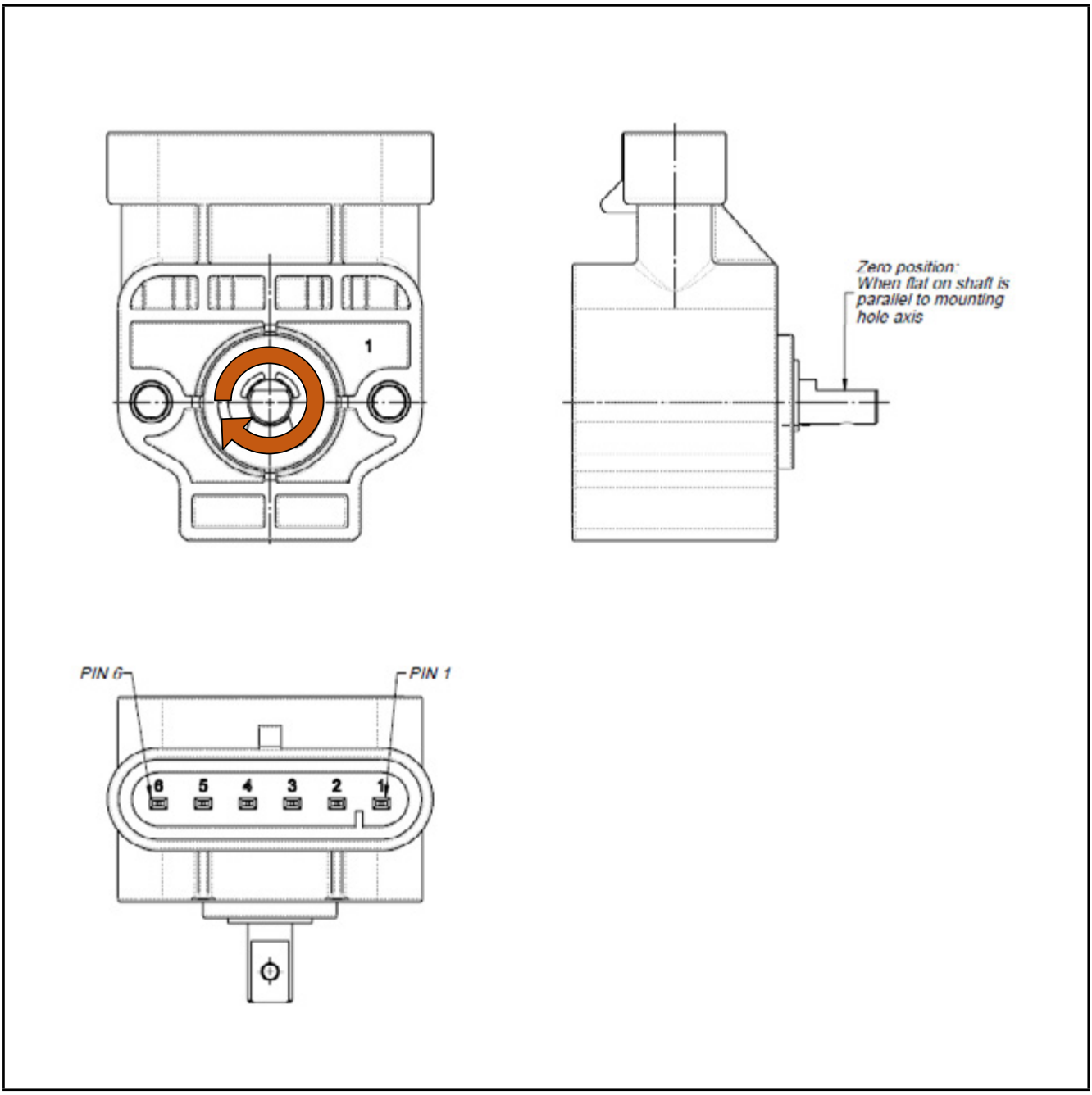



*Figure 2. Mechanical drawings of Gefran Hall-effect rotary sensor: AMP version with shaft.*

*Table 5. MP version without shaft: connections.*

| AMP Superseal 6 P 282108-1 | Meaning |
|---|---|
| 1 | OV (GND) |
| 2 | +Vs (+9 … +36 Vdc) |
| 3 | NC |
| 4 | NC |
| 5 | CAN-L |
| 6 | CAN-H |

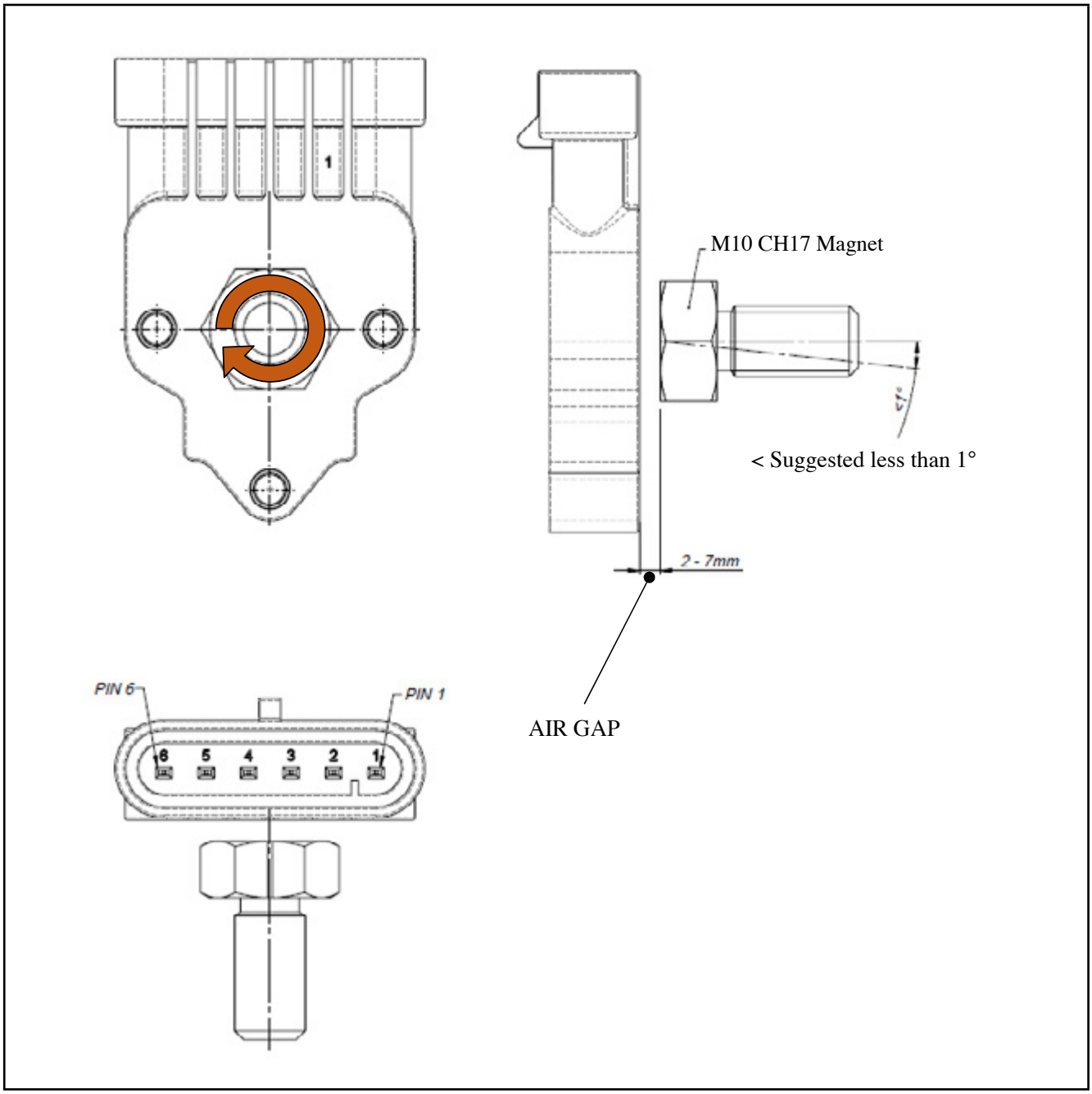



*Figure 3. Mechanical drawings of Gefran Hall-effect rotary sensor: AMP version without shaft.*

*Table 6. Cable version without shaft: connections.*

| 6 wires output 18 AWG 1.65mm OD | Meaning |
|---|---|
| BLACK | GROUND |
| RED | + SUPPLY 1 |
| YELLOW | N.C. |
| GREEN | N.C. |
| BLUE | CAN-L |
| WHITE | CAN-H |

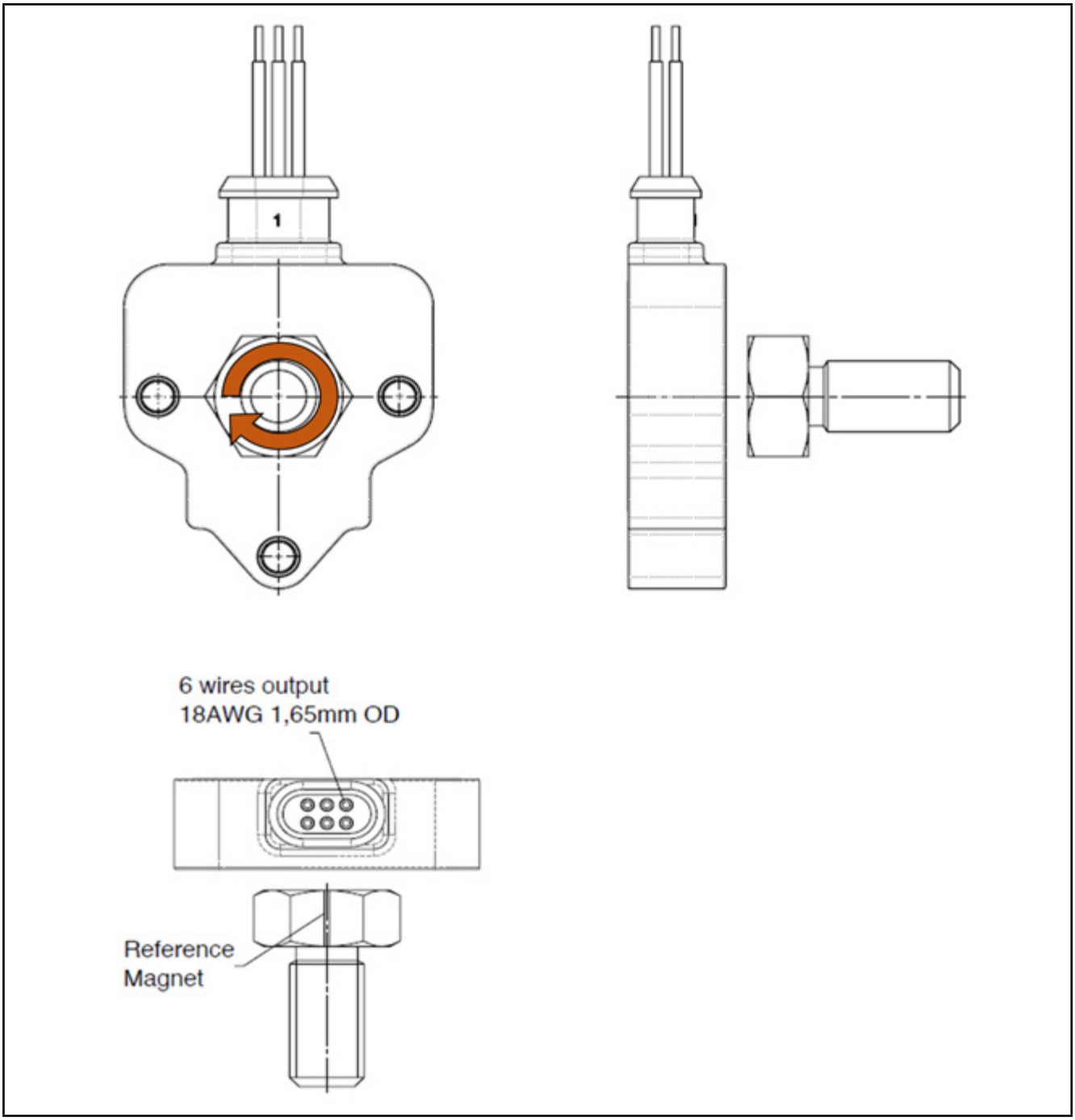



*Figure 4. Mechanical drawings of Gefran Hall-effect rotary sensor: cable version without shaft.*

**Note**: please, make sure that the CANbus is terminated. The impedance measured between CAN H and CAN L must be 60 Ω that means the cable must be connected to a 120 ohm resistor on each ends of the bus line. Internally the transducer is not terminated with the resistor of 120 ohm. Do not confuse the signal lines of the CANbus, otherwise communication with the transducer is impossible.

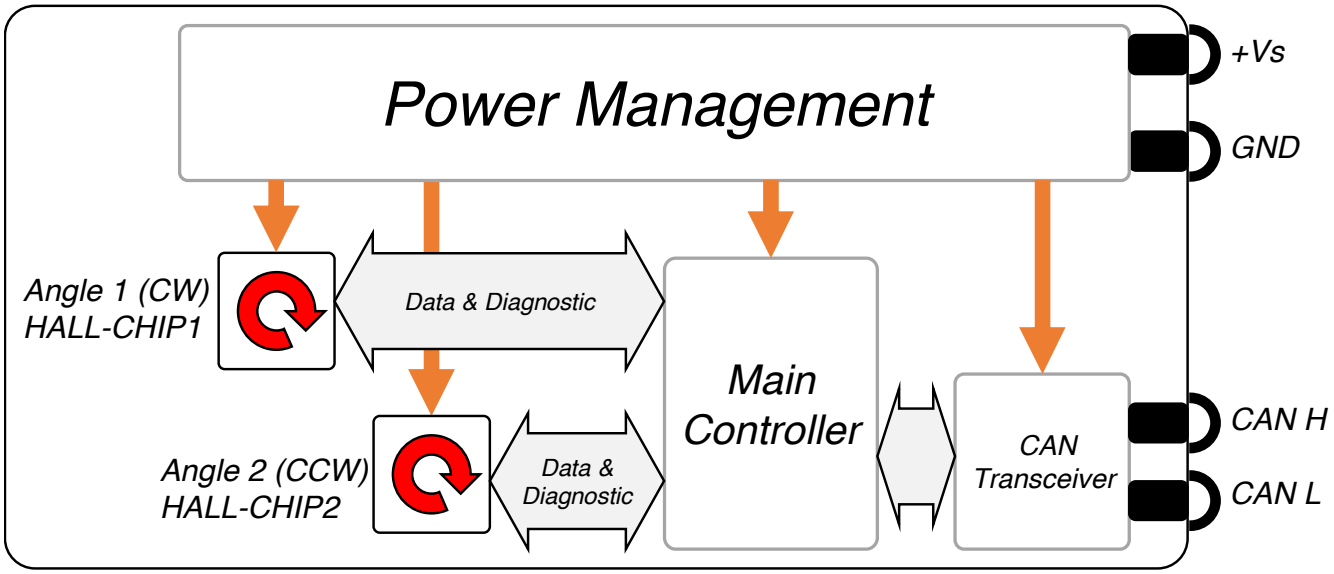



*Figure 5. Gefran Hall-effect rotary sensor: block diagram.*

- **Data rate:** 250 Kbps.
- **Arbitrary Address Capable:** 1.
- **Transmission Rate:** 100 ms.
- **Identifier:** 18FF0B15h.
- **PGN:** 65291 (0FF0Bh) – “Proprietary B”.
- **Source Address:** 21 (15h).
- **Priority:** 6.
- **Data:**
  - Byte 0, 1: Angle 1 position unsigned int 16bit: 0...3600 (CW, Angle position 0...360°; 0.1° resolution).
  - Byte 2, 3: Angle 2 position 0...3600 (CCW, Angle position 0...360°; 0.1° resolution).
  - Byte 4, 5, 6: 0xFF - Not in use.
  - Byte 7: Error Code.
- **Diagnostic message:** DM13 only supported.

The current data rate of Gefran Hall-effect single-turn rotary sensors with SAE J1939 output is 250 kbps. A typical message containing 8 data bytes is 128 bits long (excluding bits used for bit stuffing) which in time is approximately 500 $\mu$s.

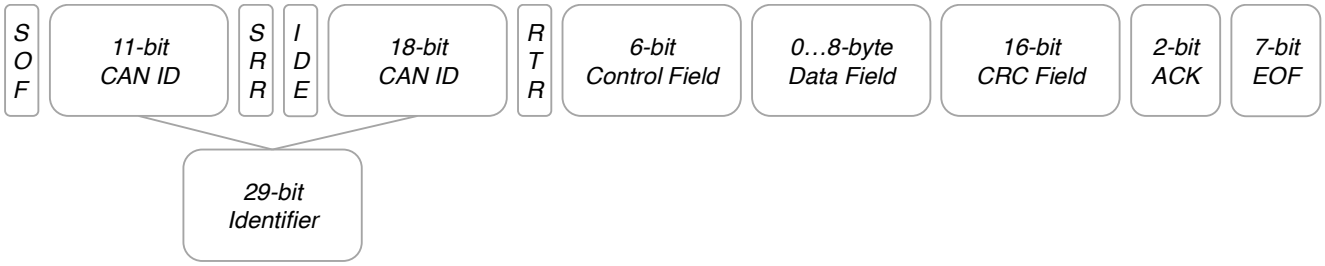



*Figure 6. SAE J1939/21 Message Format.*

J1939 uses the 29-bit identifier defined within the CAN 2.0B protocol shown in Table 7.

The device is configured as Arbitrary Address Capable device, thus it can claim other addresses, sending the Address Claimed message with the source address in the range of 128 to 247 inclusive. If no other Address Claimed message with the same Source Address is received, or if the arbitration is won, the device uses that address and begins regular network communications with that address. If no address in the range of 128 to 247 is available (arbitration always lost), the device sends the Cannot Claim Address message using the NULL address (254). In this case, regular network communications are suspended.

*Table 7. Structure of the 29bit identifier.*

| | | | | | | |
|---|---|---|---|---|---|---|
| | **3 bits** | **1 bit** | **1 bit** | 8 bits | 8bits | 8bits |
| **-** | **Priority** | **Reserved** | **Data page** | **PDU format** | **PDU specific** | **Source Address** |
| | | | | *< 240: PDU1* | *Destination Address* | |
| | | | | *≥ 240: PDU2* | *group extension* | |
| | | **PGN** | | | | |

1. When the sensor is turned on, it sends an Address Claimed message according to PGN 60928 as shown in the example of Figure 7 a pagina 10. The message is composed of:
   - **Identifier**: 18EEFFXXh (described in Table 8).
   - **Data Field**: device Name (described in Table 9).
2. After the sensor has acquired a valid address, it starts sending the angle position message according to PGN 65291 as shown in the example of Figure 8 a pagina 10. The message is composed of:
   - **Identifier**: 0x18FF0BXXh (described in Table 11).
   - **Data Field**: angle position (described in Table 12).

*In case of an error occur*s, the *angle position message will be sent with Angle 1 and* Angle 2 M*SB = 0xFF and LSB = 0xFF.*

*Table 8. PGN 60928 Address Claimed: Identifier definition.*

| 18h | | | | EEh | FFh | XXh |
|---|---|---|---|---|---|---|
| 000 | 110 | 0 | 0 | 1110 1110 | 1111 1111 | 0001 0101 |
| - | 3 bits | 1 bit | 1 bit | 8 bits | 8bits | 8bits |
| | **Priority:6** | **Reserved** | **Data page** | **PDU format: PDU1** | **PDU specific: Destination Address** | **Source Address** |
| | | **PGN 60928 (0EE00h)** | | | | |

*Table 9.* PGN 60928 Address Claimed: Name definition.

| XXh | XXh | XXh | | 5Bh | XXh | | XXh | XXh | | XXh | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| xxxx xxxx | xxxx xxxx | 100 | x xxxx | 0101 1011 | xxxx x | xxx | xxxx xxxx | xxxx xxx | 0 | x | xxx | xxxx |
| 8 bits | 8 bits | 3 bits | 5 bits | 8 bits | 5 bits | 3 bits | 8 bits | 7 bits | 1 bit | 1 bit | 3 bits | 4 bits |
| **Identity number, LSB** | **Identity number** | **Manufacturer code, LSB** | **Identity number, MSB** | **Manufacturer code, MSB** | **Function instance** | **ECU instance** | **Function** | **Vehicle system** | **Reserved bit** | **Arbitrary address bit** | **Industry group** | **Vehicle system instance** |

*Table 10.* Gefran J1939 Name definition for Halleffect single turn rotary sensors.

| Field | Description |
|---|---|
| *Arbitrary address bit* | 0: Single Address Capable device (*not implemented*)<br>1: Arbitrary Address Capable device |
| *Industry group* | 2: Agricultural and Forestry Equipment<br>3: Construction Equipment |
| *Vehicle system instance* | 0 |
| *Vehicle system* | 0 |
| *Reserved bit* | 0 |

| Field | Description |
|---|---|
| *Function* | 142 (8Eh): Rotation Sensor |
| *Function instance* | 0 |
| *ECU instance* | 0 |
| *Manufacturer code* | 732 (2DCh): Gefran S.p.A. |
| *Identity number* | Programmed by GEFRAN |

*Table 11.* PGN 65291 Proprietary B: Identifier definition.

| 18h | | | | FFh | 0Bh | XXh |
|---|---|---|---|---|---|---|
| 000 | 110 | 0 | 0 | 1111 1111 | 0000 1011 | 0001 0101 |
| - | 3 bits | 1 bit | 1 bit | 8 bits | 8bits | 8bits |
| | **Priority: 6** | **Reserved** | **Data page** | **PDU format: PDU2** | **PDU specific: group extension** | **Source Address** |
| | | **PGN 65291 (0FF0Bh)** | | | | |

*Table 12. PGN 65291 Proprietary B: angle position definition.*

| XXh | XXh | XXh | XXh | FFFFFFh | XXh |
|---|---|---|---|---|---|
| xxxx xxxx | xxxx xxxx | xxxx xxxx | xxxx xxxx | 1111 1111 1111 1111 1111 1111 | xxxx xxxx |
| 8 bits | 8 bits | 8 bits | 8 bits | 24 bits | 8 bits |
| **Angle 1, MSB** | **Angle 1, LSB** | **Angle 2, MSB** | **Angle 2, LSB** | Reserved | Error Code |
| **Data type:** 16-bit unsigned integer<br>**Resolution:** 0.1 deg<br>**Angle direction:** CW<br>**Ex.:** 008Ah = 138 = 13.8 deg | | **Data type:** 16-bit unsigned integer<br>**Resolution:** 0.1 deg<br>**Angle direction:** CCW<br>**Ex.:** 0D7Ch = 3452 = 345.2 deg | | | 00h: No error<br>01h: Angle 1 sensor chip error<br>02h: Angle 2 sensor chip error<br>03h: Angle 1 and 2 sensor chip error<br>20h: Program checksum error<br>40h: Parameter checksum error |

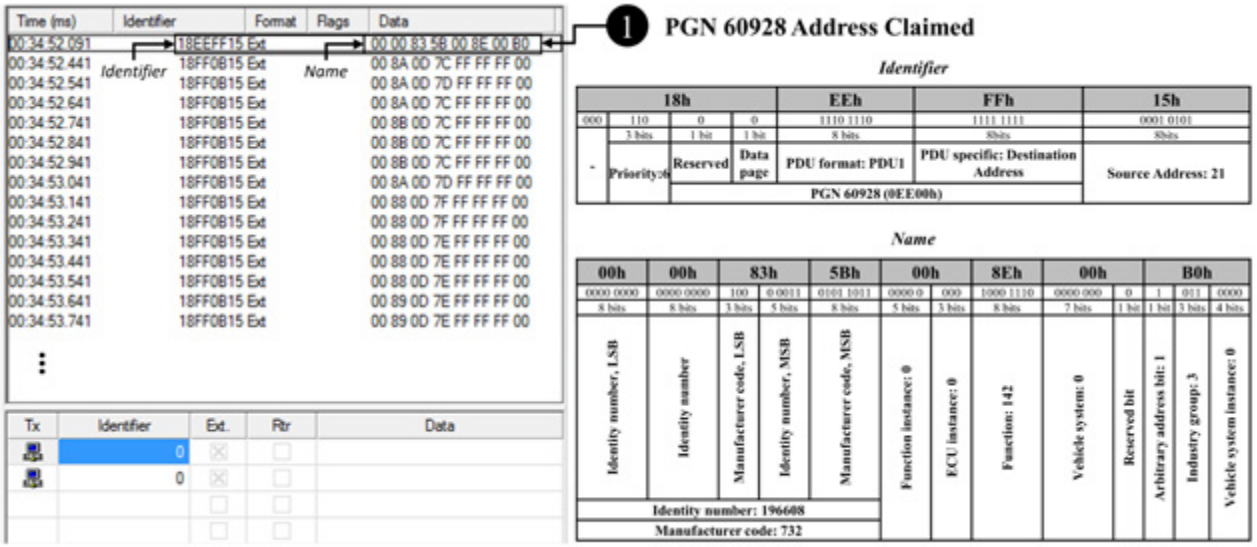



*Figure 7. Example: Address Claimed message.*

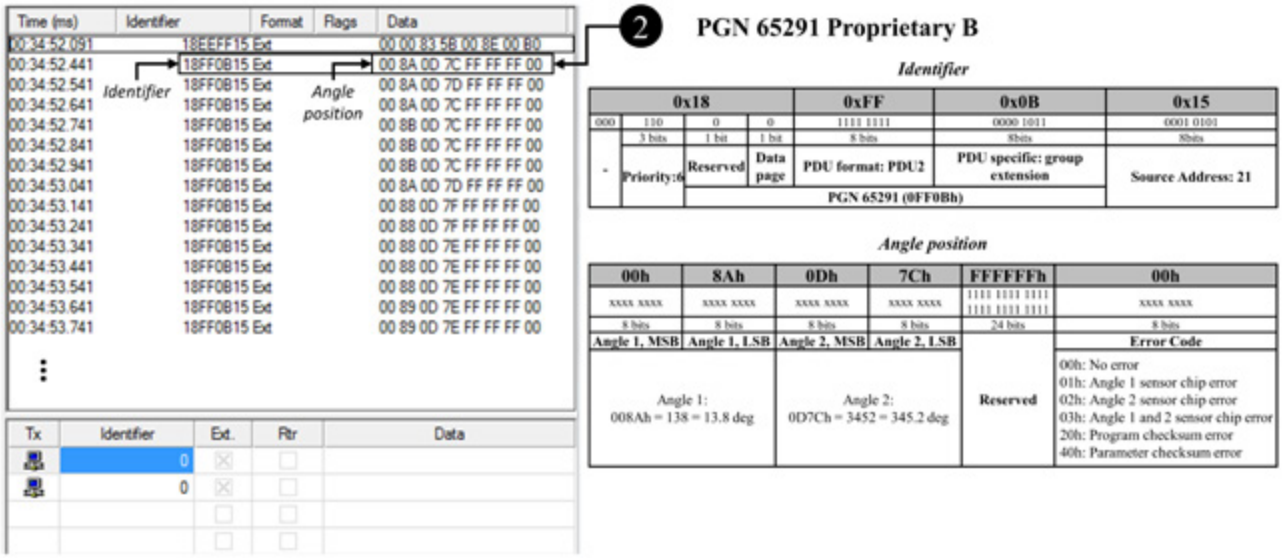



*Figure 8. Example: angle position message.*

# 7. HOW TO CHANGE THE NAME

The Name of the sensor can be configured by sending the Destination Specific – Proprietarily Configurable Message 1 according to PGN 45312 as shown in the example of Figure 9 a pagina 11. The message is composed of:

- **Identifier:** 18B1XXXXh (described in Table 13)
  **Note:** please, consider that the Destination Address is the address of the sensor, while the Source Address refers to the address of the user CAN controller that sends the message.
- **Data Field:** Proprietarily Configurable Message 1 (described in Table 14).

*Table 13. PGN 45312 Proprietarily Configurable Message 1: Identifier definition.*

| 18h | | | | B1h | XXh | XXh |
|---|---|---|---|---|---|---|
| 000 | 110 | 0 | 0 | 1011 0001 | xxxx xxxx | xxxx xxxx |
| - | 3 bits | 1 bit | 1 bit | 8 bits | 8bits | 8bits |
| | **Priority:6** | **Reserved** | **Data page** | **PDU format: PDU1** | **PDU specific: Destination Address** | **Source Address** |
| | | **PGN 45312 (0B100h)** | | | | |

*Table 14. PGN 45312 Proprietarily Configurable Message 1: message definition.*

| 67656672h | XXh | | XXh | XXh | | XXh | | |
|---|---|---|---|---|---|---|---|---|
| 0110 0111 0110 0101 0110 0110 0111 0010 | xxxx x | xxx | xxxx xxxx | xxxx xxx | 0 | x | xxx | xxxx |
| 32 bits | 5 bits | 3 bits | 8 bits | 7 bits | 1 bit | 1 bit | 3 bits | 4 bits |
| **ASCII code: "gefr"** | **Function instance** | **ECU instance** | **Function** | **Vehicle system** | **Reserved bit** | **Arbitrary address bit** | **Industry group** | **Vehicle system instance** |

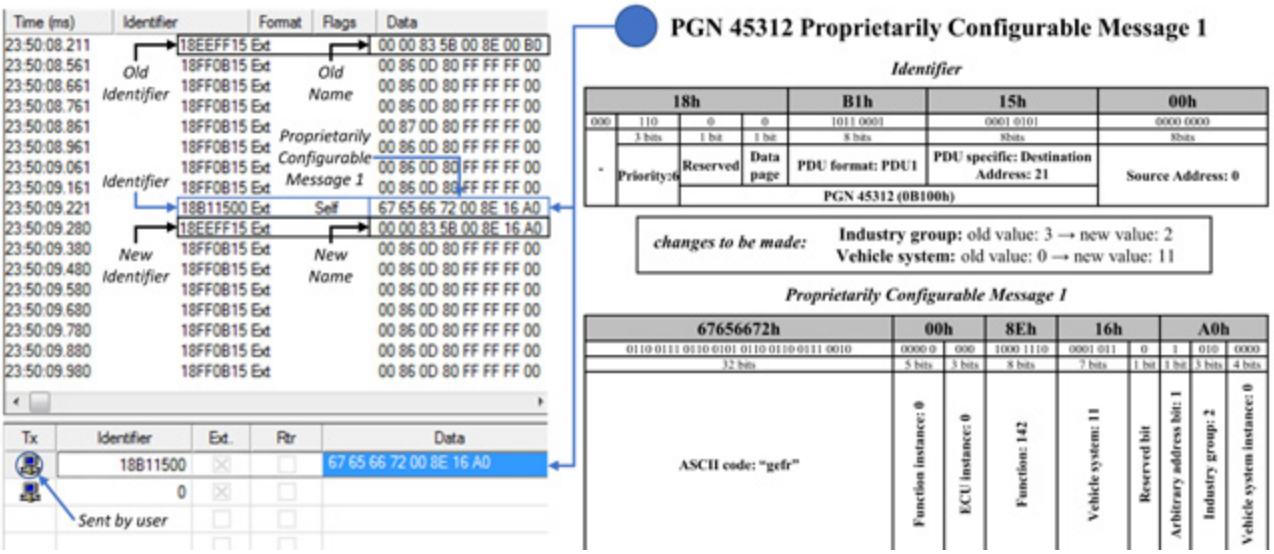



*Figure 9. Example: How to change the Name.*

# 8. HOW TO CHANGE THE TRANSMISSION RATE

The transmission rate of the sensor can be configured by sending the Destination Specific – Proprietarily Configurable Message 2 according to PGN 45568 as shown in the example of Figure 10 a pagina 12. The message is composed of:

- **Identifier:** 18B2XXXXh (described in Table 15)
  **Note:** please, consider that the Destination Address is the address of the sensor, while the Source Address refers to the address of the user CAN controller that sends the message.
- **Data Field:** Proprietarily Configurable Message 2 (described in Table 16).

*Table 15. PGN 45568 Proprietarily Configurable Message 2: Identifier definition.*

| 18h | | | | B2h | XXh | XXh |
|---|---|---|---|---|---|---|
| 000 | 110 | 0 | 0 | 1011 0010 | xxxx xxxx | xxxx xxxx |
| - | 3 bits | 1 bit | 1 bit | 8 bits | 8bits | 8bits |
| | **Priority:6** | **Reserved** | **Data page** | **PDU format: PDU1** | **PDU specific: Destination Address** | **Source Address** |
| | | **PGN 45568 (0B200h)** | | | | |

*Table 16. PGN 45568 Proprietarily Configurable Message 2: message definition.*

| 67656672h | XXh | XXh | 0000h |
|---|---|---|---|
| 0110 0111 0110 0101 0110 0110 0111 0010 | xxxx xxxx | xxxx xxxx | 0000 0000 0000 0000 |
| 32 bits | 8 bits | 8 bits | 16 bits |
| **ASCII code: "gefr"** | **Transmission rate, LSB** | **Transmission rate, MSB** | **Reserved** |
| | **Data type:** 16-bit unsigned integer<br>**Resolution:** 1 ms<br>**Range:** 10…65535<br>0 = stop transmission<br>**Ex.:** 0032h = 50 = 50 ms | | |

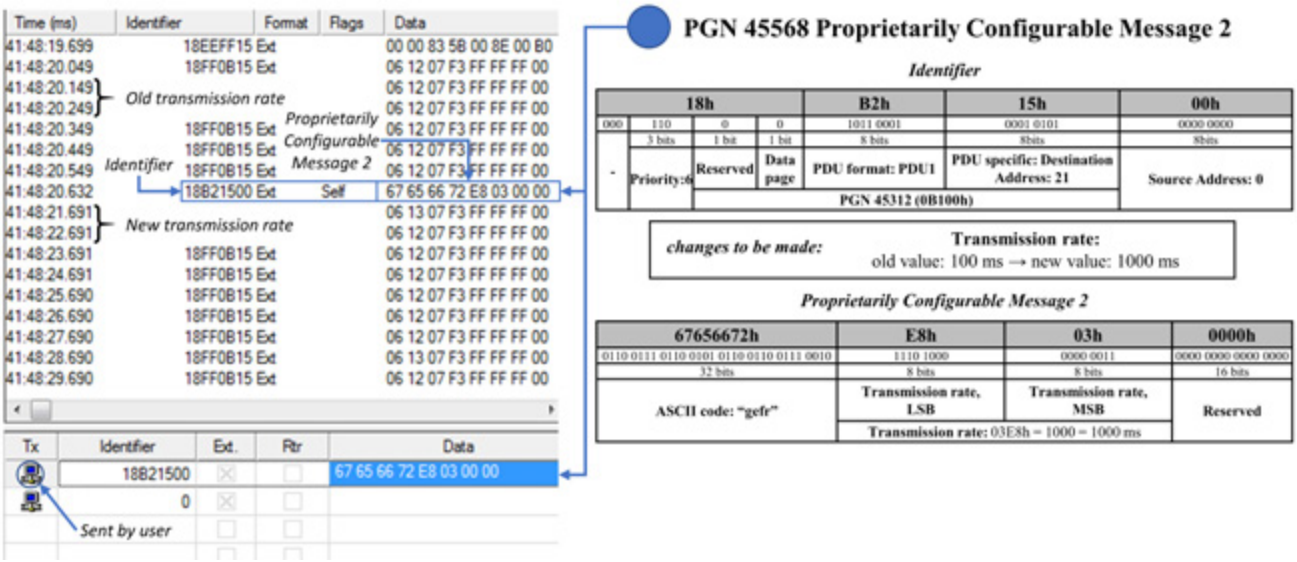



*Figure 10. Example: How to change the transmission rate*

## 9. HOW TO CHANGE THE SOURCE ADDRESS

The Source Address of the sensor can be configured by sending the Commanded Address Message according to PGN 65240 (FED8h). Since this message is 9-bit long, it is sent by using the Broadcast Announce Message of the Transport Protocol according to PGN 60416 and PGN 60160, as shown in the example of Figure 11 a pagina 14. Three messages must be sent:

**a.** Transport Protocol – Connection Management

- **Identifier:** 1CECFFXXh (described in Table 17)
- **Data Field:** Transport Protocol – Connection Management (described in Table 18).

*Table 17. PGN 60416 Transport Protocol – Connection Management: Identifier definition.*

| 1Ch | | | | ECh | FFh | XXh |
|---|---|---|---|---|---|---|
| 000 | 111 | 0 | 0 | 1110 1100 | 1111 1111 | xxxx xxxx |
| - | 3 bits | 1 bit | 1 bit | 8 bits | 8bits | 8bits |
| | **Priority:7** | **Reserved** | **Data page** | **PDU format: PDU1** | **PDU specific: Destination Address** | **Source Address** |
| | | **PGN 60416 (0EC00h)** | | | | |

*Table 18. PGN 60416 Transport Protocol – Connection Management: Broadcast Announce Message definition.*

| 20h | 09h | 00h | 02h | FFh | D8h | FEh | 00h |
|---|---|---|---|---|---|---|---|
| 0110 0111 | 0000 1001 | 0000 0000 | 0000 0010 | 1111 1111 | 1101 1000 | 1111 1110 | 0000 0000 |
| 8 bits | 8 bits | 8 bits | 8 bits | 8 bits | 8 bits | 8 bits | 8 bits |
| **Control byte** | **Total message size, number of bytes LSB** | **Total message size, number of bytes, MSB** | **Total number of packets** | **Reserved** | **PGN of the packet message, LSB** | **PGN of the packet message** | **PGN of the packet message, MSB** |

**b.** Transport Protocol – Data Transfer: packet 1

- **Identifier:** 1CEBFFXXh (described in Table 19)
- **Data Field:** Transport Protocol – Data Transfer: packet 1 (described in Table 20).

*Table 19. PGN 60160 Transport Protocol – Data Transfer: Identifier definition.*

| 1Ch | | | | EBh | FFh | XXh |
|---|---|---|---|---|---|---|
| 000 | 111 | 0 | 0 | 1110 1011 | 1111 1111 | xxxx xxxx |
| - | 3 bits | 1 bit | 1 bit | 8 bits | 8bits | 8bits |
| | **Priority:7** | **Reserved** | **Data page** | **PDU format: PDU1** | **PDU specific: Destination Address** | **Source Address** |
| | | **PGN 60160 (0EB00h)** | | | | |

*Table 20. PGN 60416 Transport Protocol – Data Transfer: packet 1.*

| 01h | XXh | XXh | XXh | | 5Bh | XXh | | XXh | XXh | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0000 0001 | xxxx xxxx | xxxx xxxx | 100 | x xxxx | 0101 1011 | xxxx x | xxx | xxxx xxxx | xxxx xxx | 0 |
| 8 bits | 8 bits | 8 bits | 3 bits | 5 bits | 8 bits | 5 bits | 3 bits | 8 bits | 7 bits | 1 bit |
| **Sequence number** | **Identity number, LSB** | **Identity number** | **Manufacturer code, LSB** | **Identity number, MSB** | **Manufacturer code, MSB** | **Function instance** | **ECU instance** | **Function** | **Vehicle system** | **Reserved bit** |

**c.** Transport Protocol – Data Transfer: packet 2

- **Identifier:** 1CEBFFXXh (described in Table 19)
- **Data Field:** Transport Protocol – Data Transfer: packet 2 (described in Table 21).

*Table 21. PGN 60416 Transport Protocol – Data Transfer: packet 2.*

| 02h | XXh | | | XXh | FFFFFFFFFFh |
|---|---|---|---|---|---|
| 0000 0010 | x | xxx | xxxx | xxxx xxxx | 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 |
| 8 bits | 1 bit | 3 bits | 4 bits | 8 bits | |
| **Sequence number** | **Arbitrary address bit** | **Industry group** | **Vehicle system instance** | **New Source Address** | **Reserved** |

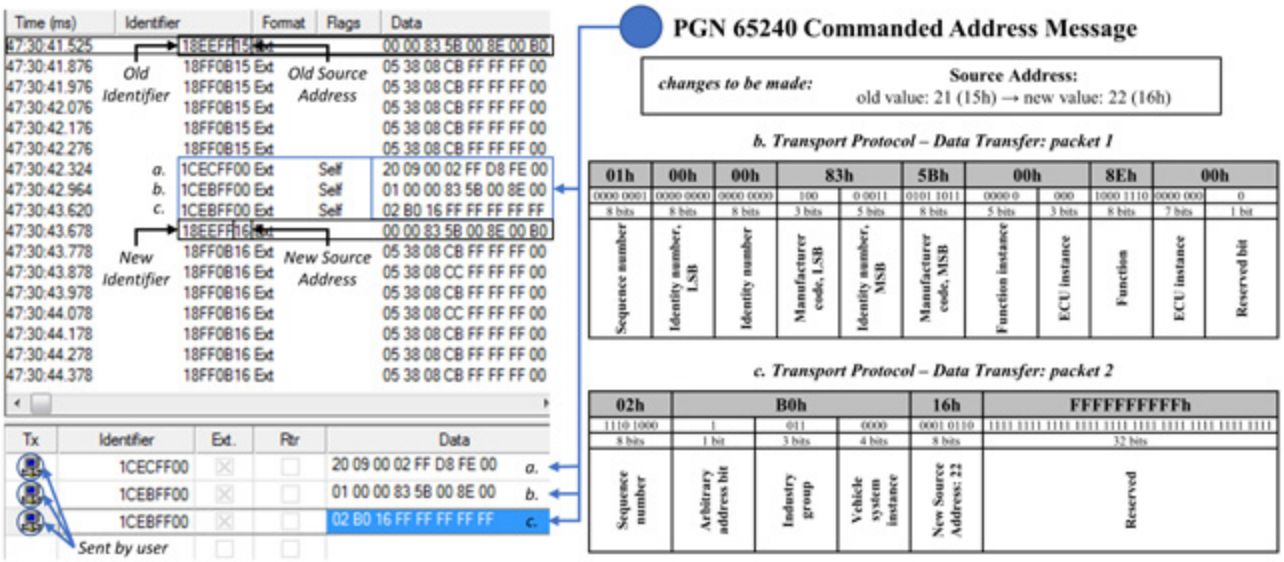



*Figure 11.* Example: How to change the Source Address.

NOTES

**GEFRAN spa**
via Sebina, 74 - 25050 PROVAGLIO D'ISEO (BS) - ITALIA
tel. 0309888.1 - fax. 0309839063 Internet: http://www.gefran.com