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# GS100 User Manual

## J1939 CAN Speed Sensor

ENGINEERING YOUR SUCCESS.

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# Publication History

The following table provides an overview of the changes made to this document over the course of its publication history

| Revision | Description of Change |
|---|---|
| Rev. 001 | First release of this document |

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# 1 Safety

Do not perform the procedures in this manual unless you are experienced in the handling of electronic equipment.

Contact the manufacturer if there is anything you are not sure about or if you have any questions regarding the product and its handling or maintenance.

The term "manufacturer" refers to Parker Hannifin Corporation.

## 1.1 Safety Symbols

The following symbols are used in this document to indicate potentially hazardous situations. When you see these symbols, follow the instructions carefully and proceed with caution.

- *Danger! Risk of death or injury.*
- *Warning! Risk of damage to equipment or degradation of signal.*

## 1.2 General Safety Regulations

Work on the hydraulics control electronics may only be carried out by trained personnel who are well-acquainted with the control system, the machine, and its safety regulations.

- Follow the manufacturer's regulations when mounting, modifying, repairing, and maintaining equipment. The manufacturer assumes no responsibility for any accidents caused by incorrectly mounted or incorrectly maintained equipment. The manufacturer assumes no responsibility for the system being incorrectly applied, or the system being programmed in a manner that jeopardizes safety.
- Do not use the product if electronic modules, cabling, or connectors are damaged or if the control system shows error functions.
- Electronic control systems in an inappropriate installation and in combination with strong electromagnetic interference fields can, in extreme cases, cause an unintentional change of speed of the output function
- This product can expose you to chemicals including **ANTIMONY TRIOXIDE,CARBON BLACK (AIRBORNE, UNBOUND PARTICLES OF RESPIRABLE SIZE)** which is known to the State of California to cause cancer and **4,4'-(PROPANE-2,2-DIYL)DIPHENOL, BPA, P,P'-ISOPROPYLIDENEBISPHENOL,** which is known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

## 1.3 Welding After Installation

If welding is required for installation, complete as much as possible of the welding work before the installation of the system. If welding must be done afterwards, proceed as follows:

- ⚠ Do not place the welding unit cables near the electrical wires of the control system
- ⚠ If sensor has been installed and additional welding is required, remove the 6-pin connector from the sensor to avoid possible electrical damage to sensor

1. Disconnect the electrical connections between the system and external equipment
2. Disconnect the negative cable from the battery
3. Disconnect the positive cable from the battery
4. Connect the welder's ground wire as close as possible to the place of the welding

## 1.4 Construction Regulations

The vehicle must be equipped with an emergency stop which disconnects the supply voltage to the control system's electrical units. The emergency stop must be easily accessible to the operator. If possible, the machine must be built so that the supply voltage to the control system's electrical units is disconnected when the operator leaves the operator’s station.

## 1.5 Safety During Installation

- ⚠ Incorrectly positioned or mounted cabling can be influenced by radio signals, which can interfere with the functions of the system.

## 1.6 Safety During Start-Up

- ⛔ *Danger! Risk of death or injury.* Do not start the machine’s engine before the control system is mounted and its electrical functions have been verified.

  Do not start the machine if anyone is near the machine.

## 1.7 Safety During Maintenance and Fault Diagnosis

Before performing any work on the hydraulics control electronics, ensure that:

- ⚠ The machine cannot start moving
- ⚠ Functions are positioned safely
- ⚠ The machine is turned off
- ⚠ The hydraulic system is relieved from any pressure
- ⚠ Supply voltage to the control electronics is disconnected

# 2 Document Introduction

## 2.1 Scope

The purpose of this document is to detail performance characteristics, installation recommendations, and define CAN messages for the GS100 Sensor product. These Instructions/guidelines are to be used as a reference tool for the manufacturer's design, production, and service personnel. The user of this manual should have basic knowledge in the handling of electronic equipment.

## 2.2 Terminology

The abbreviations and acronyms used in this manual are defined in the following table.

| Abbreviation | Explanation |
|---|---|
| GS100 | Gear Speed 100 series: J1939 CAN Speed Sensor |
| CAN | Controller Area Network |
| EMI | Electromagnetic Interference |
| PGN | Parameter Group Number |
| JTAG | Joint (European) Test Access Group- type of a connector |
| SAE | Society of Automotive Engineers |
| SA | Source Address |
| DA | Destination Address |
| PGN | Parameter Group Number |
| CI | Component Identification |
| SOFT | Software Identification |
| AC | Address Claim |
| FMI | Failure More Indicator |
| SPN | Suspect Parameter Number |
| CA | Commanded Address |

*Table 2.2:1 Abbreviation List*

# 3 Product Information

## 3.1 Overview

The GS100 sensor belongs to the Parker family of gear speed sensors which can measure speed and direction of a ferrous gear based on principles of Hall-effect technology. This sensor broadcasts the measured data over a CAN bus using SAE J1939 protocol. OEMs can customization multiple CAN parameters like baud rate, message frequency rate, and source address which provides easy tuning of the sensor according to the application need.

The sensor also provides direct access to Hall element's open-drain output for diagnostic purposes. Users can pull this output pin High through an external pull-up resistor and can observe the Hall switching by connecting to an oscilloscope.

The sensor is designed to be completely application-ready with a very robust performance and reliability across the temperature range (-40° C to 85°C) while supporting many electrical and mechanical industrial standards to withstand rugged applications. The sensor offers great immunity to RFI, EMI and EMC. The sensor is designed and manufactured by keeping Parker quality standards in mind that offers a wide airgap range between the target gear to the sensor nose that helps producing a reliable speed output across the specified airgap. The GS100 sensor is suitable for applications which requires to share the target's speed and direction information over CAN to all other devices in the application without complex dedicated wiring in between. The sensor maintains great connection to the host even in harsh environment applications; thanks to DTM04-6P standard integral connector, which has an interfacial seal that protects pins from moisture and corrosion.

The features like Re-programming the sensor's firmware over CAN, enables our development team to rapidly add custom software features to the sensor's firmware to improve functionality over time and gives the ability to the end user to seamlessly update the sensor's firmware on deployed devices without unmounting the sensor from application.

## 3.2 Features and Benefits

- Measures both Speed and Direction of a Ferrous target gear
- CAN based output along with a digital ON/OFF Open-drain output
- Wide Airgap range and operating Voltage
- Robust and Reliable across the temperature range
- Great Immunity to external interreference.
- Over Voltage, Reverse Voltage and Short Circuit Protected
- IP67 and IP69K rated design
- Reprogrammable over CAN

# 4 Sensor Specifications

## 4.1 Operating Characteristics

| Characteristic | Symbol | Min | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| ***Electrical*** | | | | | |
| Supply Voltage | $V_{cc}$ | 8 | 12 | 16 | V |
| Reverse Voltage Protection | $V_{Rcc}$ | - | - | -26 | V |
| Under Voltage Lockout | $V_{cc(UV)}$ | - | 5 | - | V |
| Over Voltage Lockout | $V_{cc(OV)}$ | - | 19.5 | - | V |
| Supply Current @8V [1] | $I_{cc\ @8V}$ | 25 | 33 | 42 | mA |
| Supply Current @12V [1] | $I_{cc\ @12V}$ | 26 | 34 | 43 | mA |
| Supply Current @16V [1] | $I_{cc\ @\ 16V}$ | 28 | 35 | 44 | mA |
| Startup Voltage | $V_{cc(Startup)}$ | 6 | - | - | V |
| Startup Duration | $t_{startup}$ | 380 | 450 | 700 | ms |
| ***Temperature Characteristics*** | | | | | |
| Operating Ambient Temperature | $T_A$ | -40 | 25 | 85 | °C |
| Storage Temperature | $T_{stg}$ | -40 | - | 105 | °C |
| ***Input and Output Signal Characteristics*** | | | | | |
| Operational Airgap [2] | AG | 1.02 | - | 2.03 | mm |
| External Pull-Up | $R_{ext}$ | | 6.8 | | kΩ |
| Recommended Pull-Up Voltage | $V_{cc\text{-}Pullup}$ | - | 5 | 12 | V |
| Operational Frequency [3] | $f_{op}$ | 0.01 | | 5 | kHz |
| Output signal Rise Time [4] | $t_r$ | - | 30 | - | µs |
| Output signal Fall Time [4] | $t_f$ | - | 0.6 | - | µs |
| Output signal High Voltage (sink) [4] | $V_{OH}$ | 3.45 | 3.69 | 3.95 | V |
| Output signal Low Voltage (sink) [4] | $V_{OL}$ | 0.45 | 0.7 | 0.95 | V |

| ***CAN (SAE J1939) communication characteristics*** | | | | | |
|---|---|---|---|---|---|
| CAN baud rate | $CAN_{baud}$ | 125 | 250 | 1000 | KBPS |
| CAN Message data Rate | $MD_r$ | 10 | 50 | 2000 | ms |
| Number of Output Pulse Samples for Speed and direction | $N_{ssD}$ | 1 | 8 | 15 | - |
| Speed output Tolerance | | -2 | - | 2 | % |
| Tooth Pulse Counter [5] | $P_{counter}$ | 0 | - | 1,000,000 | - |
| CAN Message Counter [5] | $M_{counter}$ | 0 | - | 7 | - |
| CAN default Source Address | $SA_d$ | 0x80 | | | - |
| CAN default Broadcast PGN | $B_{PGN-d}$ | 0xFF75 | | | - |

[1] Supply current is measured with 6.8kΩ pull-up resistor connected to an external 5V supply.
[2] Airgap is dependent on the target geometry and material dependent and should be independently characterized.
[3] The sensor broadcasts 0Hz CAN output for any speeds below 10Hz.
[4] This reading was measured when sensor was connected to a 12V power supply with a 6.8KΩ pull-up to external 5V
[5] Once it reaches the max value, this value falls back to 0 and starts counting again.

## 4.2 Product Features

| ***General Notes*** | |
|---|---|
| Mounting Fastener Torque | 11.3 N-m |
| O-ring | AS-568A-114 or equal |
| Input and Output Wires | 20 AWG SXL |
| Connector | DTM04-6P Deutsch |
| Weight | 0.10 kg |
| ***Environmental*** | |
| EMC | EMC Emissions - Level 1 (ANSI/ASAE EP455 R2008)<br>EMC Susceptibility - Level 3 (ISO 13766 2006) |
| ESD | Direct Contact: ± 8KV<br>Air: ± 15KV |
| EMI | ISO 7637-2 and 3 transients |
| Load Dump | ISO 7637-2 2004 Pulse 5a, +87V peak 400ms duration |
| Climate | IP67 and IP69K rated |
| Chemical | Liquids (resistance) standard automotive |
| ***Certifications*** | |
| EU RoHS 2<br>CE EN61000-6-2, EN61000-6-4, EN 13309, ISO 13766-1, ISO13766-2, ISO 14982 | |

## 4.3 Product Dimensions

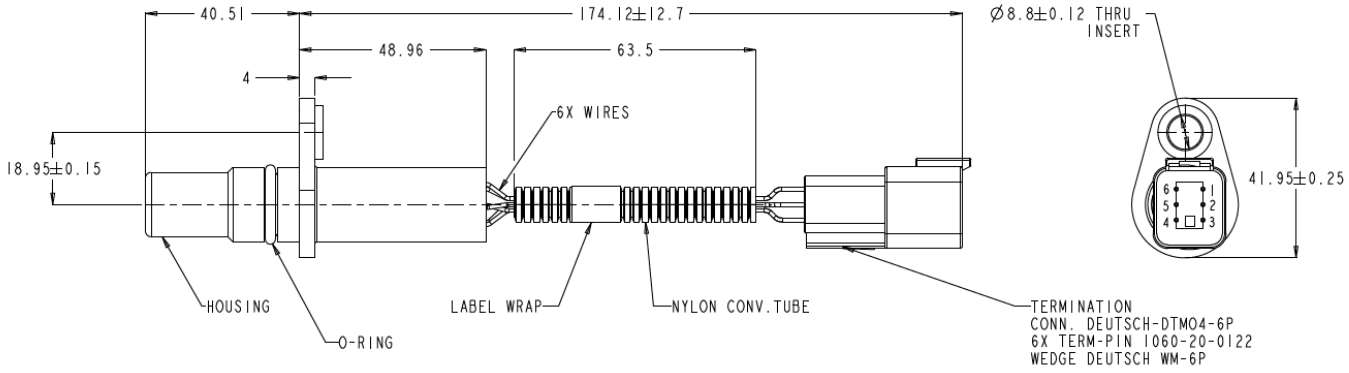


*Figure 4.3.1 GS100 Dimensions*

## 4.4 Connector Pinout

The GS100 utilizes the Deutsch DTM04-6P connector. See below for pinout definitions:


*Figure 4.4.1 GS100 Pin Position (DTM04-6P)*

| Terminal / Pin | Description | Wire Color |
|---|---|---|
| 1 | Supply Voltage | Red |
| 2 | Ground | Black |
| 3 | Speed Open Drain Output | White |
| 4 | CAN Source Address Offset Resistor Input | Orange |
| 5 | CAN H | Yellow |
| 6 | CAN L | Green |

*Table 4.4:1 GS100 Pinout*

# 5 Product Usage

## 5.1 Functional Block Diagram

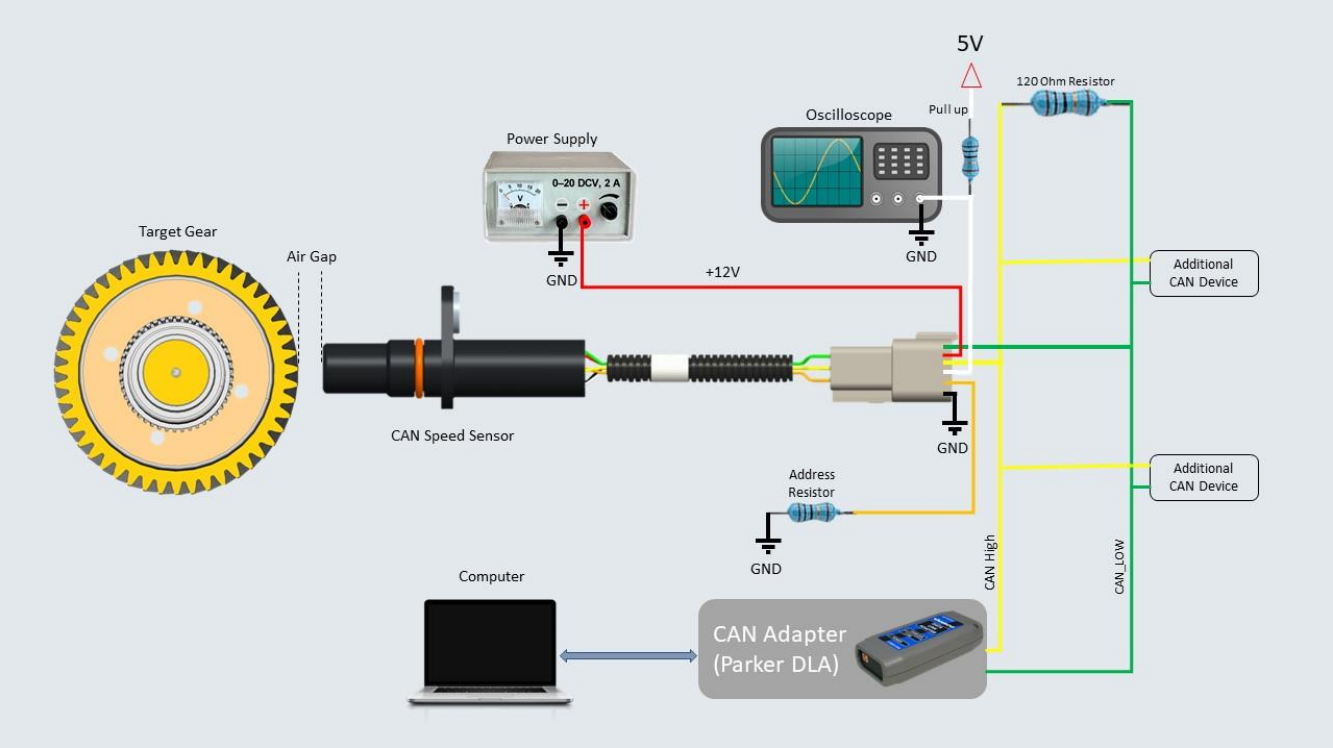


*Figure 5.1.1 GS100 Functional Block Diagram*

## 5.2 Address Resistor Selection Guide

The sensor has an address offset resistor input pin, which enables users to connect multiple sensors on a same CAN bus network. During power up, the sensor considers Source Address from input resistor value connected to the offset input pin ($4_{th}$ pin) and starts operating with that address; the table below shows the input resistor values and corresponding source addresses.

If this feature is not required, user should connect the pin to ground and should not be left this pin floating.

If the address resistor value is greater than 10KΩ, then sensor operates using the saved address from flash memory. If there is no address found in the flash, it uses the default source address 0x80.

Sensor also supports J1939 based source address claim methods and user can save their preferred address into flash memory in the sensor anytime during normal operation.

**Note:** Replacing the offset resistor value with a new input value during the sensor normal operation, will not change the source addresses immediately. New source Address will only be effective after a power cycle to the sensor.

| Resistor Value [Ω] | Source Address |
|---|---|
| <294 | 0x80 |
| 590 | 0x81 |
| 976 | 0x82 |
| 1.5k | 0x83 |
| 2.3k | 0x84 |
| 3.32k | 0x85 |
| 5.36k | 0x86 |
| 9.53k | 0x87 |
| >10k | Source Address retrieved from Flash Memory |
| GND | 0x80 |

*Table 5.2:1 Resistor Source Address Selector*

# 6 Installation Guidelines

## 6.1 Operating Conditions

⚠ The GS100 should not be continuously submerged in any liquid without added protection. The operating temperatures for the sensor are -40 to +85°C.

## 6.2 Power Supply Requirements

⚠ The GS100 Sensor is designed for 12V battery vehicles and will operate normally with input voltages between 8V to 16V. Cold Crank Start-up Voltage for this sensor is 6V up to 40ms. The detailed power requirements are mentioned in previous chapters and Electrical notes.

## 6.3 Mating Connection

⚠ The GS100 uses the Deutsch DTM04-6P connector. The mating connector would be the DTM06-6S.
Note the GS100 terminals are nickel plated. It is recommended to use nickel plated connections to avoid galvanic corrosion over time.

## 6.4 Mounting Guideline

✖ Always depower and depressurize the application prior to installing or replacing the sensor.

⚠ The sensor is designed to fit a hydraulic accessory port with a diameter of 20.00/20.052 millimeters [mm.]. Bore depth of 12mm is suggested for O-ring engagement. An O-ring provides the necessary fluid seal that prevents the bypass of fluids from the internal cavity of the application.

✖ The O-ring seal in GS100 sensor is intended for tank pressure applications, typically of 5 psi or less. Fluid pressure above this limit risks damage to the sensor and fluid leaks. Customer shall verify the performance of the sensor and O-ring seal subjected to application pressures.

⚠ Product shall be used with the O-ring provided with the sensor. Contact Parker Engineering to discuss alternatives.

⚠ Tighten the mounting fastener enough to prevent vibration and loosening. Do not exceed 11.3 Nm mounting torque (Based on M8 Grade 8.8 fastener).

⚠ The sensor harness should be securely mounted to prevent strain and vibration. Review application movement prior to selecting mounting points to avoided pinch points as well as vibration and strain as these things could damage to the harness and lead to intermittent failures in the output signals.

⚠ Air gap is one of the vital requirements to this sensor to operate normally and to measure the target gear's speed and direction accurately. It varies from target to target, contact Parker Engineering for optimum airgap before installing the sensor in the application. Failing to mount the sensor within the optimized airgap range, would cause incorrect output information and may not give output at all.

⛔ Always prevent the sensor making physical contact with the rotating target as will lead to damage of the sensor and/or damage to the surrounding environment.

⚠ Sensor orientation is as important to the operation. If the mounting orientation is not measured for a specific target, application could see signal jitter which causes inaccurate speed measurements.

The perfect optimized orientation would be the Hall elements inside the sensor should be 90 degrees to the target gear's tooth angle.

⚠ Due to manufacturing tolerances, evaluation by the OEM is required to verify the output signal is of acceptable quality after the sensor is properly mounted.

# 7 CAN Information

## 7.1 SAE J1939

The J1939 standards come from the international Society of Automotive Engineers (SAE) and were developed to provide a standard architecture by which multiple electronic systems on a vehicle can communicate. J1939 has been implemented in a broad range of vehicles and transportation systems and provides a reliable communication protocol over a high-speed CAN network.

The GS100 uses this protocol to transmit its condition as a predefined set of outputs. All messages are SAE J1939 Proprietary B PGN's except the address claim request and response.

## 7.2 Network Compatibility

The GS100 is compatible with 125kbps, 250 kbps or 500kbps CAN baud rates, qualifying it as a “High-Speed” CAN sensor. Per ISO 11898-2, the linear bus must be terminated with two 120 Ω resistors at the ends of the transmission lines.

External CAN termination is required and not provided with the GS100 product. Follow SAE J1939 standards when creating the harness connected to the sensor.

## 7.3 Identifier Description

The J1939 protocol uses a 29-bit identifier. The 29-bit identifier is built up as follows:

- Bit 1-8 is Source Address (**SA**)
- Bit 9-24 is Parameter Group Number (**PGN**)
- Bit 25 is Data Page (**DP**)
- Bit 26 is Reserved (**R**)
- Bit 27-29 is Priority (**P**)

Each identifier has an associated 8-byte data field. The data field is built up as shown below.

| | **29-bit IDENTIFIER** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **P**riority | | | **R** | **D P** | **P**arameter **G**roup **N**umber | | | | | | | | | | | | | | **S**ource **A**ddress | | | | | | | | |
| | | | | | | PDU Format | | | | | | | | PDU Specific | | | | | | | | | | | | | | | |
| CAN 29 Bit ID Position | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

*Table 7.3:1 J1939 CAN Identifier Structure*

## 7.4 Data field structure

The Data Field is structured as Little Endian within the bytes, and Big Endian for the Data Field.

| DATA FIELD | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BYTE 1 | | | | | | | | BYTE 2 | | | | | | | | BYTE 3-7 | | | | | BYTE 8 | | | | | | | |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | … | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

*Table 7.4:1 Data Field Structure*

## 7.5 Communication Message Types

The GS100 uses two communication message types: Global and Specific Address.

**Global Message:** This is the operational “Broadcast mode” message for all the axis tilt information and pitch and roll information on the sensor. In these messages the unit broadcasts the outgoing data on the J1939 at 50 ms intervals.

**Specific Address Message:** This is the “Command mode” message for the sensor. In these messages the GS100 receives write and query messages to its node address from the J1939 bus.

⚠ Ensure there is no loss of power while making programming changes with the GS100 in service mode

## 7.6 Adjustable User Parameters

The sensor has ability to change parameters over CAN that can be used to tune the sensor in different application scenarios. More detailed information and example usages are discussed in following chapters.

- Broadcast Message PGN (Default is FF75)
- Number of Samples taken to calculate Speed (can choose between 1-15 but the default is 8 samples)
- Message Data Rate (It can be varied from 10 ms to 2000 ms, default is 50ms)
- Source Address (Default is 0x80)
- CAN Baud Rate (125 kbps, 250 kbps, 500 kbps, and 1000 kbps. Default is 250kbps)

The following Tables will describe the CAN message information in detail and some application CAN examples are provided at the end.

## 7.7 Transmitted Messages

| **Broadcast Status Message** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Default PGN 0xFF75** (65397) | | PF **255** | PS **117** | SA **SA**(1) | Parameter Group Definition **Proprietary B** | Default Priority **6** | Default Broadcast Interval **50 ms**(2) |
| **Data Byte** | Length | Parameter Name | | | Format | Value | Description |
| **1** | 2 bytes | Frequency | | | Unsigned Integer | Resolution: 1 Hz/bit<br>Data range: 0 to 10,000 Hz | Calculated Frequency<br>Byte1: LSB, Byte2: MSB. |
| **3** | 1 byte | Operational State | | | Unsigned Integer | 0 – Initialize<br>1 – Operational<br>2 – Hall Faulted | Operational State |
| **4** | 1 byte | Unused Bits | | | Unsigned Integer | 0xFF | Unused Bits |
| **5** | 20 bits | Pulse Counter(3) | | | Unsigned Integer | Resolution: 1 pulse per bit<br>Data Range: 0 to 1,000,000 | Measured pulse counter value. Byte 5:LSB. |
| **7.5** | 2 bits | Forward Direction | | | Unsigned Integer | 0x00 - Not in Forward<br>0x01 - Forward<br>0x10 - Fault<br>0x11 - Not available | Direction: Forward, Reverse, No Move. |
| **7.7** | 2 bits | Reverse Direction | | | Unsigned Integer | 0x00 - Not in Reverse<br>0x01 - Reverse<br>0x10 - Fault<br>0x11 - Not available | |
| **8** | 4 bits | Message Counter | | | Per SPN 4206 | 0 to 7 | Increments from 0 to 7, overflows to 0. |
| **8.5** | 4 bits | Checksum | | | Per SPN 4207 | - | Calculated Checksum(4) |

1. SA is the source address, DA is destination address, PF is PDU Format, PS is PDU Specific, PGN is Parameter Group Number.
2. Broadcast interval for CA Speed Sensor status message can be configured (see parameter number 02 in Configuration Parameters, Table 9).
3. The pulse counter will roll over to 0 when it passes 1,000,000 in a forward direction. The pulse counter will roll over to 1,000,000 when passes 0 in a reverse direction. The pulse counter will default to 0 at startup.
4. Checksum = Byte1 + Byte2 + Byte3 + Byte4 + Byte5 + Byte6 + Byte7 + Message Counter & 0x0F + Message ID Low Byte + Message ID Mid Low Byte + Message ID Mid High Byte + Message ID High Byte
5. Message Checksum = (((Checksum >> 6) & 0x03) + (Checksum >> 3) + Checksum) & 0x07.

| Address Claim Messages | | | | | |
|---|---|---|---|---|---|
| ***Address Claimed – AC(1)(2)*** | | | | | |
| **PGN** | | PF | PS | SA | Parameter Group Definition |
| **0xEE00(60928)** | | **238** | **255** | **SA**(1) | **PDU1 Format** |
| **Data Byte** | Length | Parameter Name | | | Format |
| **1** | 21 bits | Identity Number | | | SPN 2837, Manufacturer Serial Number |
| **3.6** | 11 bits | Manufacturer Code | | | SPN 2838, 71 – Vansco, cannot be changed |
| **5.1** | 3 bits | ECU Instance | | | SPN 2840, ECU Instance is 0. |
| **5.4** | 5 bits | Function Instance | | | SPN 2839, Function Instance is 0. |
| **6** | 1 byte | Function | | | SPN 2841, Speed Sensor function for industry group and vehicle system. |
| **7.1** | 1 bit | Reserved | | | For Speed Sensor this bit is 0. |
| **7.2** | 7 bits | Vehicle System | | | SPN 2842, Vehicle System is 0. |
| **8.1** | 4 bits | Vehicle System Instance | | | SPN 2843, Vehicle System Instance is 0. |
| **8.5** | 3 bits | Industry Group | | | SPN 2846, Industry Group is 0. |
| **8.8** | 1 bit | Arbitrary Address Capable | | | SPN 2844, 0 – Not capable of selecting alternate Source Address itself, cannot be changed. |
| **Cannot Claim Address** | | | | | |
| **PGN** | | PF | PS | SA | Parameter Group Definition |
| **0xEE00(60928)** | | **238** | **255** | **254** | **PDU1 Format** |
| **Data Byte** | Length | Parameter Name | | | Format |
| **1** | 21 bits | Identity Number | | | SPN 2837, Manufacturer Serial Number |
| **3.6** | 11 bits | Manufacturer Code | | | SPN 2838, 71 – Vansco, cannot be changed |
| **5.1** | 3 bits | ECU Instance | | | SPN 2840,  ECU Instance is 0. |
| **5.4** | 5 bits | Function Instance | | | SPN 2839, Function Instance is 0. |
| **6** | 1 byte | Function | | | SPN 2841, speed sensor function for industry group and vehicle system. |
| **7.1** | 1 bit | Reserved | | | 0 |
| **7.2** | 7 bits | Vehicle System | | | SPN 2842, Vehicle System is 0. |
| **8.1** | 4 bits | Vehicle System Instance | | | SPN 2843, Vehicle System Instance is 0. |
| **8.5** | 3 bits | Industry Group | | | SPN 2846, Industry Group is 0. |
| **8.8** | 1 bit | Arbitrary Address Capable | | | SPN 2844, 0 – Speed Sensor is not capable of selecting alternate Source Address itself, cannot be changed |

| **DM1(1) Messages** | | | | | | | |
|---|---|---|---|---|---|---|---|
| PGN<br>**0xFECA (65226)** | | PF<br>**255** | PS<br>**202** | SA<br>**SA** | Parameter Group Definition<br>**Proprietary B** | Default Priority<br>**6** | Default Broadcast Interval **1 sec**(2) |
| **Data Byte** | Length | Parameter Name | | | Format | Value | Description |
| **1** | 2 bytes | Unused bytes | | | Unsigned Integer | 0xFFFF | Reserved. |
| **3** | 19 bits | SPN(3) | | | Unsigned Integer | 0x7F000 | Proprietary SPN, used to indicate an error with the hall effect sensor. |
| **5.4** | 5 bits | FMI | | | Unsigned Integer | 0 or 8 | 0 - speed is greater than 10 kHz.<br>8 - Either of the two hall sensor outputs is missing. |
| **6** | 1 bit | SPN Conversion Method | | | Unsigned Integer | 0 | Speed Sensor uses version 4 conversion method. This requires that the SPN conversion mode is zero. |
| **6.2** | 7 bits | Occurrence Count(4) | | | Unsigned Integer | 0 to 126 | - |
| **7** | 2 bytes | Unused Bytes | | | Unsigned Integer | 0xFFFF | Reserved |

| **DM1 Example (No Error)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Identifier | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | | **D6** | **D7** |
| 18FECA80 | 0xFF | 0xFF | 0x00 | 0x00 | 0x00 | 0x00 | | 0xFF | 0xFF |
| DA = 0xF9,<br>SA = 0x80(Speed Sensor). | Unused | | 19 bits – Proprietary SPN | | 5 bits - FMI | 1-bit SPN | 7 bits - Occur. Count | Unused | |

1. DM1 messages represent the currently active diagnostic trouble codes (DTCs).
2. A DM1 message will be transmitted, regardless of the presence or absence of any DTC, once every second and on state change. No more than one state change per DTC per second be transmitted.
3. The 19-bit Suspect Parameter Number is used to identify the item for which diagnostics are being reported.
4. The 7-bit Occurrence Count field contains the number of times a fault has been independently detected. The occurrence count will not be incremented from 126 to 127.

## 7.8 Request and Response Messages

| **SOFT, CI and Address Claim Message Request** | | | | | |
|---|---|---|---|---|---|
| ***J1939 Request PGN(3)(4)(5)*** | | | | | |
| PGN | | PF | PS | SA | Parameter Group Definition |
| 0xEA00 (59904) | | **0xEA(234)** | **DA(2)** | **SA** | **PDU1 Format** |
| Data Byte | Length | Parameter Name | | | Format |
| 1 | 3 bytes | Supported PGN list(1), LSB First | | | |
| 4 | 5 bytes | Reserved | | | 0xFF |

1. The GS100 supports request messages sent to the following PGN:
   - 0x00EE00 – Address Claimed
   - 0x00FEDA – Software Identification (SOFT)
   - 0x00FEEB – Component Identification (CI)
2. The request message may be sent to the specific Source address (0-253) or the Global destination address (255).
3. The GS100 will respond to a request message for Address Claimed with a successful Address Claimed (AC) message before resuming other transmissions; otherwise the Cannot Claim Address message will be sent, and the speed sensor will remain silent.
4. The GS100 will respond to a request message for Software Identification with the SOFT message.
5. The GS100 will respond to a request message for Component Identification with the Component Identification (CI) message.

**SOFT and CI Message Response**

***Software Identification – SOFT(1)(2)(3)***

| PGN | PF | PS | SA | Parameter Group Definition |
|---|---|---|---|---|
| 0xFEDA (65242) | 254 | 218 | SA | PDU2 Format |

| Data Byte | Length | Parameter Name | Format |
|---|---|---|---|
| 1 | 1 byte | Number of Software Identification Fields | SPN 965, 4 (software number, software version type, software version major, software version minor) |
| 2 | 6 bytes | Software Description | 953604, 6 ASCII characters. |
| 7 | 1 byte | Software Type | ASCII character, ‘P’ = production, ‘B’ = beta |
| 8 | 1 byte | Software Major Version | Software major version, 1 ASCII character. |
| 9 | 2 bytes | Software Minor Version | Software minor version, 2 ASCII characters. |
| 11-N | Variable | Software Identification | SPN 234, ASCII characters, software number, software version type, software version major and software version minor, each parameter is followed by an ASCII ‘*’ delimiter. |

***Component Identification – CI(1)(2)***

| PGN | PF | PS | SA | Parameter Group Definition |
|---|---|---|---|---|
| 0xFEEB (65259) | 254 | 235 | SA | PDU2 Format |

| Data Byte | Length | Parameter Name | Format |
|---|---|---|---|
| A | 0 bytes | Make | SPN 586, Not used, replace with ASCII ‘*’ delimiter. |
| B | 7 bytes | Model | SPN 587, 7 ASCII characters, Parker SAP part number. |
| C | 7 bytes | Serial Number | SPN 588, 7 ASCII characters, identity number from NAME, set by parameter number 001. |
| D | 0 bytes | Unit Number (Power Unit) | SPN 233, Not used, replace with ASCII ‘*’ delimiter.<br>Note: Each parameter is followed by an ASCII ‘*’ delimiter even if not used. |

1. Transport protocol (RTS/CTS for destination specific or BAM for global request) is required since the number of data bytes exceeds 8.
2. Sent in response to request PGN (See SOFT, CI and Address Claim Message Request Table).
3. Requesting the SOFT message will not impact the transmission of the functional message.

| Version Request and Response Messages | | | | | |
|---|---|---|---|---|---|
| ***Version Request Messages Received by Speed Sensor Application or Bootloader*** | | | | | |
| PGN | | PF | PS | SA | Parameter Group Definition |
| 0xEF00 (61184) | | 239 | DA | SA | Proprietary A |
| Data Byte | Length | Parameter Name | | | Format |
| 1 | 1 byte | Command type | | | Unsigned Integer, message function for version number request. Value is 0x12. |
| 2 | 1 byte | Request type | | | Unsigned Integer, Boot block Version Number- 100, boot block Part Number-101, Application Version Number-110, Application Part Number-111, boot block Version Number with mode- 0x00 or 0xFF. |
| 3 | 5 bytes | Reserved | | | 0xFF |
| ***Response to Request for Version Number*** | | | | | |
| PGN | | PF | PS | SA | Parameter Group Definition |
| 0xEF00 (61184) | | 239 | DA | SA | Proprietary A |
| Data Byte | Length | Parameter Name | | | Format |
| 1 | 1 byte | Version Number Response Command | | | Unsigned Integer, message function for version number request.<br>Value is 0x13 |
| 2 | 1 byte | Request type or Operating mode | | | If the request type is 0xFF or 0x00, this byte indicates operating mode. 0- Run mode, 1- Reprogramming mode, otherwise this byte indicates request type. |
| 3 | 2 bytes | Software Version | | | Ex: If the Version number is 104. 1-Major version, 04-minor version (LSB byte first).<br>The version number will be indicated by 0x68 in hex. |
| 5 | 2 bytes | Hardware Version | | | Ex: if the Version number is 104. Means 1-Major version, 04-minor version (LSB byte first). |
| 7 | 1 byte | Software Build Number | | | Unsigned Integer, build number. |
| 8 | 1 byte | Reserved | | | 0xFF |
| ***Response for version request messages, If the request type is for part number*** | | | | | |
| PGN | | PF | PS | SA | Parameter Group Definition |
| **0xEF00 (61184)** | | **239** | **DA** | **SA** | **Proprietary A** |
| Data Byte | Length | Parameter Name | | | Format |
| 1 | 1 byte | Version number response command | | | Unsigned Integer, message function for version number request.<br>Value is 0x13 |
| 2 | 1 byte | Request type | | | |
| 3 | 4 bytes | Part Number | | | Unsigned Integer, 953604- Speed Sensor application, 953612- Speed Sensor bootloader. (LSB byte first MSB byte last). |
| 7 | 1 byte | Reserved | | | 0xFF |

## 7.9 Sensor Configuration Messages

| Configuration Message Format | | | | | |
|---|---|---|---|---|---|
| Speed Sensor Configuration Parameter Read/Write/Response(1) | | | | | |
| PGN | | PF | PS | SA | Parameter Group Definition |
| 0xEF00 (61184) | | **239** | **DA**(2) | **SA** | **Proprietary A** |
| Data Byte | Length | Parameter Name | | | Format |
| 1 | 1 byte | Command Type | | | Unsigned Integer, message function for configuring Speed Sensor. Value is 0x81. |
| 2 | 1 byte | Configuration Parameter Number | | | Unsigned Integer, configuration parameter to read/write (see Configuration Parameters, Table 9) |
| 3 | 1 byte | Read/Write/Response | | | 0 = Read Configuration Parameter, 1 = Write configuration parameter, 2 = Response from Speed Sensor |
| 4 | Up to 5 bytes | Data | | | Configuration parameter specific data (see Configuration Parameters, Table 9)<br>**Note: Data may be omitted or set to all 1's for read request** |

1. After receiving a valid read message, the speed sensor will send a response message with the Destination Address (DA) set to the Source Address of the requestor. For write messages, Speed Sensor will not give response or acknowledgement.
2. When sending a read/write message the Destination Address (DA) will be the Source Address of the Speed Sensor receiving the message. Some examples for the configuration parameters read/write messages can be found at the end of the document.

| Configuration Parameters | | | | | |
|---|---|---|---|---|---|
| **Parameter Number** | **Speed Sensor Configuration Parameter** | **R/W Capable** | **Length** | **Format** | **Default** |
| 001 | Reserved | NC | - | - | - |
| 002 | Message Rate | R/W | 2 bytes | Unsigned Integer, valid range: valid range: 10 to 2000 ms | 50 ms |
| 003 | Moving Average Filter Sample Size | R/W | 1 byte | Unsigned Integer, valid range: 1 to 15. | 8 |
| 004 | PGN for Broadcast Messages | R/W | 2 bytes | Unsigned Integer. valid range: 0x0000 to 0xFFFF. | 0xFF75 |
| 005 | CA Baud rate | R/W | 1 byte | Unsigned Integer,<br>0 = 125 kbps<br>1 = 250 kbps<br>2 = 500 kbps<br>3 = 1000 kbps | 1<br>(250 kbps) |
| 006 | CA Base Source Address(1) | R/W | 1 byte | Unsigned Integer, valid range: 0 to 253, 254 = NULL, 255 = global | Input Resistor, else 0x80 |
| 007 | Hardware Revision Number | R | 5 bytes | Unsigned. YR, WK, 04, Number<br>020,01,04,1 = 2020, first week, 04, first unit of that week | - |

1. On power ON, Speed Sensor considers ADC resistor input source address. If the resistor value is >10k, then it will consider the value in flash. If no value is available in flash, then 0x80 default source addresses will be used.

   Resistor input modified during running will not change the source address or store the value in flash. When source address is modified using CA message, it will update during runtime and stores in flash. If the source address value changed using CAN message is out of range, Speed Sensor will ignore the request.

# 8 Application Examples/How Do I…

## 8.1 Read/Write Sensor's Message Rate

| Example - Read Configuration Parameter, Message Rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EFF980 | 0x81 | 2 | 0 | FF | FF | FF | FF | FF |
| DA = 0x80 (Speed Sensor)<br>SA = 0xF9 | Command Type | Configuration Parameter Number | Read Configuration | Reserved Bytes | | | | |

| Example - Response for Read Configuration Parameter, Message Rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EF80F9 | 0x81 | 2 | 2 | 0x0A | 0 | 00 | 00 | 00 |
| DA = 0xF9<br>SA = 0x80 (Speed Sensor) | Command Type | Configuration Parameter Number | Response | Data D3(LSB),D4(MSB) | | Unused Bytes | | |

| Example - Write configuration parameter, Message Rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EFF980 | 0x81 | 2 | 1 | 0x0A | 0 | FF | FF | FF |
| DA = 0x80(Speed Sensor)<br>SA = 0xF9 | Command Type | Configuration Parameter Number | Write Operation | Data D3(LSB),D4(MSB) | | Reserved Bytes | | |

- For configuration parameter write operation, Speed Sensor will not send any acknowledgment or response.

## 8.2 Read/Write Example for Sensor's Moving Average Filter Sample Size

| Example - Read Configuration Parameter, Moving Average Filter Sample Size | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EFF980 | 0x81 | 3 | 0 | FF | FF | FF | FF | FF |
| DA = 0x80(Speed Sensor)<br>SA = 0xF9 | Command Type | Configuration Parameter Number | Read Configuration | Reserved Bytes | | | | |

| Example - Response for Read Configuration Parameter, Moving Average Filter Sample Size | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EF80F9 | 0x81 | 0x03 | 0x0A | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 |
| DA = 0xF9<br>SA = 0x80(Speed Sensor) | Command Type | Configuration Parameter Number | Data | Unused Bytes | | | | |

| Example - Write Configuration Parameter, Moving Average Filter Sample Size | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EFF980 | 0x81 | 3 | 1 | 0x0A | FF | FF | FF | FF |
| DA = 0x80(Speed Sensor)<br>SA = 0xF9 | Command Type | Configuration Parameter Number | Write Operation | Data | Reserved Bytes | | | |

## 8.3 Read/Write Example for Sensor's Broadcast Status Message PGN

| Example - Read Configuration Parameter, Message Rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EFF980 | 0x81 | 4 | 0 | FF | FF | FF | FF | FF |
| DA = 0x80(Speed Sensor)<br>SA = 0xF9 | Command Type | Configuration Parameter Number | Read Configuration | Reserved Bytes | | | | |

| Example - Response for Read Configuration Parameter, Message Rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EF80F9 | 0x81 | 4 | 2 | 0x75 | 0xFF | 0 | 0 | 0 |
| DA = 0xF9,<br>SA = 0x80(Speed Sensor) | Command Type | Configuration Parameter Number | Response | Data D3(LSB),D4(MSB) | | Unused Bytes | | |

| Example - Write Configuration Parameter, PGN For Broadcast Messages | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EFF980 | 0x81 | 4 | 1 | 0x75 | 0xFF | FF | FF | FF |
| DA = 0x80(Speed Sensor)<br>SA = 0xF9 | Command Type | Configuration Parameter Number | Write Operation | Data D3(LSB),D4(MSB) | | Reserved Bytes | | |

## 8.4 Read/Write Example for Sensor's CAN Baud Rate

| Example - Read Configuration Parameter, CAN Baud Rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Identifier | D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 |
| 18EFF980 | 0x81 | 5 | 0 | FF | FF | FF | FF | FF |
| DA = 0x80(Speed Sensor)<br>SA = 0xF9 | Command Type | Configuration Parameter Number | Read Configuration | Reserved Bytes | | | | |

| Example - Response for Read Configuration Parameter, CAN Baud Rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EF80F9 | 0x81 | 0x05 | 0x02 | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 |
| DA = 0xF9<br>SA = 0x80(Speed Sensor) | Command Type | Configuration Parameter Number | Data | Unused Bytes | | | | |

| Example - Write configuration parameter, CAN Baud Rate (1) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18EFF980 | 0x81 | 5 | 1 | 0 | FF | FF | FF | FF |
| DA = 0x80(Speed Sensor)<br>SA = 0xF9 | Command Type | Configuration Parameter Number | Write Operation | Data | Reserved Bytes | | | |

## 8.5 Configuring Source Address using CAN Command

| Example - Configuration of Source Address using CAN Command (1) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Identifier** | **D0** | **D1** | **D2** | **D3** | **D4** | **D5** | **D6** | **D7** |
| 18ECFF44 | 20(2) | 9 | 0 | 2 | FF | D8 | FE | 0 |
| 18EBFF44 | 1(3) | FF | F5 | E1 | 8 | 0 | 0 | 0 |
| 18EBFF44 | 2(4) | 0 | 5 | FF | FF | FF | FF | FF |
| DA = 0x80(Speed Sensor)<br>SA = 0xF9 | Command Type | Configuration Parameter Number | Write Operation | Data | Reserved Bytes | | | |

1. Two methods can configure the Source Address; Resistor input and Commanded Address Message.
2. Commanded Address message will be sent to Speed Sensor by using BAM message, As the message contains more than 8bytes. It includes, NAME field of the sensor (for which source address need to modify – 8bytes) and source address value need to set – 1byte. Total message includes 9 bytes of information.
3. Connection management for Transport protocol BAM message as per J1939-21 standard.
4. Packet Number.

# 9 FAQ

The FAQ for GS100 can be found at http://blog.parker.com/faqs for additional product support.

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