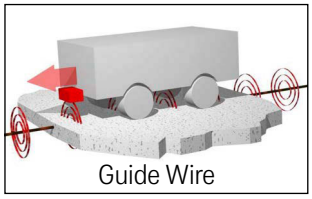


Multifrequency Sensor, Inductive, USB

HG G-19370-B/HG G-19380-B

Inductive track guidance along a guide wire / energy track, Variants
HG G-19370: 20/25 kHz Energy Track, ZB: CAN-Bus, YB: Profinet
HG G-19380: 140 kHz Energy Track, ZB: CAN-Bus, YB: Profinet

English, Revision 07	Date: 26.10.2023	Dev. by: LF	Author(s): RAD

Summary

Characteristics of the inductive guidance sensor HG G-19370-B/HG G-19380-B:

• 5 programmable simultaneously usable frequencies (2 – 20 kHz) • If there is an existing ground installation for the contact-less inductive energy transmission (energy track) this can also be used for the track guidance: HG G-19370: 20/25 kHz, 140 mm wire spacing, 85 A HG G-19380: 140 kHz, 110 mm wire spacing, 45 A Within the zone of influence of an active energy track guide wire signals can not be used.	• Works with single wire and double wire installations • IP 54, Indoor • Reading height: 40 – 200 mm, nominal reading height 60 mm, customizable via programmable gain • Version ZB: CAN/CANopen® interface • Version YB: Profinet® interface • USB interface • Serial interface service/configuration (via USB Virtual Port Driver) • Possibility to connect and evaluate an incremental encoder

The Götting KG in D-31275 Lehrte has a certified quality management system according to ISO 9001.

Contents

1 About this Document

1.1 Function

This device description contains information regarding the correct mounting, electric installation, commissioning and maintenance of the inductive guidance sensor HG G-19370-B/HG G-19380-B for the technical personnel of a manufacturer who wants to integrate the sensor into an automated guided vehicle (AGV).

This device description does not contain information regarding the usage of the superordinate system, e.g. the automated guided vehicle (AGV). For this information consult the documentation of the vehicle manufacturer resp. the operator of a facility.

This device description applies to devices with firmware version 1.07 and higher (see Figure 10 on page 20).

1.2 Presentation of Information

For you to be able to use your product simply and safely this device description uses consistent warning notices, symbols, terms and abbreviations. Those are described in the following sections.

1.2.1 Warning Notices

In this device description warning notices appear before sequences of actions that may lead to damage to persons or property. The listed actions for the danger prevention have to be observed.

Warning notices have the following structure:

⚠ SIGNAL WORD

Kind or source of the danger

Consequences

▶ Danger prevention

- The **warning symbol** (warning triangle) indicates danger to life or risk of injury.
- The **signal word** indicates the severity of the danger.
- The paragraph **kind or source of the danger** names the kind or source of the danger.
- The paragraph **consequences** describes the consequences of not observing the warning notice.
- The paragraphs for **danger prevention** explain, how to avoid the danger.

The signal words have the following meanings:

Table 1 *Hazard classification according to ANSI Z535.6-2006*

Warning Symbol, Signal Word	Meaning
DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	NOTICE indicates property damage: The product or the environment could be damaged.

1.2.2 Symbols

In this device description the following symbols and formatting are used:

If this information is ignored the product may not be operated in an optimal way.

Indicates one or more links to the Internet.

- www.goetting.de/xxx
- www.goetting.de/yyy

Indicates tips for easier operation of the product.

✓ The check mark lists a requirement.

▶ The arrow shows an action step.
The indentation shows the result of an action or an action sequence.

- Program texts and variables are indicated through the use of `a fixed width font`.
- Menu items and parameters are shown in *cursive characters*.
- Whenever the pressing of letter keys is required for program entries, the required L etter K eys are indicated as such (for any programs of Götting KG small and capital letters are equally working).

2 Introduction

The inductive guidance sensor HG G-19370-B/HG G-19380-B is used for the inductive track guidance of Automated Guided Vehicles (AGV). Up to 5 different guide wire frequencies may be detected and evaluated simultaneously. If there is an existing ground installation for the contact-less inductive energy transmission with two wires (from here on also *energy track*) this can also be used for the track guidance. Within the zone of influence of an active energy track guide wire signals can not be used.

The guide wire frequencies to be detected are configured via the USB interface. The energy track depends on the variant of the inductive guidance sensor and is supported in the implementations listed in Table 2 below. Additionally an incremental encoder for the measurement of distance or speed may be connected directly to the sensor. All incremental encoders can be used that have a switching threshold > 10 V between high level and low level (typically 24V incremental encoders). The encoder values are also output via the bus.

2.1 Variants/Versions

The inductive guidance sensor is available in two different variants with different bus / interface types. The variant is printed on the device‘s identification label.

Table 2 *Variant Overview*

Variant		Interface	Energy Track
HG G-19370	ZB	CAN Bus	25 kHz, 140 mm wire spacing, 85 A
	YB	Profinet	
HG G-19380	ZB	CAN Bus	140 kHz, 110 mm wire spacing, 45 A
	YB	Profinet	

2.2 Range of Use

- The inductive guidance sensor is intended for indoor usage.
- Inside the track a guide wire is layed that is operated in the frequency range 2 to 20 kHz. If there is an existing ground installation for the contact-less inductive energy transmission this can also be used for the track guidance. These energy tracks are supported in the implementations listed in Table 2 above. A matching variant of the inductive guidance sensor has to be used. Within the zone of influence of an active energy track guide wire signals can not be used.
- The inductive guidance sensor can follow turn-offs in guide wire installations by using different frequencies for the different wires.
- The inductive guidance sensor can **not follow** turn-offs in energy track installations. Thus the energy track may not have switch points. For energy track installations with switch points Götting has different antennas with more than one detection system.
- The inductive guidance sensor is installed so that its underside faces the roadway and meets the nominal reading distance towards the guide wire.

2.3 Qualification of the Users

The personnel intended to operate the inductive guidance sensor

- ✓ has been provided with this documentation.
- ✓ is familiar with the functionality of the inductive guidance sensor.
- ✓ is trained sufficiently in mounting and configuring the inductive guidance sensor and qualified to perform those tasks.
- ✓ knows the risks posed by driverless vehicles and is trained in the necessary safety precautions to assess the safe operational state of the system.

All personnel in the area of influence of the inductive guidance sensor is instructed regarding the kind of the vehicle and the risks resulting from the driverless operation.

2.4 Intended Use

The inductive guidance sensor HG G-19370-B/HG G-19380-B is intended for the track guidance of automated guided vehicles (AGV) along guide wires or ground installations for the contact-less inductive energy transmission (energy track). The sensor detects the magnetic field above a guide wire or energy track with active current flowing through it and continually calculates the actual deviation from the center of the track. This deviation information is output via the bus.

DANGER

Missing protection equipment

The inductive guidance sensor does not contain functionality to detect obstacles or persons in front of a vehicle.

- ▶ The vehicle manufacturer resp. operator has to include suitable safety equipment.

DANGER

The vehicle leaving the track

Interferences as specified in section 3.3.1 on page 11 may lead to inaccurate outputs whereby the vehicle may leave the track.

- ▶ The vehicle manufacturer resp. operator has to include functionality to detect this and stop the vehicle if needed

As an aid the *Detect* signal may be used (see below)

In case the inductive guidance sensor is used for other purposes than specified above or is modified all warranties against the Götting KG are null and void.

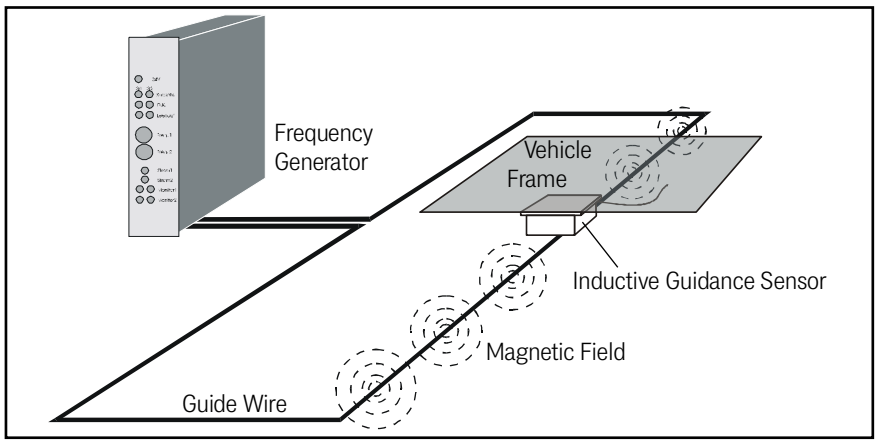
The sensor is only used according to section 2.2 on page 7. The sensor is only mounted, configured, commissioned, operated, maintained and dismounted by personnel according to section 2.3 on page 8.

2.5 Functional Principle

The functional principle below is explained using a guide wire installation. An energy track installation has slightly different voltage curves but the basic principle is the same.

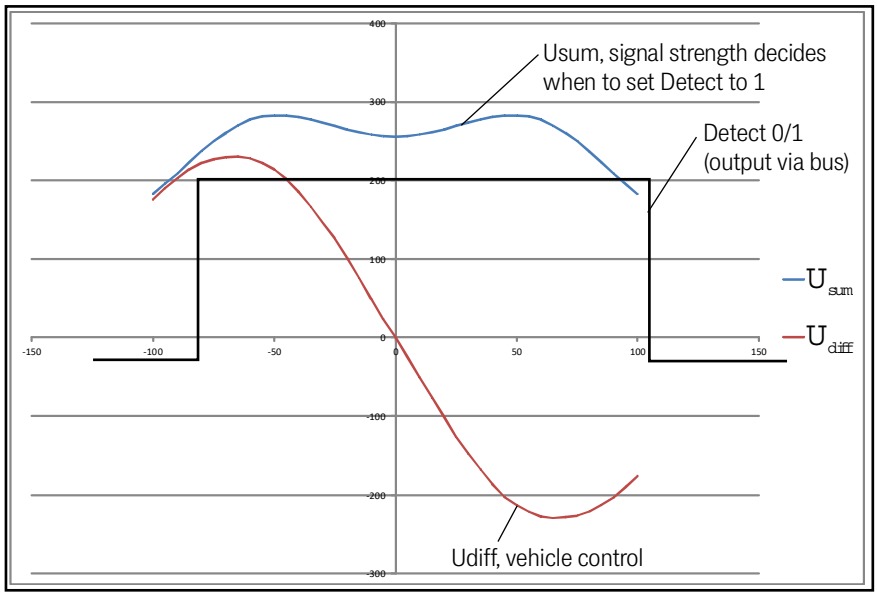
A frequency generator feeds a current into a guide wire installed in the ground. Along this wire an alternating magnetic field is generated. The sensor measures the magnitude of the induced voltage in two horizontal coils.

Figure 1 *Principle of the guide wire track guidance*



By evaluating the voltages induced in the two horizontal coils for each frequency a sum and difference signal are calculated – U_{sum} and U_{diff} – and output via the bus. The difference signal shows maxima at both sides of the wire (one positive and one negative) and crosses zero directly above the wire. Thus it may be used to control the vehicle.

Figure 2 *Voltage curves guide wire track guidance: Sum / difference signal and Detect*



Due to the two coils the sum voltage may show two maxima. This depends on the distance to the guide wire. The sum voltage is solely used to detect a guide wire (Detect signal). For this a detector circuit is implemented. The detector sets the *Detect signal* to 1 for valid frequencies if the sum voltage exceeds a defined threshold.

Vehicle manufacturers may use the *Detect signal* as an aid to detect whether the vehicle leaves the track.

3 Mounting

3.1 Guide Wire

The guidelines for the ground installation of guide wires are explained in a separate document. You can download the PDF file from the following address (section Application Examples and Downloads):

http://www.goetting-agv.com/components/inductive/introduction

3.2 Energy Track

An existing ground installation for the contact-less inductive energy transmission is used. The inductive guidance sensor is available in different variants for common energy track installations, s. Table 2 on page 7.

3.3 Inductive Guidance Sensor

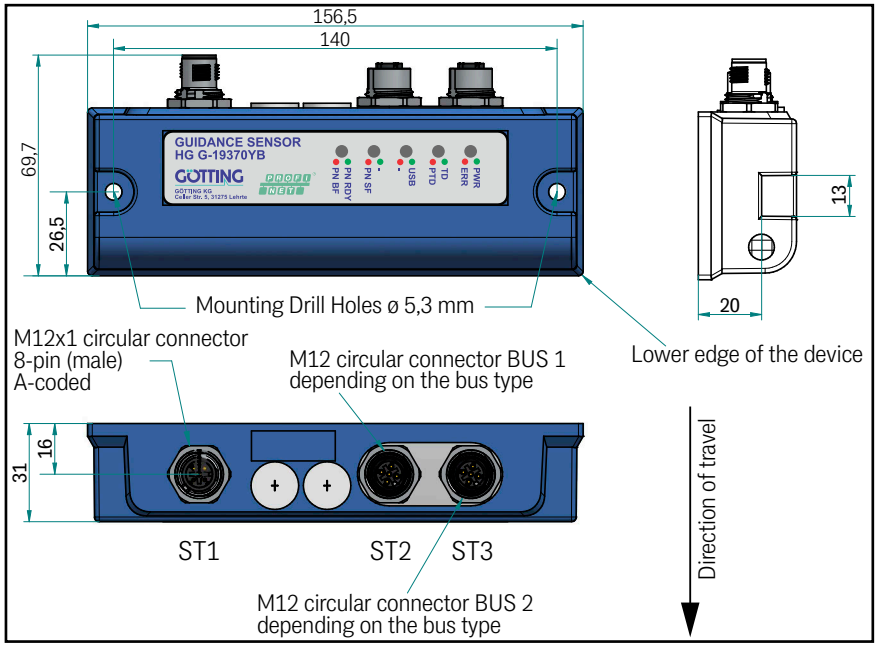
3.3.1 Requirements

Additional magnetic fields close to the sensor can affect the system characteristics. Therefore:

- The limit value for the magnetic field of e.g. transverters/engines/wire connections at the position of the inductive guidance sensor is circa 0,01 A/m.

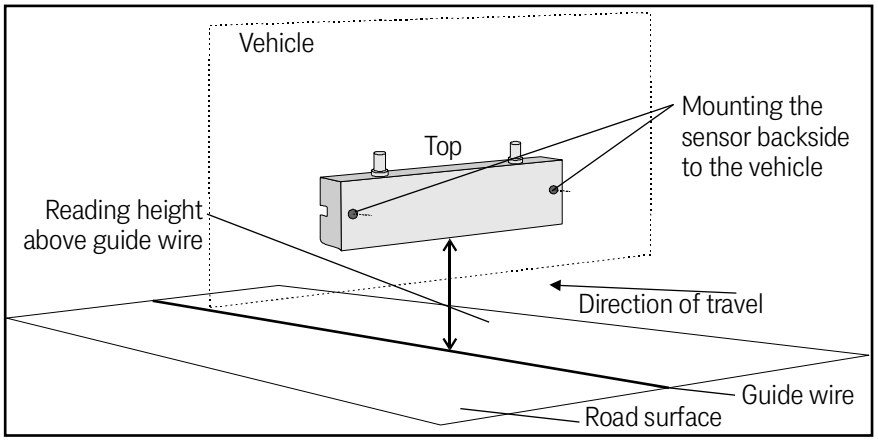
3.3.2 Mounting on the Vehicle

Figure 3 *Casing dimensions and mounting drill holes (all variants)*



The inductive guidance sensor has two mounting drill holes with a diameter of 5.3 mm each with which it can be mounted by putting screws through the holes. The drill holes have a distance of 140 mm to each other (center of hole <—> center of hole). The inductive guidance sensor is to be mounted diagonally to the direction of travel with the connectors facing upwards (first sketch in Figure 3 above). The recommended reading height is 40 to 200 mm from the bottom edge of the casing to the guide wire. Nominal reading height is 60 mm.

Figure 4 *Possible mounting position for the inductive guidance sensor*



3.3.3 Connection Cables (assembled on one side) / Terminating Resistors

Continue by connecting the sensor to the vehicle control. For this you can use the connectors ST 1, ST 2 and ST 3. The pin assignment is shown in section 5.1.2 on page 15 so that you can make matching cables yourself that fit onto the standard M 12 connectors.

NOTICE

Interferences of the CAN bus communication

Unshielded cables do not offer sufficient interference resistance.

▶ For CAN shielded cables have to be used.

Alternatively the following connection cables can be ordered from Götting that are pre-assembled on one side, the sensor side. The other side is a cable tail. ST 1 is the same for all versions of the sensor. If you use the CAN bus version HG G-19370ZB/ HG G-19380ZB you can also order cables/terminators for ST 2 and ST 3. For the Profinet version HG G-19370ZB/HG G-19380ZB there are no pre-configured cables for ST 2 and ST 3 available.

Table 3 *Accessories / connection cables / terminators*

Possible Connection Cables			
Connector	**Version**	**Order No.**	**Description**
ST 1	19370/80ZB	HW CAB00008	Connection cable, PUR, 5 m, one-sided M12 8 pin socket, A coded, straight
	19370/80YB		
ST 2	19370/80ZB	HW CON00055 or self-tailored	– CAN bus jack M12 with terminating resistor, 5 pin, A coded, if the sensor is the last device on the CAN bus – Alternatively the CAN bus may be connected through to further devices with a self-made cable
	19370/80YB	self-tailored	Profinet
ST 3	19370/80ZB	HW CAB00064	Connection cable CAN bus, 10 m, 5-pol., with shielding, one-sided M12 socket straight, A coded
	19370/80YB	self-tailored	Profinet

4 Commissioning

The inductive guidance sensor is pre-configured for a reading height of 60 mm and the frequencies ordered by the customer. Thus it can theoretically be used without an explicit commissioning.

The configuration has to be changed if the CAN bus version HG G-19370ZB/HG G-19380ZB is used or an incremental encoder is to be connected. The Profinet interface of version HG G-19370YB/HG G-19380YB does not have to be configured.

The CAN parameters have to be changed if — as is done in many applications — two guidance sensors are mounted to one vehicle. Then the sensors need different Node IDs. Thus at least one of the sensors has to have a different Node ID assigned.

For the commissioning configuration the USB interface is used. Connect it to your PC as described in section 6.2 on page 19. Start a compatible terminal program on the PC and open the guidance sensor‘s service program in it (section 6.4 on page 20). With the service program you can e.g. alter the following settings.

Depending on the application and the version the following settings may need to be changed:

1. The six frequencies (they are pre-set according to what the customer ordered)
2. The gain and the thresholds (the sensor is pre-configured to a reading height of 60 mm, for the adaption to higher reading distances these can be changed)
3. CAN-BUS Node ID (if two inductive guidance sensors are used on the same vehicle they need to have different Node IDs, so at least one of them need to be re-configured)
4. CAN-BUS Baudrate (for adapting the CAN bus speed used in the vehicle)
5. Incremental encoder mode (if an incremental encoder is to be connected)

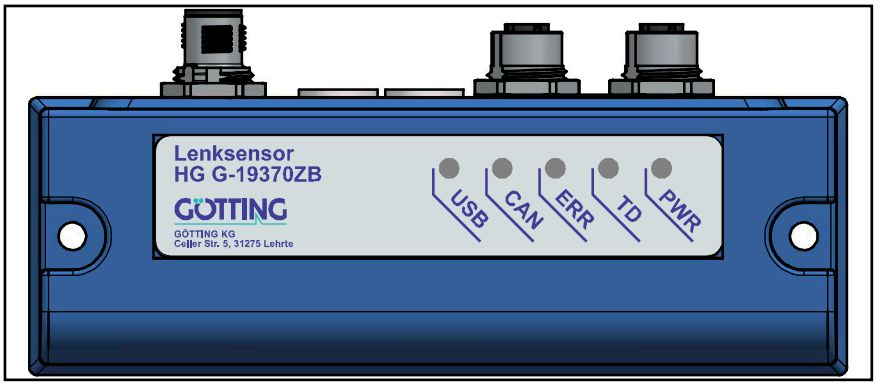
5 Hardware

5.1 HG G-19370ZB/HG G-19380ZB (CAN Bus)

5.1.1 LEDs

Five LEDs allow a function check.

Figure 5 *HG G-19370/80ZB (CAN): Position of the LEDs*



LEDs are used, which can light up green or red.

Table 4 *HG G-19370/80ZB (CAN): Function of the LEDs*

LED		Function
PWR	●	lit when operating voltage is connected
	●	lit for errors (controller has detected an incorrect state during initialization)
TD	●	Track Detect, lit when a guide wire is detected (sum voltage higher than configured threshold)
	●	lit when an energy track is detected
ERR	●	–
	●	lit for CAN bus errors
CAN	●	– blinking periodically when the sensor is ready for CAN bus communication – lit permanently during active CAN bus communication
	●	–
USB	●	lit when a PC is connected (see section 6.2 on page 19)
	●	–

5.1.2 Pin Assignment

The inductive guidance sensor has three connectors. The 8 pin plug ST 1 combines the USB interface and allows to connect an incremental encoder. The USB connection to a PC can be used to configure the sensor (see section 6.4 on page 20). The 5 pin connectors CAN 1 and CAN 2 are used for the CAN bus communication. The power supply is alternatively possible via ST 1 (USB 5V configuration only to Ub 24V) or the CAN bus plugs (Ub 24V). Matching connection cables are listed in section 3.3.3 on page 12.

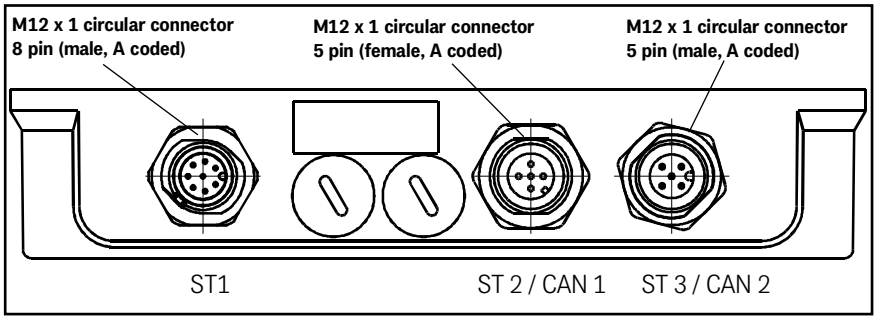
NOTICE

Interferences of the CAN bus communication

Unshielded cables do not offer sufficient interference resistance.

▶ For CAN shielded cables have to be used.

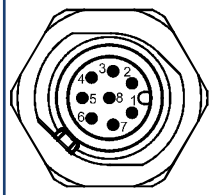
Figure 6 *HG G-19370/80ZB (CAN): Position of the connectors*



5.1.2.1 ST 1

8 pin M 12 panel plug (A coded)

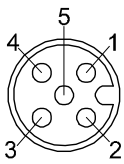
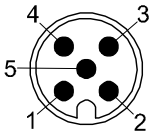
Table 5 *HG G-19370/80ZB (CAN): Pin assignment ST 1 8 pin*

ST 1, male, A-codiert	Pin	Signal	
	1	VBUS (5V via USB from the PC) or +Ub	
	2	GND	Incremental encoder signals
	3	Track A	
	4	Track B	
	5	Index Z	
	6	D+ (USB)	
	7	D- (USB)	
	8	GND	

5.1.2.2 ST 2 / ST 3 (CAN 1 / CAN 2)

5 pin M 12 panel plugs (female / male)

Table 6 *HG G-19370/80ZB (CAN): Pin assignment ST 2 (CAN 1) and ST 3 (CAN 2), 5 pin*

ST 2, CAN 1, female, A coded	ST 3, CAN 2, male, A coded	Pin	Signal
		1	—
		2	+Ub
		3	GND
		4	CAN_H
		5	CAN_L

For information about the CAN bus communication see chapter 7 on page 27.

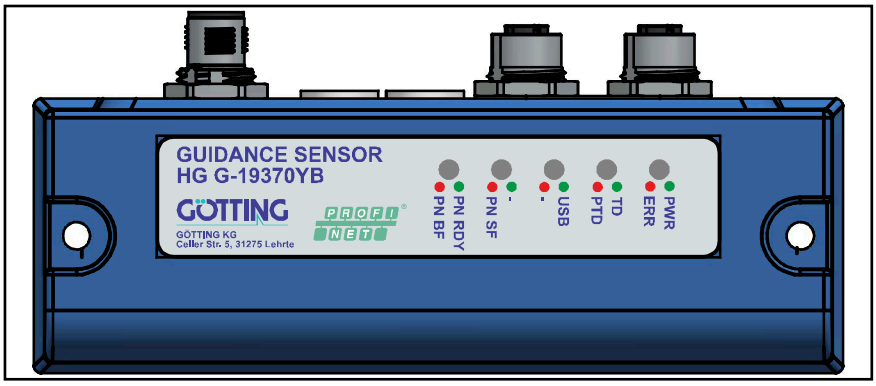
Typically the inductive guidance sensor is the last device in the device chain on the CAN bus. In this case a CAN terminating resistor (terminator) has to be plugged into one of the CAN connectors (see section 3.3.3 on page 12).

5.2 HG G-19370YB/HG G-19380YB (Profinet)

5.2.1 LEDs

Five LEDs allow a function check.

Figure 7 *HG G-19370/80YB (Profinet): Position of the LEDs*



LEDs are used, which can light up green or red.

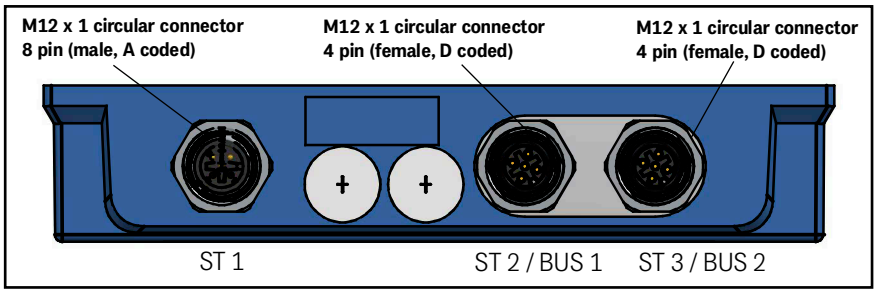
Table 7 *HG G-19370/80YB (Profinet): Function of the LEDs*

LED		Function
PWR	●	lit when operating voltage is connected
ERR	●	lit for errors (overmodulation of the amplifiers)
TD	●	Track Detect, lit when a guide wire is detected (sum voltage higher than configured threshold)
PTD	●	lit when an energy track is detected
USB	●	lit when a PC is connected (see section 6.2 on page 19)
–	●	–
–	●	–
PN SF	●	lit for Profibus errors
PN RDY	●	– lit when Profinet is ready – blinking periodically when waiting for Profinet synchronization
PN BF	●	– blinking periodically if a Profinet connection exists but there is no communication with the Profinet controller – lit when there is no Profinet connection available

5.2.2 Pin Assignment

The inductive guidance sensor has three connectors. The 8 pin plug ST 1 combines the USB interface and allows to connect an incremental encoder. The USB connection to a PC can be used to configure the sensor (see section 6.4 on page 20). The 4 pin connectors ST 2 and ST 3 are used for the Profinet communication. The power supply is realized via ST 1 (USB 5V configuration only up to Ub 24V).

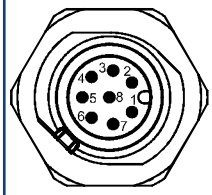
Figure 8 *HG G-19370/80YB (Profinet): Position of the connectors*



5.2.2.1 ST 1

8 pin M 12 panel plug (A coded)

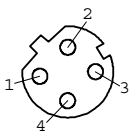
Table 8 *HG G-19370/80YB (Profinet): Pin assignment ST 1 8 pin*

ST 1, male, A coded	Pin	Signal	
	1	VBUS (USB, 5V- via USB from the PC) or +Ub	
	2	GND	Incremental encoder signals
	3	Track A	
	4	Track B	
	5	Index Z	
	6	D+ (USB)	
	7	D- (USB)	
	8	GND	

5.2.2.2 ST 2 / ST 3 (BUS 1 / BUS 2)

5 pin M 12 panel plugs (female / male)

Table 9 *HG G-19370/80YB (Profinet): Pin assignment ST 2 & ST 3 (Profinet, female) 4 pin*

ST 2 & ST 3, female, D coded	Pin	Signal
	1	TX+
	2	RX+
	3	TX-
	4	RX-

For information about the Profinet communication see chapter 8 on page 36.

6 Configuration

6.1 Turn-On Characteristic

The device is functional directly after switching it on (by connecting the operating voltage). It is ready to receive and send bus messages or to be configured via the USB interface.

6.2 Connection to a PC via the USB Interface

The inductive guidance sensor is equipped with a USB interface for the diagnosis, configuration and the update of its internal firmware. The USB interface is available via the 8 pin connector St 1. A connection cable is listed in section 3.3.3 on page 12. You have to attach a USB adapter/plug yourself to the following pins.

NOTICE

Damage to the inductive guidance sensor, computer or other devices connected via USB

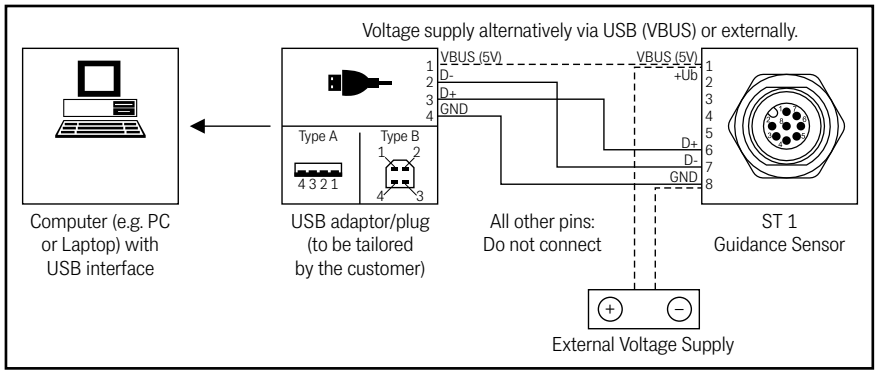
If an external power supply and the VBUS power supply are connected at the same time, +Ub is switched to the USB interface of the computer, which can damage the interface.

- Only connect either the VBUS (5V-) power supply or the external power supply.
- If you use the external power supply, leave pin 1 unconnected.

The USB interface does not have a leading ground contact. If you plug in or unplug USB connectors while an external power supply is connected to the inductive guidance sensor, voltage spikes can occur that will damage the devices connected via USB.

- When using an external power supply, always disconnect the steering sensor from the power supply before plugging or unplugging USB connectors. When all connections are made, turn on the external power supply to use the USB connection.

Figure 9 *Connection example: Connection to the USB interface of a PC*



The PC with Microsoft® Windows® needs to have the STM32 Virtual COM Port Driver (STSW-STM32102) installed. This driver offers a virtual COM port. This COM port (serial interface) can be used to establish a connection with a terminal program (see below). If the STM32 Virtual COM Port Driver is not available via Plug & Play you can download a setup program for the driver from the following address:

http://www.st.com/en/development-tools/stsw-stm32102.html

6.3 Terminal Program

Every terminal program compatible with the ANSI emulation can be used, examples are HyperTerminal® or Tera Term®. HyperTerminal has been included in earlier versions of Microsoft® Windows®. Additionally it can be downloaded from the following address:

https://www.hilgraeve.com/hyperterminal/

Start the terminal program on the PC. The COM port has to be set to the port configured by the virtual port driver.

6.4 Service Program

When the connection inside the Terminal Program (see above) is successfully established press any key to make the following main menu appear.

6.4.1 Main Menu

The main menu differs for the sensor versions. For version HG G-19370ZB/HG G-19380ZB an additional CAN menu is available. The main menu always shows the five guide wire frequencies and the frequency of the energy track as well as the corresponding actual sum and difference values.

6.4.1.1 HG G-19370/80ZB (CAN)

Figure 10 *HG G-19370/80ZB (CAN): Main menu*

```
HG 19370 ZB V1.07                  Main menu                  Goetting KG

Frequencies:   5000  6000  7000  8000 10000 25000
Sum:              0     0     0     0   358     0
Dif:              0     0     0     0     0     0

Encoder:          0

1:  Frequency config
2:  Calibration config
3:  Encoder config
4:  Serial Data-Stream
5:  CAN config

U:  Firmware Update
```

6.4.1.2 HG G-19370/80YB (Profinet)

Figure 11 *HG G-19370/80YB (Profinet): Main menu*

```
HG 19370 YB V1.07                Main menu                  Goetting KG

Frequencies:   5000  6000  7000  8000 10000 25000
Sum:              0     0     0     0  358     0
Dif:              0     0     0     0    0     0

Encoder:          0

1:  Frequency config
2:  Calibration config
3:  Encoder config
4:  Serial Data-Stream

U:  Firmware Update
```

- [1] Frequency config, s. section 6.4.2 on page 21
- [2] Calibration config, s. section 6.4.3 on page 22
- [3] Encoder config, s. section 6.4.4 on page 23
- [4] CSV, s. section 6.4.5 on page 23
- [5] CAN config, s. section 6.4.6 on page 24 (only visible for version HG G-19370ZB/HG G-19380ZB)
- [U] Firmware Update, s. section 6.4.5 on page 23

6.4.2 (1) Frequency Config

Definition of the six frequencies for which the sum and difference signals are calculated. All sub menus may be quit by pressing any key that is not used in the respective menu.

Figure 12 *Menu Frequency Config*

```
HG 19370 xB V1.07            Frequency Config            Goetting KG

Frequencies:   5000  6000  7000  8000 10000 25000
Sum:              0     0     0     0  358     0
Dif:              0     0     0     0    0     0


1:  Edit 1. Frequency
2:  Edit 2. Frequency
3:  Edit 3. Frequency
4:  Edit 4. Frequency
5:  Edit 5. Frequency
6:  Edit Energy Frequency
```

6.4.3 (2) Calibration Config

In the calibration menu, the threshold values for detection, as well as the gain can be set.

Figure 13 *Menu Calibration Config*

```
HG 19370 ZB V1.07              Calibration Config             Goetting KG


Frequencies:    5000 5700 6300 7000 8000 25000
Sum:               0    0    0    0    0    0
Dif:               0    0    0    0    0    0
Gain 1:           13
Gain 2:           13
Threshold:       150
Lower unsecure Threshold:  25
Upper unsecure Threshold: 110
Detect mode:     normal

1: Edit Gain 1
2: Edit Gain 2
3: Edit Threshold
4: Edit lower unsecure Threshold
5: Edit upper unsecure Threshold
6: Edit detect mode
+: increase Gain
-: decrease Gain
s: save Gain
```

1/2: *Gain 1* and *Gain 2* set the gain for the induced voltages in the two coils. 0 is the minimum gain, 255 is the maximum value. This gain only relates to guide wire guidance. The induced voltage depends on the current in the guide wire and the distance between sensor and guide wire.

NOTICE

Overmodulation of the signal

A too high gain leads to an overmodulation of the signal.

- The gain should be chosen so that the sum of all simultaneously occurring sum and difference voltages is less than 3,3V.

As a guiding value the gain should be set so that the sum signal goes up to a maximum value of about 300.

+/-: These keys allow to increase/decrease the gain of both voltages *Gain1* and *Gain2*.

S: With this key changed gains are permanently stored and used for the evaluation.

3: The *Threshold* (in mV) defines above which sum level a guide wire is detected.

4/5: At the transition from a guide wire to an energy track there‘s an area where the guidance can not safely be guaranteed. *Lower unsecure Threshold* and *upper unsecure Threshold* define this area for the sum signal of the energy track. In this transition area (approx. 10 cm) in the status byte transmitted via the bus the bit *Frequency insecure* is set.

6: This is used to set the *Detect mode*. This determines whether a normal guide wire (*normal*) or a double wire (*two-wire mode*) is used for the 5 guide wire frequencies. The selection matching the installation is necessary, because only in two wire mode it is guaranteed that – in the case of a double wire – the *detect* signal (see section 2.5 on page 9) is only switched between the two wires.

6.4.4 (3) Encoder Config

Configuration of the mode of the incremental encoder.

Figure 14 *Menu Encoder Config*

```
HG 19370 xB V1.07                  Encoder Config          Goetting KG


Encoder max. Value: 65535
Encoder mode: A
Encoder polarity: Normal

1:  Edit max. Value
2:  Edit mode
3:  Edit polarity









Press any other key to quit
```

6.4.5 (4) CSV

Serial output of the sum and difference signals as Comma Separated Values (CSV). These values can be written to a file via the terminal program. Those files can then be imported into a spreadsheet application like Microsoft® Excel® and then evaluated. As long as the sum voltage is below the threshold 0 is output. The values for the induced voltages are output in mV as shown in Figure 2 on page 9.

Figure 15 *Example for a CSV output*

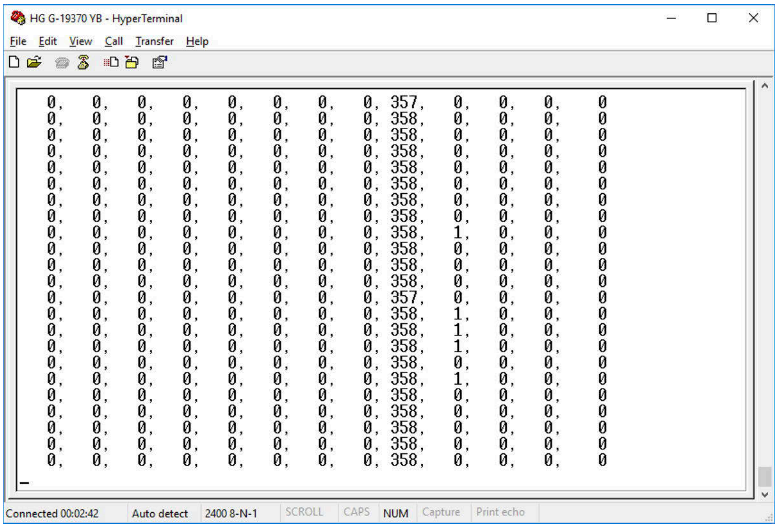


Table 10 *Meaning of the values output in the menu CSV*

Freq. 1		Freq. 2		Freq. 3		Freq. 4		Freq. 5		Energy Track		Encoder
Sum1	Diff1	Sum2	Diff2	Sum3	Diff3	Sum4	Diff4	Sum5	Diff5	Sum6	Diff6	Incr. Enc.

In case you want to have values output at all times you can temporarily set the Detect threshold in the menu Calibration Config to 0.

CAUTION

Invalid Detect Signal

A threshold of 0 means that the sensor permanently detects a track. Then *Detect Signal* can no longer be used as an aid to detect whether the vehicle leaves the track.

- Only ever set this threshold to 0 for testing purposes.

6.4.6 HG G-19370ZB/HG G-19380ZB: (5) CAN Config

In this menu it is possible to switch between CAN and CANopen® Mode. Depending on which mode is selected, different selection options are available.

If CAN settings are changed, the device must be restarted for the changed settings to take effect.

The sub menu CAN Status lists the reception and transmission counters as well as possible errors. Additionally CAN statistics are shown (RX packet counter, TX packet counter, error counter).

Figure 16 *Menu CAN Status*

```
HG 19370 ZB V1.07                CAN Config                      Goetting KG


 CAN TX Counter: 0
 CAN RX Counter: 0
 CAN ERROR Counter: 0
```

6.4.6.1 Mode CAN

Configuration of NodeID and Baudrate.

Figure 17 *Menu CAN config*

```
HG 19370 ZB V1.07                CAN Config                      Goetting KG


 Mode:            CAN
 NodeID:          1
 Baudrate:        250 kBit/s


 1: Edit Mode
 2: Edit NodeID
 3: Edit Baudrate
 4: CAN Status









 Press any other key to quit
```

6.4.6.2 Mode CANopen

Configuration of NodeID, baud rate, event time of the PDOs in ms and of the CANopen® transmission type (also refer to section 7.2.1 on page 29).

Figure 18 *Menu CANopen config*

```
HG 19370 ZB V1.07                CAN Config                      Goetting KG


 Mode:           CANopen
 NodeID:         1
 Baudrate:       250 kBit/s
 Eventtime PDO1: 10
 Eventtime PDO2: 10
 Eventtime PDO3: 10
 Eventtime PDO4: 10
 Transmission type: 255


 1: Edit Mode
 2: Edit NodeID
 3: Edit Baudrate
 4: CAN Status
 5: Edit Eventtime PDO1
 6: Edit Eventtime PDO2
 7: Edit Eventtime PDO3
 8: Edit Eventtime PDO4
 9: Edit Transmission type


 Press any other key to quit
```

6.4.7 Firmware Update

If necessary this menu can be used to update the firmware of the inductive guidance sensor to a new version. In order to update the firmware the device has to be put into DFU (Device Firmware Upgrade) mode.

Figure 19 *Firmware Update Menu*

```
Press y to reboot the device in DFU mode
Press any other key to quit
```

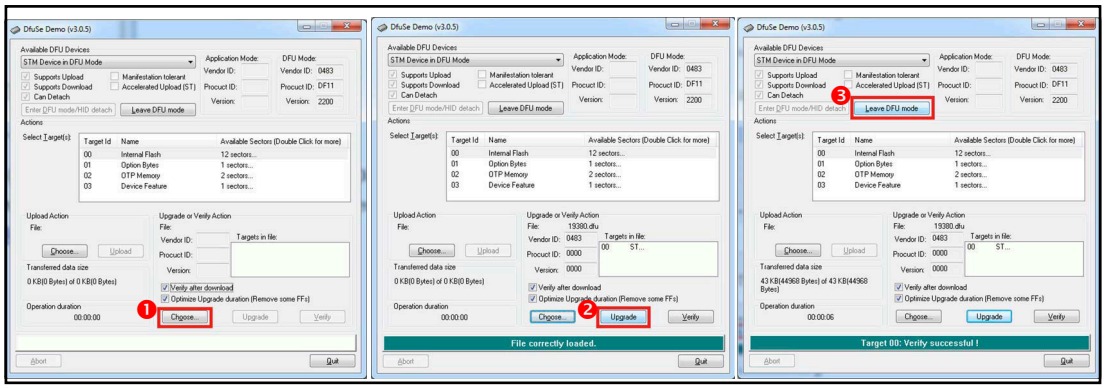
After pressing [Y] the connection in the terminal program should be closed until the update in DFU mode is finished.

You need the *.dfu* firmware file and the software *DfuSe* by ST Microelectronics®. You can request *.dfu* firmware files from Götting and they will be sent to you via e-mail. You can download the DfuSe software from the following address:

http://www.st.com/en/delvelopment-tools/stsw-stm32080.html

1. After starting *DfuSe Demo* click on *Choose* to select the *.dfu* file.
2. Then start the firmware update by clicking on *Upgrade*.
3. After the successful update click on Leave DFU mode.

Figure 20 *DFU Firmware Update*



Now you can re-establish the connection in the terminal program.

7 CAN Bus Communication (HG G-19370ZB/HG G-19380ZB)

The inductive guidance sensor can be operated in CAN mode or in CANopen® mode. The mode is selected via the serial service program, see section 6.4.6 on page 24. The CAN or CANopen® configuration is structured according to ISO 11898 or EN 50325-4.

7.1 Mode CAN

The CAN bus communication is coordinated by the vehicle control. The vehicle control sends commands with specific CAN IDs and receives the reply telegrams of the addressed devices on the bus. The inductive guidance sensor sends its status, the sum and difference values for the 6 frequencies and the incremental encoder values.

7.1.1 Telegrams

The devices expect a telegram on CAN ID 0x200 + NodeID and reply accordingly on CAN-ID 0x180 + NodeID. With the control word (see below) the output of the sum and difference signals can be de-/activated for each frequency (aka track).

Table 11 *CAN telegrams*

IO	CAN-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
IN	0x200 + Node-ID	Control_0	Control_1						
OUT1	0x180 + Node-ID	Status_0	Status_1	Status_2	Status_3	Enc_0	Enc_1	Speed_0	Speed_1
OUT2	0x280 + Node-ID	S1_Sum0	S1_Sum1	S1_Dif0	S1_Dif1	S2_Sum0	S2_Sum1	S2_Dif0	S2_Dif1
OUT3	0x380 + Node-ID	S3_Sum0	S3_Sum1	S3_Dif0	S3_Dif1	S4_Sum0	S4_Sum1	S4_Dif0	S4_Dif1
OUT4	0x480 + Node-ID	S5_Sum0	S5_Sum1	S5_Dif0	S5_Dif1	S6_Sum0	S6_Sum1	S6_Dif0	S6_Dif1

Bytes listed with a 0 as the last position of the description stand for LowByte. The byte with the highest number for the same value is the HighByte.

- Control, Status, Enc and Speed are explained in the tables for IN and OUT1 below. Enc is the counter reading for the incremental encoder as a 16 bit integer value (going from 0 to 65,535, then it re-starts with 0). For speed every 10 ms the difference between the previous and the actual encoder counter reading is calculated.
- The telegrams OUT2 to OUT 4 have a uniform structure. They transmit the sum and difference values in mV for two frequencies each. The sum voltage is an unsigned 16 bit integer value. The difference voltage is a signed 16 bit integer value. The values are from the range as shown in Figure 2 on page 9.

7.1.2 Control and Status Telegrams

7.1.2.1 Incoming Telegram (IN)

Meaning shown for bit = 1 each.

Table 12 *CAN IN telegram structure (control bits)*

Control Bit	Meaning
0	Track 1 active
1	Track 2 active
2	Track 3 active
3	Track 4 active
4	Track 5 active
5	Track 6 active
6	Mute ON
7	Cyclic transmission ON (the sensor sends a CAN telegram every 10 ms)
8	Incremental encoder ON
9	Invert direction of incremental encoder
10 - 15	—

7.1.2.2 Outgoing Telegram OUT1

Table 13 *CAN OUT1 telegram structure (status, incremental encoder)*

Bit	Type	Meaning
0	Status	Track 1 active
1		Track 2 active
2		Track 3 active
3		Track 4 active
4		Track 5 active
5		Track 6 active
6		Mute ON
7		Cyclic transmission ON
8		Incremental encoder ON
9		Invert direction of incremental encoder
10 - 15		—
16		Track 1 detected
17		Track 2 detected
18		Track 3 detected
19		Track 4 detected
20		Track 5 detected
21		Track 6 detected
22		–
23		Frequency insecure: Frequency 6 detected, signal weak resp. insecure
24 - 31		Counter as sign of life, is incremented for each telegram
32 - 47	Enc	Incremental encoder counter reading
48 - 63	Speed	Difference between current incremental encoder counter reading and the counter reading from 10 ms ago

7.2 Mode CANopen®

The node ID and the transmission rate must be selected via the CANopen® menu of the serial service program described in section 6.4.6.2 on page 25. The measured values of the system are transmitted via 4 so-called TxPDO. The parameterization is done via SDOs. The CAN identifiers are derived from the node address (1 to 127).

7.2.1 Definitions CANopen®

Important terms and abbreviations are explained in this section as small assistance. For further information, you can consult the standards or go to

http://www.can-cia.org/en/standardization/technical-documents/

and download the technical specifications of the CANopen® standards after a free registration. For devices that support CANopen®, EDS (Electronic Data Sheet) files can be downloaded from the Götting website (see section 7.2.5 on page 35). The complete configuration is stored in these files. CANopen® Magic from PEAK System is an example of a program that can be used to access EDS files:

http://www.canopenmagic.com

Table 14 *CANopen®: Parameter PDO operating mode*

Value	cyclic	acyclic	synchronous	asynchronous	only on request (RTR)
0		x	x		
1-240	x		x		
241-251	reserved				
252			x		x
253				x	x
254				x	
255				x	

Note that not every device supports every operating mode. Götting devices normally support operating modes 1 to 240 and 255.

Table 15 *CANopen®: PDO operating modes*

Operating mode	Explanation
Cyclic	Every nth Sync telegram will transmit data
Acyclic	Sends if an event has occurred since the last Sync telegram
Synchronous	Data are transmitted after receipt of a Sync telegram
Asynchronous	Data is transmitted event-controlled
RTR	Only on request by a remote frame
Inhibit Time	Minimum time span that must elapse before the next transmission of the same PDO
Event Time	Triggers an event at expiration. Restarted after each event.

Table 16 *Definitions CANopen®*

Abbreviations	Name	Meaning
PDO	Process data objects	Maximum 8 bytes of process data
TPDO	Transmit-PDO	Process data sent from a device
RPDO	Receive-PDO	Process data received from a device
SDO	Service data objects	Used for reading and writing device parameters. No size limitation
Sync	Synchronization telegram	Bus-wide telegram sent by the CANopen® Master
–	CAN-Identifier	The address at which a PDO,SDO is sent
–	Node ID	For CANopen®, the address of the device that is added to the CAN-Identifier

Table 17 *CAN: Bit and byte sequences*

Name	Meaning
Low Byte First	Little-Endian format, Intel format The byte with the smallest value of a multibyte value is sent first
High Byte First	Big-Endian format, Motorola format The most significant byte of a multibyte value is sent first
Left-justified	Sequence of bits in a byte from left (most significant) to the right (smallest)

Table 18 *CANopen® operating mode*

Name	Significance
Stopped	Only network management services executable
Pre-Operational	Full configuration possible, no transmission of PDOs
Operational	Full configuration possible, set PDOs are transmitted

Note that a CAN identifier or for CANopen® the combination of CAN identifier and node identifier must always be unique.

7.2.2 Description of the Process Data Objects (PDO)

7.2.2.1 Send Objects

Fixed places in the PDOs are assigned to the measured values, dynamic mapping is not provided. The PDO operation mode can be set cyclic-synchronous or asynchronous. For cyclic transmission, the event time must be selected accordingly. A TxPDO can be permanently deactivated by selecting the asynchronous operating mode (255) with Event_time = 0. In addition, it can be temporarily deactivated/activated by setting/deleting the most significant bit in the corresponding PDO COB identifier [1800,01] or [1801,01]. TX_PDO1 is sent with the identifier 0x180 + node address. It contains 8 bytes.

Table 19 *CANopen®: TX_PDOs*

IO	CAN-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
TX_ PDO1	0x180 + Node-ID	Status_0	Status_1	Status_2	Status_3	Enc_0	Enc_1	Speed_0	Speed_1
TX_ PDO2	0x280 + Node-ID	S1_Sum0	S1_Sum1	S1_Dif0	S1_Dif1	S2_Sum0	S2_Sum1	S2_Dif0	S2_Dif1
TX_ PDO3	0x380 + Node-ID	S3_Sum0	S3_Sum1	S3_Dif0	S3_Dif1	S4_Sum0	S4_Sum1	S4_Dif0	S4_Dif1
TX_ PDO4	0x480 + Node-ID	S5_Sum0	S5_Sum1	S5_Dif0	S5_Dif1	S6_Sum0	S6_Sum1	S6_Dif0	S6_Dif1

Bytes listed with a 0 as the last position of the description stand for LowByte. The byte with the highest number for the same value is the HighByte.

- Control, Status, Enc and Speed are explained in the tables for IN and OUT1 below. Enc is the counter reading for the incremental encoder as a 16 bit integer value (going from 0 to 65,535, then it re-starts with 0). For speed every 10 ms the difference between the previous and the actual encoder counter reading is calculated.
- The telegrams TX_PDO2 to TX_PDO4 have a uniform structure. They transmit the sum and difference values in mV for two frequencies each. The sum voltage is an unsigned 16 bit integer value. The difference voltage is a signed 16 bit integer value. The values are from the range as shown in Figure 2 on page 9.

7.2.2.2 Outgoing Telegram TX_PDO1

Table 20 *CANopen®: TX_PDO1 telegram structure (status, incremental encoder)*

Bit	Type	Meaning
0	Status	Track 1 active
1		Track 2 active
2		Track 3 active
3		Track 4 active
4		Track 5 active
5		Track 6 active
6		–
7		–
8		Incremental encoder ON
9		Invert direction of incremental encoder
10 - 15		–
16		Track 1 detected
17		Track 2 detected
18		Track 3 detected
19		Track 4 detected
20		Track 5 detected
21		Track 6 detected
22		–
23		Frequency insecure: Frequency 6 detected, signal weak resp. insecure
24 - 31		Counter as sign of life, is incremented for each telegram
32 - 47	Enc	Incremental encoder counter reading
48 - 63	Speed	Difference between current incremental encoder counter reading and the counter reading from 10 ms ago

7.2.2.3 Incoming Telegram RX_PDO1

Table 21 *CANopen®: Telegram structure of RX_PDO1*

IO	CAN-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
RX_ PDO1	0x200 + Node-ID	Control_0	Control_1						

Meaning shown for bit = 1 each.

Table 22 *CANopen®: Telegram structure of RX_PDO1 (control bits)*

Control Bit	Meaning
0	Track 1 active
1	Track 2 active
2	Track 3 active
3	Track 4 active
4	Track 5 active
5	Track 6 active
6	–
7	–
8	Incremental encoder ON
9	Invert direction of incremental encoder
10 - 15	–

7.2.3 Description of the Service DataObjects (SDOs)

The service data object is used for accesses to the object directory. An SDO is transmitted acknowledged, i.e. each receipt of a message is acknowledged. The identifiers for read and write access are:

- Read access: 0x600 + node address
- Write access: 0x580 + node address

The SDO telegrams are described in the CiA® standard DS-301. The error codes due to faulty communication are listed in the following table:

Table 23 *CANopen®: SDO telegram error codes*

Name	Number	Description
SDO_ABORT_UNSUPPORTED	0x06010000	non-supported access to an object
SDO_ABORT_READONLY	0x06010002	write access to a read-only object
SDO_ABORT_NOT_EXISTS	0x06020000	object is not implemented

7.2.4 Object Directory

All objects relevant for the device are included in the CANopen® Object Directory. Each entry is indicated by a 16 bit index. Sub-components are indicated by a 8 bit sub index. RO indicates read only entries. Communication parameters are marked with C in the following tables, Manufacture parameters with M. The object index is subdivided into the following areas:

Table 24 *CANopen®: Communication specific entries*

Index	Subindex	Access	Description	EEProm
0x1000	0	RO	Device Typ	
0x1001	0	RO	Error Register	
0x1008	0	RO	Device Name	
0x1009	0	RO	Hardware Version	
0x100A	0	RO	Software Version	
0x1010	0	RO	Number of entries of Save Parameter	
	1	RW	Store all	
0x1011	0	RO	Number of entries of Restore Default Parameter	
	1	RW	Restore Default all	
0x1017	0	RW	Producer Heartbeat Time	X
0x1018	0	RO	Number of entries of Identity Object	
	1	RO	Vendor ID	
	2	RO	Product Code	
	3	RO	Revision	
0x1400	0	RO	Number of entries of Receive PDO_1	
	1	RW	COB-ID	
	2	RO	Transmission Type	
0x1600	0	RO	Number of Objects mapped to Receive PDO_1	
	1	RO	Specification of Appl. Object 1	
	2	RO	Specification of Appl. Object 2	
0x1800	0	RO	Number of entries of Transmit PDO_1	
	1	RW	COB-ID	
	2	RO	Transmission Type	
	3	RW	Inhibit Time	X
	5	RW	Event Time	X
0x1A00	0	RO	Number of Objects mapped to Transmit PDO_1	
	1	RO	Specification of Appl. Object 1	
	2	RO	Specification of Appl. Object 2	

Table 25 *CANopen®: Standardized device profile area in the range from 0x6100 to 0x6401*

Index	Subindex	Access	Content
0x6100	0	RO	16 Bit Digital Inputs
	1	RO	Encoder
	2	RO	Speed
0x6120	0	RO	32 Bit Digital Inputs
	1	RO	Status
0x6200	0	RO	8 Bit Digital Outputs
	1	RW	Gain 1
	2	RW	Gain 2
0x6300	0	RO	16 Bit Digital Outputs
	1	WO	Control
	2	RW	Freq1
	3	RW	Freq2
	4	RW	Freq3
	5	RW	Freq4
	6	RW	Freq5
	7	RW	Freq6
	8	RW	Threshold
	9	RW	Energy_lower_threshold
	A	RW	Energy_upper_threshold
0x6401	0	RO	16 Bit Analog Inputs
	1	RO	S1_Sum
	2	RO	S1_Dif
	3	RO	S2_Sum
	4	RO	S2_Dif
	5	RO	S3_Sum
	6	RO	S3_Dif
	7	RO	S4_Sum
	8	RO	S4_Dif
	9	RO	S5_Sum
	A	RO	S5_Dif
	B	RO	S6_Sum
	C	RO	S6_Dif

7.2.5 EDS File

For our devices with CANopen® interface we provide EDS files. You can download the EDS file for the steering sensor at the following address:

https://www.goetting-agv.com/components/19370-19380

8 Profinet Communication (HG G-19370YB/HG G-19380YB)

The guidance sensor is equipped with an internal Profinet switch. The sum and difference signals of the six frequencies are updated every 10 ms.

A GSDML file can be used to configure the Profinet interface. You can download this file from the following address:

https://www.goetting-agv.com/components/19370-19380

8.1 Input Bytes

27 input bytes are available.

Table 26 *Profinet Input Bytes (part 1 of 2)*

Byte	Meaning
0	High byte sum signal frequency 1
1	Low byte sum signal frequency 1
2	High byte difference signal frequency 1
3	Low byte difference signal frequency 1
4	High byte sum signal frequency 2
5	Low byte sum signal frequency 2
6	High byte difference signal frequency 2
7	Low byte difference signal frequency 2
8	High byte sum signal frequency 3
9	Low byte sum signal frequency 3
10	High byte difference signal frequency 3
11	Low byte difference signal frequency 3
12	High byte sum signal frequency 4
13	Low byte sum signal frequency 4
14	High byte difference signal frequency 4
15	Low byte difference signal frequency 4
16	High byte sum signal frequency 5
17	Low byte sum signal frequency 5
18	High byte difference signal frequency 5
19	Low byte difference signal frequency 5
20	High byte sum signal frequency 6
21	Low byte sum signal frequency 6
22	High byte difference signal frequency 6
23	Low byte difference signal frequency 6

Table 26 *Profinet Input Bytes (part 2 of 2)*

Byte	Meaning
24	Status / Detect (see section 8.2 below)
25	High byte encoder
26	Low byte encoder

8.2 Status/Detect (Byte 24)

The status/detect byte allow to check, which track has been detected.

Table 27 *Profinet Status/Detect (Byte 24)*

Bit	Meaning
0	Detect frequency 1
1	Detect frequency 2
2	Detect frequency 3
3	Detect frequency 4
4	Detect frequency 5
5	Detect frequency 6
6	–
7	Frequency insecure: Frequency 6 detected, signal weak resp. insecure

9 Maintenance

The device is mostly maintenance-free. The maintenance is limited to

- a visual inspection of the sensor (all screws sit tight, cables and connectors are attached correctly).

If necessary update the firmware as shown in section 6.4.7 on page 25). Date and version of the firmware are shown in the main menu (Figure 10 on page 20).

10 Technical Data

Table 28 *Technical Data*

Technical data inductive guidance sensor	
Casing	156,5 x 53 x 21 mm (W x H x D) Height including connectors: 70 mm Polycarbonat (PC)
Weight	approx. 200 g
Protection Class	IP 54
Relative humidity	95% at 25° C (without condensation)
Temperature ranges	– Operation: -20° C to +50° C – Storage: -20° C to +70° C
Supply voltage +Ub	– 5 V (USB, configuration only) – Nominal (vehicle): 12 VDC – 24 VDC – Maximum: 10 VDC – 30 VDC
Current consumption	– HG G-19370/80ZB (CAN): 60 mA @ 24 V – HG G-19370/80YB (Profinet): 110 mA @ 24 V
Reading height	40 – 200 mm Nominal reading height 60 mm (preset) Different reading distances via programmable gain
Frequencies	– 5 programmable guide wire frequencies, simultaneously usable, 2 – 20 kHz, 100 Hz resolution – 1 programmable frequency for an energy track (see below)
Energy track	Two possible configurations (variants): – HG G-19370-B: Frequency: 25 kHz, wire spacing: 140 mm, wire current of the inductive energy transmission: 85 A – HG G-19380-B: Frequency: 140 kHz, wire spacing: 110 mm, wire current of the inductive energy transmission: 45 A
Measuring rate	100 Hz (every 10 ms a new value is calculated)
Connectors	3 M12 circular connectors
ST 1	8 pin male, A coded, supply, USB, incremental encoder
ST 2 / ST 3	– HG G-19370ZB: 5 pin female/male, A coded, CAN bus – HG G-19370YB: 4 pin female, D coded, Profinet
USB	Configuration / firmware update with emulation of a serial interface
Incremental encoder	Input for the processing of an incremental encoder. All incremental encoders can be used that have a switching threshold > 10 V between high level and low level (typically 24V incremental encoders).

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14 Document Changelog

The following table lists the revisions of this device description that have been published so far with the most important changes in each case.

Table 29 *Document changelog*

Revision	Edited by	Description of changes
01 Date: 16.05.2017	RAD	– Translation of German device description Rev. 01. – For Firmware Version 1.01.
02 Date: 15.03.2018	RAD	– Adaptation to German Rev. 03. – Combined device description for HG G-19370-B/HG G-19380-B.
03 Date: 05.05.2020	RAD/GW	Corrections as specified by GW.
04 Date: –	–	Was skipped.
05 Date: 01.04.2022	RAD	Change of the layout to A design.
06 Date: 16.05.2017	RAD/GW/LF	– For firmware version 1.06 – 1.06: Addition of CAN Object 6200 (Gain) in Table 25 – Error message LEDs 19370 CAN – New EDS file on website
07 Date: 26.10.2023	RAD	– For firmware version 1.07 – 1.07: For the guide wire frequencies in the menu adjustable if single wire (Detect Mode: Normal) or double wire (Detect Mode: Two wire mode) is used – 1.07: Adjustment of the Calibration Config screenshot and the corresponding explanations, "Detect Mode" added – Added and designed this chapter Document History.

15 Copyright and Terms of Liability

15.1 Copyright

This manual is protected by copyright. All rights reserved. Violations are subject to penal legislation of the Copyright.

15.2 Exclusion of Liability

Any information given is to be understood as system description only, but is not to be taken as guaranteed features. Any values are reference values. The product characteristics are only valid if the systems are used according to the description.

This instruction manual has been drawn up to the best of our knowledge. Installation, setup and operation of the device will be on the customer's own risk. Liability for consequential defects is excluded. We reserve the right for changes encouraging technical improvements. We also reserve the right to change the contents of this manual without having to give notice to any third party.

15.3 Trade Marks and Company Names

Unless stated otherwise, the herein mentioned logos and product names are legally protected trade marks of Götting KG. All third party product or company names may be trade marks or registered trade marks of the corresponding companies.

Innovation through Guidance

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