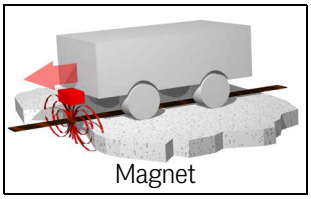


Magnet Sensor

HG G-19600ZA

Track Guidance along Magnetic Tape

English, Revision 04	Date: 13.01.2022	Dev. by: TE	Author(s): RAD / GW

Summary

Characteristics of the magnet sensor HG G-19600ZA:

- Indoor / IP 54
- Digital magnetometer technology, robust and maintenance free
- For axially polarized magnetic tape (widths 50 mm), reading distance 60 mm
- Magnetic band easy to install
- Detection of the magnetic tape not influenced by dirt on the track
- Display of the system status via 5 LEDs
- Three independent detection systems for the recognition of turnoffs
- Turnoffs in the track can be selected via digital inputs
- Analog outputs: Flux density Z (0 ... 10 VDC), flux density X (-10 ... +10 VDC)
- Digital output: Detection of a magnetic tape in the reading area (+24 VDC, max. 20 mA)
- Avoid strong magnetic fields close to the sensor, see section 3.2.1 on page 11

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 magnet sensor HG G-19600ZA for the technical personnel of a manufacturer who wants to integrate the magnet 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 V0.40 and higher (see Figure 15 on page 24 on how to detect which firmware version your device has).

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 Letter Keys are indicated as such (for any programs of Götting KG small and capital letters are equally working).

2 Introduction

2.1 Range of Use

- The magnet sensor is intended for indoor usage.
- On the surface of the track roadway compatible magnetic tape is layed. Alternatively a magnetic bar can be embedded into the roadway (see section 3.1 on page 10).
- The magnetic sensor is installed so that its underside faces the roadway and meets the nominal reading distance towards the surface of the magnetic tape (see section 3.2 on page 11).

2.2 Qualification of the Users

The personnel intended to operate the magnetic sensor

- has been provided with this documentation.
- is familiar with the functionality of the magnetic sensor.
- is trained sufficiently in mounting and configuring the magnet 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 magnetic sensor is instructed regarding the kind of the vehicle and the risks resulting from the driverless operation.

2.3 Intended Use

The magnet sensor HG G-19600ZA is intended for the track guidance of automated guided vehicles (AGV) along magnetic tape. The sensor detects the magnetic field above magnetic tape in vertical and horizontal direction and thus continually determines the actual deviation from the center of the track (center of the magnetic tape). The deviation is output as analog voltages.

⚠ DANGER

Missing protection equipment

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

▶ The vehicle manufacturer has to include suitable safety equipment.

DANGER

The vehicle leaving the track

Interferences as specified in section 3.2 on page 11 may lead to inaccurate outputs whereby the vehicle may leave the track.

- The vehicle manufacturer has to include functionality to detect this and stop the vehicle if needed

As an aid the digital output DOUT1 track detect can be used, see section 5.2.2 on page 21.

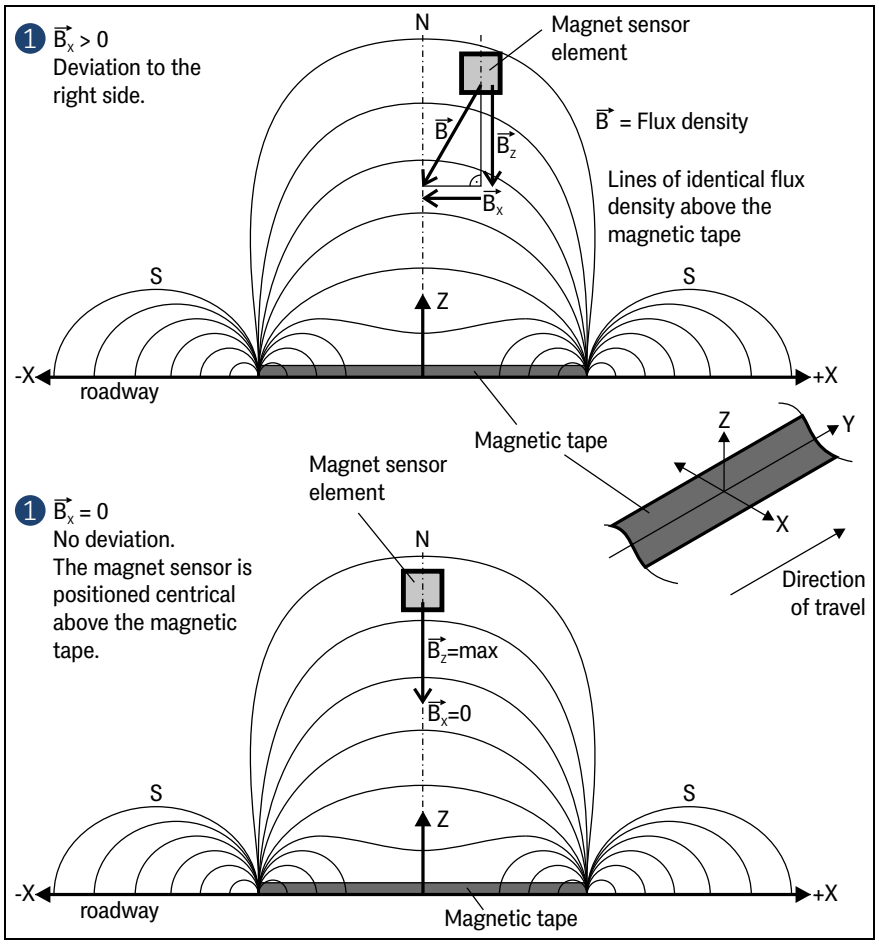
In case the magnetic sensor is used for other purposes than specified above or is modified all warranties against the Götting KG are null and void.

The magnet sensor is only used according to section 2.1 on page 7. The magnet sensor is only mounted, configured, commissioned, operated, maintained and dismounted by personnel according to section 2.2 on page 7.

2.4 Functional Principle

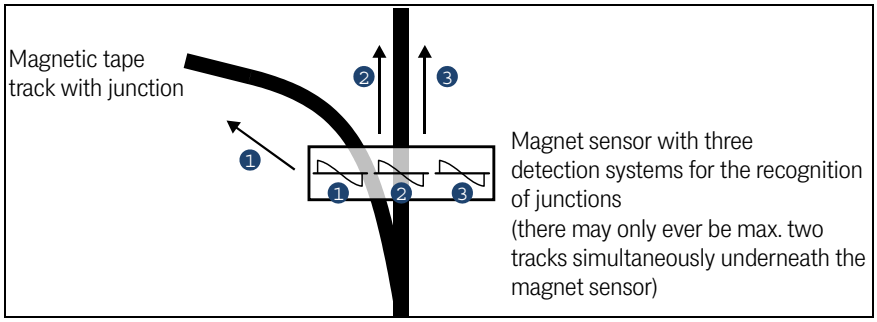
The sensor is based on digital magnetometer technology for the detection of the magnetic field above the magnetic tape.

Figure 1 *Detection of the magnetic field*



The sensor has three independent detection systems. Via two digital inputs one of two tracks can be chosen dynamically. Thus the sensor can detect junctions and follow turnoffs (also see 5.3 on page 21).

Figure 2 *Three detection systems for the recognition of junctions*



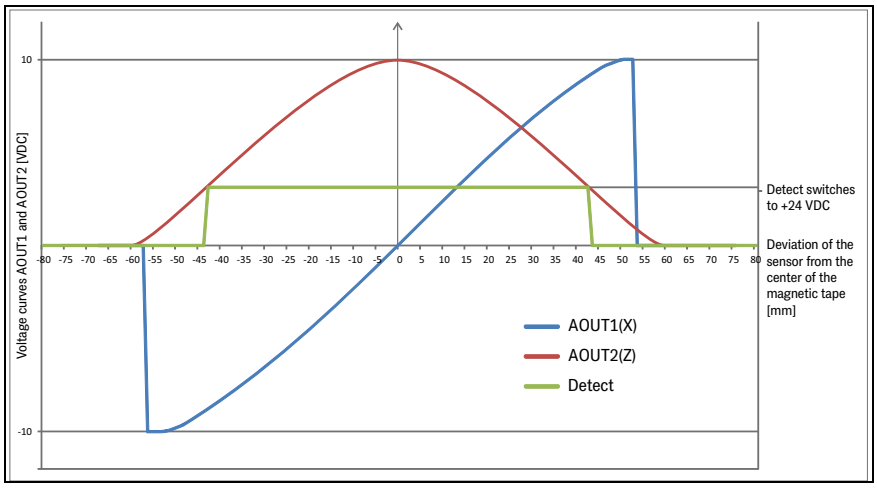
Five LEDs show the operational state (PWR), error state (ERR) and a detected track underneath the independent systems (TR1, TR2, TR3).

Via two analog outputs the deviation from the track and the actual level of the magnetic field are output. Additionally a detect signal is generated when a magnetic tape is detected underneath the sensor.

The detection range depends on the mounting height of the sensor and the type of the magnetic tape. As shown in Figure 1 above the sensor detects the deviation X from the center of the track by measuring the horizontal magnetic flux density. The higher the deviation the higher the output analog voltage.

Figure 3 shows the signals of the outputs (AOUT 1, AOUT 2, Detect) when moving the sensor in X direction above the magnetic tape (crosswise to the direction of travel).

Figure 3 *Voltage curves of the analog outputs (idealized diagram)*

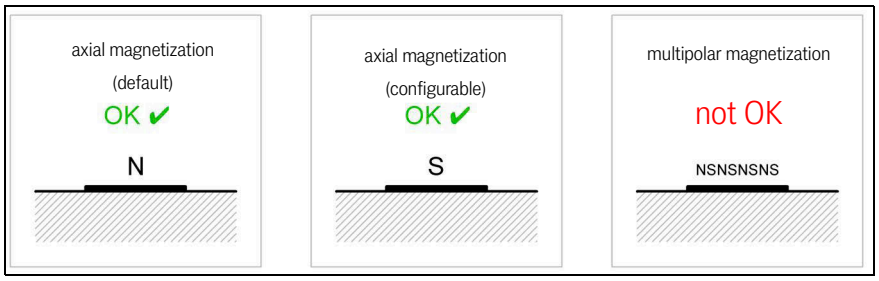


3 Mounting

3.1 Magnetic Tape

For the operation of the magnet sensor HG G-19600ZA axially polarized magnetic band is to be used. The direction of the polarization can be configured s. Figure 19 on page 27). The polarization has to be identical for a whole facility.

Figure 4 *Supported and unsupported magnetization of the magnetic tape*



3.1.1 Magnetic Tape Types

Götting offers suitable magnetic tapes. Magnetic tape is sticked to the ground. Alternatively embedded magnetic bar can be used that is layed in a groove cut into the ground. Götting magnetic tapes always have the north pole on the top. The following elements are available:

Table 2 *Order numbers magnetic tape*

Order no.	Description	Notes
HW MAT00003	Magnetic tape, self-adhesive, on a roll W x H 50 x approx. 1,2 mm	Roll, length 15.2 m
HW MAT00004	Embedded magnetic bar, W X H 6 x 10 mm	quote length
HW MAT00005	Magnetic tape, self-adhesive curve segment 30° segment of circle, radius 600 mm	Curve segments
HW MAT00006	Magnetic tape, self-adhesive curve segment 30° segment of circle, radius 800 mm	
HW MAT00007	Magnetic tape, self-adhesive curve segment 30° segment of circle, radius 1,000 mm	
HW MAT00008	Magnetic junction, branch to the right, self-adhesive, radius 1,000 mm	Junction segments
HW MAT00009	Magnetic junction, branch to the left, self-adhesive, radius 1,000 mm	

3.1.2 Magnetic Tape Installation

The installation of both the magnetic tape and the embedded magnetic bar is specified in a separately available document that you can download at the following address:

http://goetting-agv.com/components/19600

3.2 Magnet Sensor

3.2.1 Requirements

DANGER

False output due to interfering signals

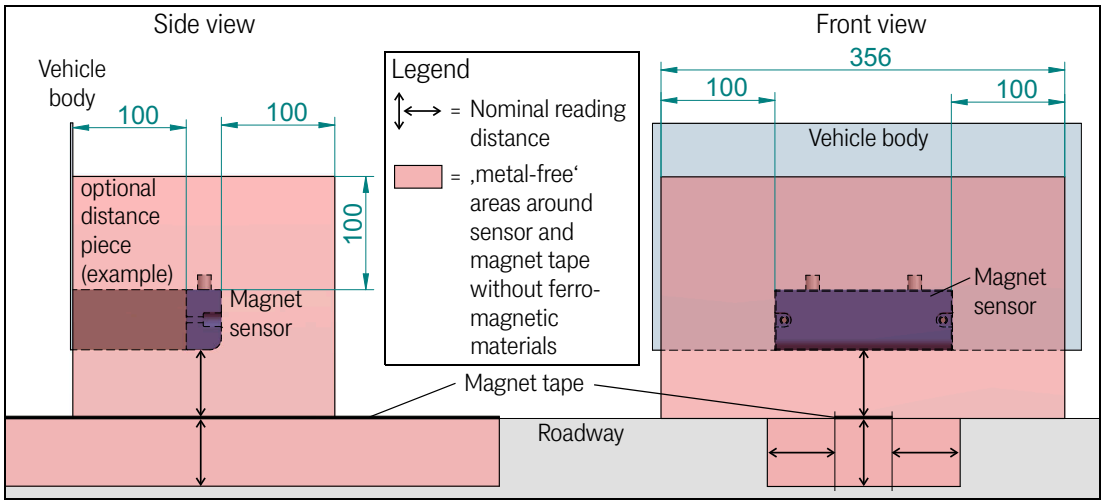
Additional magnetic fields close to the magnet sensor can affect the system characteristics. This may lead to the vehicle leaving the track.

- The vehicle manufacturer has to include functionality to detect this and stop the vehicle if needed

As an aid the digital output DOUT1 track detect can be used, see section 5.2.2 on page 21.

External magnetic fields with a field strength below the Earth's magnetic field do not influence the magnet sensor. For stronger fields the strength and position of the field determine whether the magnet sensor is affected or can even be configured to compensate the influence. Fields that asymmetrically influence from a certain direction (left or right) or only occur at certain points of the course are harder to compensate. Generally interferences should be minimized so that the magnet sensor can detect the track reliably. Therefore:

Figure 5 *Areas around sensor and tape that need to be free of ferromagnetic materials*



- An area of 100 mm around the sensor should be free of ferromagnetic materials. Those divert the magnetic field and distort the readings. Similarly an area with a diameter of approximately the nominal reading height around the magnetic tape should be free of ferromagnetic materials.

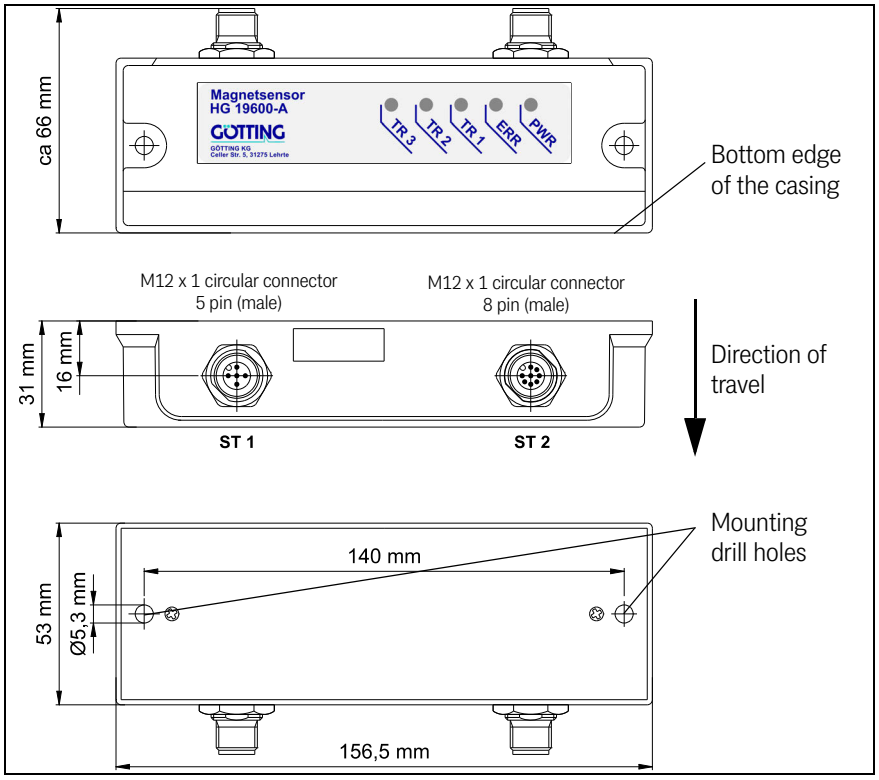
- Around the sensor and the magnetic tape there may be no additional magnetic fields (permanent magnets, electromagnets, electrical wires, etc.). How much the readings are disturbed by interferences depends on the field strength.
- Electric motors have to be sufficiently shielded.

Interferences from the vehicle occur permanently, interferences along the track temporarily. Permanent interferences can sometimes be compensated with offsets (see 6.4.2 on page 27). Constant magnetic interferences (e. g. brakes that are released electromagnetically) can, starting with firmware version 0.45, be compensated, see section 4.2 on page 16.

Interferences along the track have to be avoided e.g. by moving the magnetic track or by shielding the source.

3.2.2 Mounting on the Vehicle

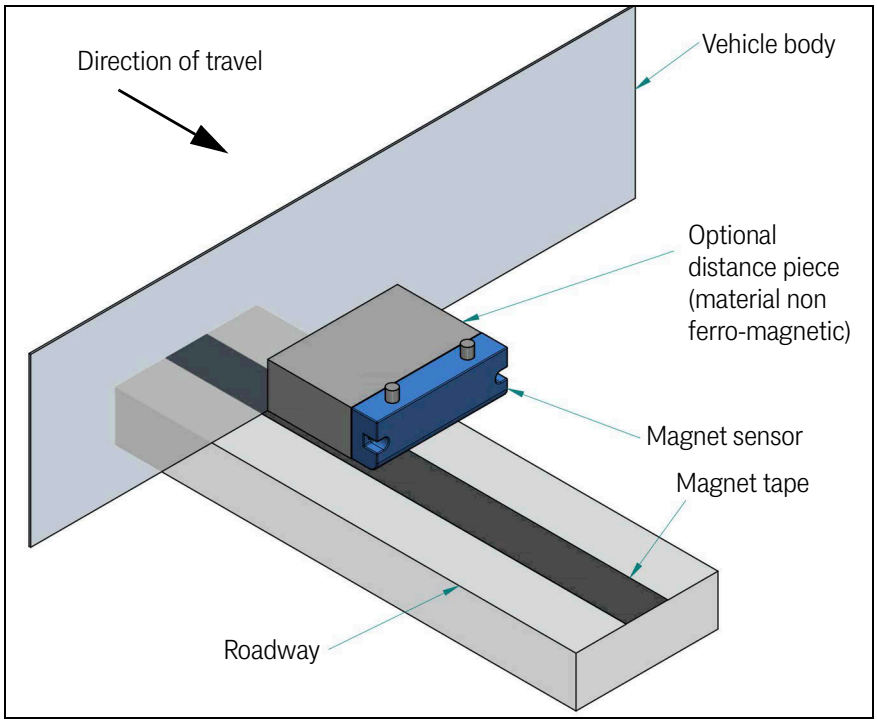
Figure 6 *Casing dimensions and mounting drill holes of the magnet sensor*



The magnet sensor has two drill holes with a diameter of 5 mm each with which it can be mounted by putting screws through the holes. **We recommend the usage of non-magnetizable VA screws.** The drill holes have a distance of 140 mm to each other (center of hole <—> center of hole). The magnet sensor is to be mounted diagonally to the direction of travel with the connectors facing upwards (first sketch in Figure 6 above). The recommended reading height is 60 mm from the bottom edge of the casing to the magnetic tape.

Around the sensor there has to be an area free of ferromagnetic materials. Thus the sensor usually can‘t be mounted directly onto the body of the vehicle. We recommend using a mounting bracket or mounting plate, e.g. made from Aluminium or acrylic glass (e.g. Plexiglas®), see Figure 7 below.

Figure 7 *Possible mounting pos. for the magnet sensor when using an optional distance piece*



If the magnet sensor has to be mounted side-inverted (aka backwards) the output voltages for the left and right deviations may be interchanged compared to what the vehicle control expects. In this case the output voltage AOUT1 can be inverted inside the sensor, see 6.4.2 on page 27.

3.2.3 Connection Cable (assembled on one side)

Connect the sensor to the vehicle control. For this the connectors ST 1 and ST 2 are used. The assignment of the pins is shown in section 5.2 on page 20. The following optional cable extensions can be used.

Table 3 *Accessories / cable extensions*

Order no.	Description
HW CAB00001	Cable PUR, 5m with one M12 angle coupling, 5 pin, A coded, one end open
HW CAB00007	Cable PUR, 2m with M12 angle coupling, 8 pin, A coded, one end open

4 Commissioning

The sensor is pre-configured to detect a single track without turnoffs. For this application it may be sufficient to install the sensor and connect it to the vehicle control. We recommend to always connect it to a PC and configure it as shown below to minimize interferences. If more than one track is to be detected and if there are turnoffs in the driving course then the configuration as shown below has to be performed.

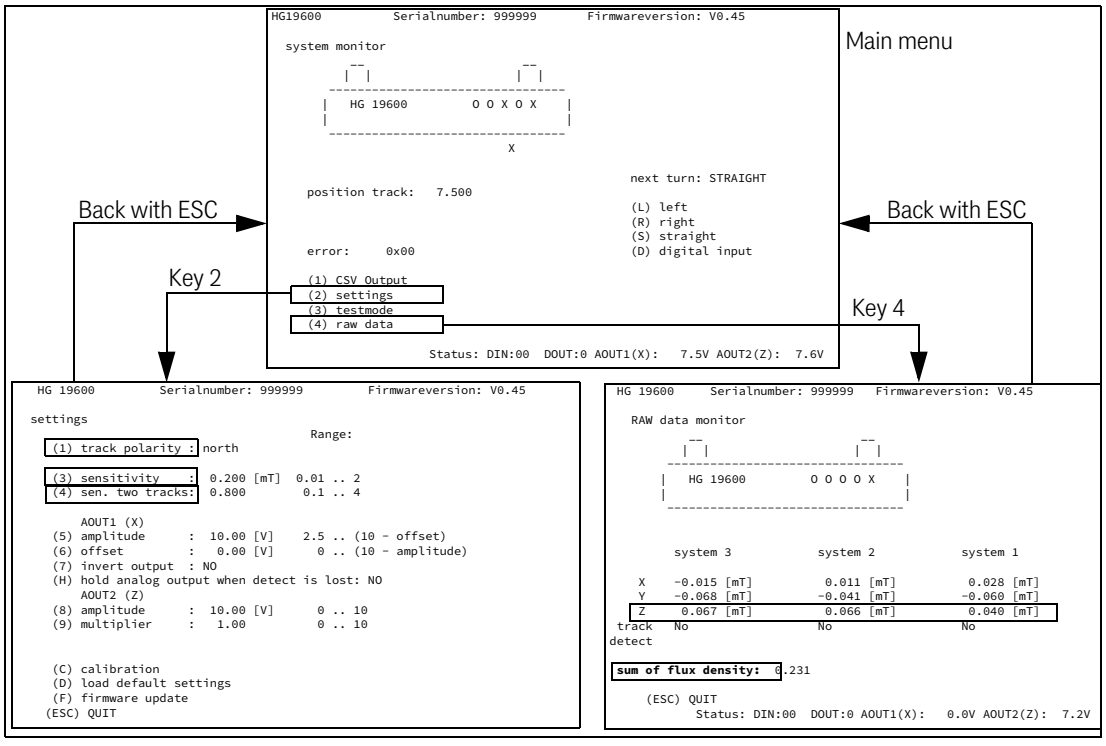
For the commissioning configuration the serial interface in connector ST 1 is used. Connect ST 1 to a PC as shown in section 6.2 on page 23. Then start a compatible terminal program with ANSI emulation (see section 6.3 on page 23). Then you can use the service program that runs inside the magnet sensor (section 6.4 on page 24).

For the following explanations we assume that your sensor is running with its default configuration. If needed the default settings can be restored in the *settings* menu, see section 6.4.2 on page 27.

4.1 Configuration of the Magnet Sensor

The goal of the configuration is the reliable recognition of magnetic tracks. For this the thresholds for the detection of one (resp. two) tracks have to be adjusted. The detection of two tracks is necessary if there are to be junctions in the track. A track is detected when the magnetic flux density is above the set threshold. The track detection has an internal switching delay of 2 % so that it does not react too sensitively in border areas. For the commissioning the following menus and sub-items of the service program are used:

Figure 8 *Commissioning: Menus of the service program*



Meaning of the highlighted parameters:

- *track polarity* in *settings* menu: Polarity of the magnetic tape
- *sensitivity* in *settings* menu: Sensitivity of the detection of a magnetic track, threshold value in milliTesla (mT)
- *sen. two tracks* in *settings* menu: Sensitivity of the detection of two magnetic tracks. For applications without junctions set to maximum value *4*.
- *sum of flux density* in *raw data menu*: Flux density of a magnetic tape underneath the sensor

When using one of the magnetic tapes listed in section 3.1.1 on page 10 (HW MAT00003, HW MAT00008 and HW MAT00009) the threshold sen. two tracks for two magnetic tracks can be set according to the following table:

Table 4 *Thresholds for two magnetic tracks with standard magnetic tapes*

Reading height [mm]	50	60	70	80	90	100
sen. two tracks [mT]	0.8	0.64	0.5	0.4	0.32	0.275

If there are problems detecting the track or when the working conditions are different we recommend the following configuration sequence:

1. Configure the polarity of the magnetic tape (*track polarity* in *settings* menu). Default for Götting magnetic tape or embedded magnetic bar: North.
2. Place the sensor centered above a piece of the used magnetic tape (default reading height 60 mm). The piece should be long enough so that at least 10 cm protrude behind and in front of the sensor.
3. Switch to the menu *raw data* and write the shown *sum of flux density* down. Then switch to the *settings* menu and configure the *sensitivity* to be approx. one fifth of the *sum of flux density*.
4. Switch to the main menu and move the sensor diagonally to the magnetic tape. Check that the track is reliably detected even when it reaches the lateral edges of the magnet sensor. Optionally the *sensitivity* in the *settings* menu has to be reduced if the track is not detected in the border areas.
5. If the turnoff function is to be used the threshold *sen. two tracks* has to be configured. Table 4 above shows typical values when Götting magnetic tape is used. Typically the threshold for the detection of two tracks is about three times the value for one track. If the turnoff function is not needed (because there are no junctions in the track) *sen. two tracks* should be set to its maximum value of *4*. A good starting point for the threshold for detection of two tracks is three times the limit for one track.
6. In order to test the threshold for two tracks place two pieces of magnetic tape underneath the sensor so that the left edge of the left tape should be directly underneath the left edge of the sensor, the right edge of the right tape should match the right edge of the sensor. Now when the digital inputs are switched (left, right, straight; via the vehicle control, see 5.2.3 on page 21, or via the manual controls in the main menu of the service program, see Figure 15 on page 24) two magnetic tapes should be detected.

4.2 Compensation of Permanent Magnetic Interferences

NOTICE

Only static interferences can be compensated

- The source of the interferences has to move together with the magnet sensor and its strength may not change.

NOTICE

There is currently no possibility to enable or disable the compensation during operation! If there is e.g. an electromagnetic brake that emits interferences when activated but emits no interferences when it is inactive this can not be dynamically compensated. If a permanent compensation would be set for the possible interferences the output of the magnet sensor would be off by the scope of the compensation whenever the brake is inactive.

- The compensation is only usable for permanent interferences.

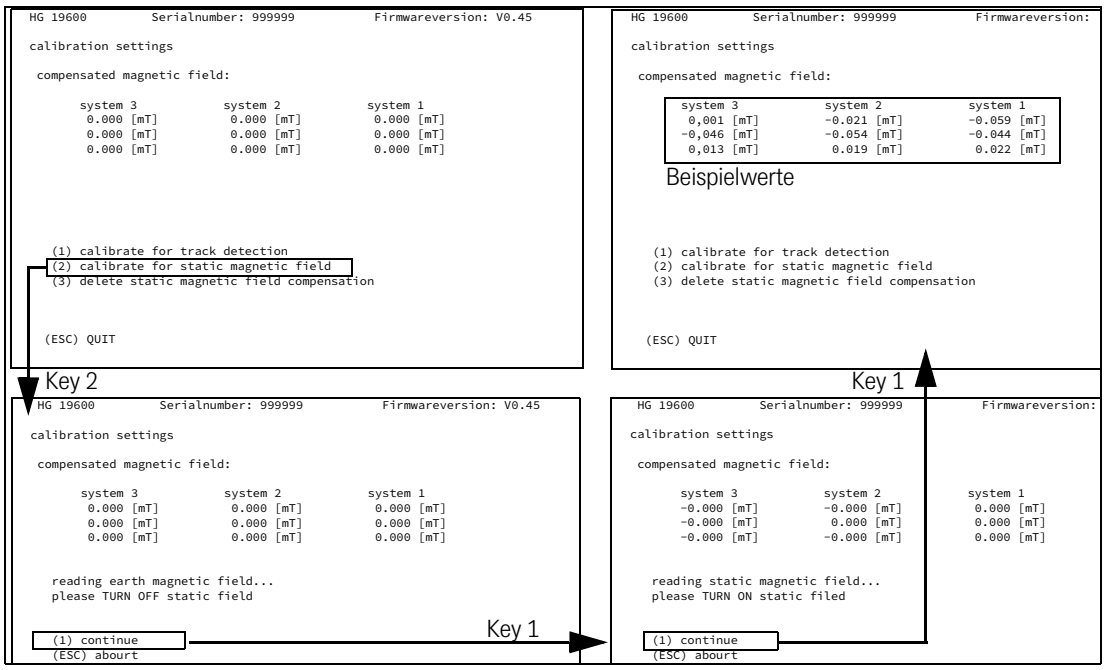
NOTICE

The compensation of interferences limits the range of the magnetic field that can be used for the track detection.

- The magnetic field and the compensated interferences together have to fit inside the maximum detection range of the magnet sensor.

4.2.1 Compensation of Static Magnetic Interferences

Figure 9 *Commissioning: Compensation of static magnetic interferences*



Take the following steps:

1. Mount the magnet sensor at the desired mounting position on the AGV.
2. In menu *Settings* choose the option [C] *Calibration*.
3. Use menu entry [2] *calibrate for static magnetic field*.
4. Deactivate the interferences.
5. Confirm with [1] *continue*. the sensor measures the magnetic field in its surroundings.
6. Turn the interferences on. Don‘t move the sensor/vehicle while doing so.
7. Confirm with [1] *continue*. The sensor measures the magnetic field in its surroundings and calculates the amount of the interferences.
8. The calculated interferences are shown in the menu and will be subtracted from the sensor‘s raw data.

4.2.2 Deleting the Compensation

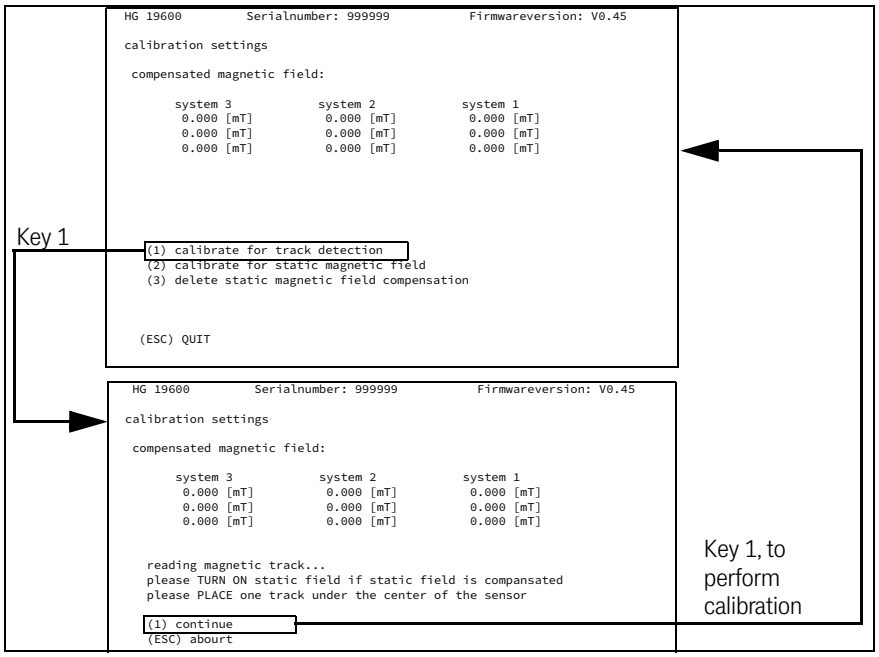
1. In menu *Settings* choose the option [C] *Calibration*.
2. Use menu entry [3] *delete static magnetic field compensation*. The parameters for the static compensation are deleted and no longer used.

4.3 Automatic Calibration of the Track Detection

In order to make it easier to set the thresholds starting with firmware version 0.45 it is possible to use the automatic configuration. In order to do so place the magnet sensor centered above the magnetic track, then start the calibration (see below). It is still possible to manually set the parameters or to change the parameters found during the automatic calibration.

If static interferences are compensated (see above) the interferences have to be present during the automatic calibration since they are subtracted from the measured field.

Figure 10 *Commissioning: Automatic calibration*



Take the following steps:

1. Place the magnet sensor in the desired height centered above a single magnetic track.
2. In menu 2 *Settings* choose the option C *Calibration*.
3. Use menu entry 1 *calibrate for track detection*.
4. If the compensation from section 4.2 on page 16 is in use make sure that the interferences are present.
5. Confirm with 1 *continue* that the sensor is placed centered above a single track.
6. The following parameters are automatically configured: *sensitivity*, *sen. two tracks*, *AOUT2 multiplicator*.

5 Hardware

5.1 LEDs

There are 5 LEDs to control the sensor‘s function.

Figure 11 *Positions of the LEDs*

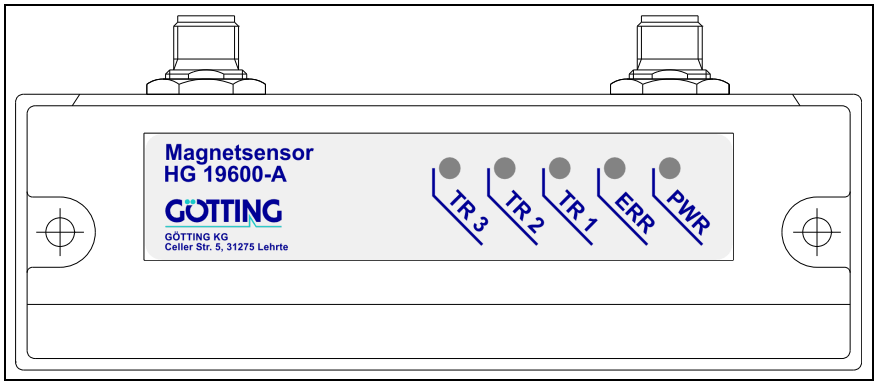


Table 5 *Meaning of the LEDs*

LED	Meaning
PWR	blinks during normal operation
ERR	blinks if errors occur; error codes see Table 6 below
TR 1	Threshold left system exceeded
TR 2	Threshold center system exceeded
TR 3	Threshold right system exceeded

Table 6 *Output of error codes via the LEDs / possible correction*

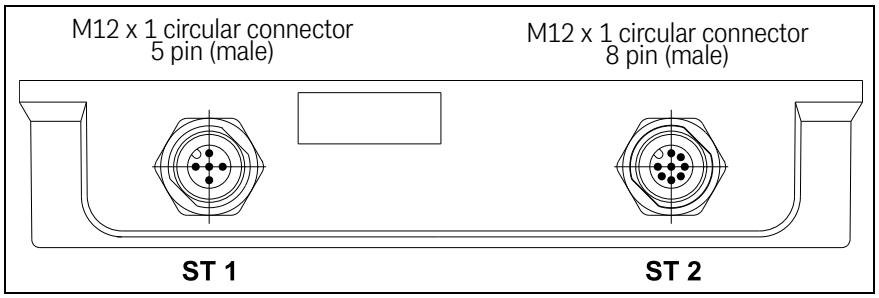
TR3	TR2	TR1	Error code *)	Error description	Possible correction
off	off	on	0x01	– sensor over-loaded – magnetic field too strong	– remove magnetic interference source – sensor mounted too low
off	on	off	0x02	System error	Please contact the Götting service department
on	off	off	0x04		

*) Errors can occur simultaneously, then the error codes in the output of the service program are summed up.

5.2 Pin Assignment

The magnet sensor has two electrical connectors. The 8 pin connector ST 2 carries all signals that are necessary for operating the sensor. The 5 pin connector ST 1 is used for configuration, diagnosis and software updates. This connector should be accessible or extende to an accessible place (for possible connection cables see section 3.2.3 on page 13). Both connectors can alternatively be used to supply power to the sensor. The pins for supply voltage and supply GND are plated-through, thus if both connectors are to be connected to supply voltage at once the supply voltage has to come from the same source.

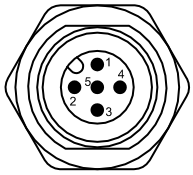
Figure 12 *Positions of the connectors*



5.2.1 ST 1 Service / Configuration

5 pin M 12 panel connector (A coded)

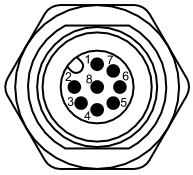
Table 7 *Pin assignment ST 1 5 pin*

ST 1	Pin	Signal	Annotation
	1	+Ub (24V)	supply voltage (plated-through to ST 2 Pin 1)
	2	—	n.c.
	3	TxD	RS232 data output
	4	RxD	RS232 data input
	5	GND	supply GND (plated-through to ST 2 Pin 5)

5.2.2 ST 2 Operation

8 pin M 12 panel connector (A coded)

Table 8 *Pin assignment ST 2 8 pin*

ST 2	Pin	Signal	Annotation
	1	+Ub (24V)	supply voltage
	2	GND	supply GND
	3	DIN 1	digital inputs: Turnoff selection, s. 5.3 on page 21
	4	DIN 2	
	5	AOUT 1 (X) *)	analog outputs: Outputs track guidance
	6	AOUT 2 (Z) *)	
	7	DOUT1 (max. 20mA)	digital Detect output: Output track detected +Ub (24V)
	8	n.c.	
*) Voltage range configurable (see section 6.4.2 on page 27)			

5.2.3 Digital Inputs Turnoff Selection

Via the two digital inputs in connector ST 2 it is possible to dynamically select one of three tracks (left, center, right), also see section 5.3 below.

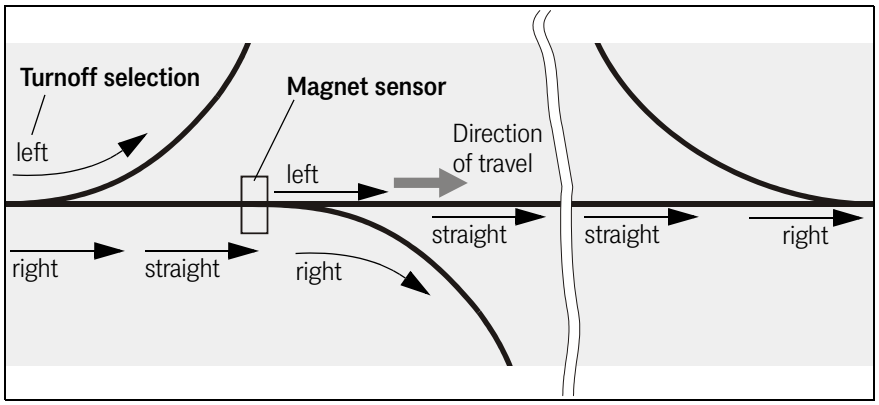
Table 9 *Turnoff selection via digital inputs DIN 1 and DIN 2*

DIN 1	DIN 2	Track
1	0	Left
0	1	Right
0	0	Straight
1	1	Straight

5.3 Turning off from the Main Track

If the vehicle is to turnoff to a second track the second track has to be started as shown in Figure 13. Suitable magnetic tape for turnoffs is listed in Table 2 on page 10. In addition to the main track there may only ever be one branch track in the reading area of the sensor. Crossroads thus have to be realized with the left turnoff and the right turnoff having an offset.

Figure 13 *Layout of turnoffs*



The sensor receives the turnoff commands via its digital inputs (see above) or via the main menu of the service program (for testing purposes, see 6.4 on page 24). The command has to be sent before the sensor detects the second track. It should be reset shortly after the turnoff. Due to optimized algorithms the magnet sensor stays centered over the chosen track during turnoffs.

CAUTION

Random behavior of the track guidance

If at a junction the digital input is set to straight the behavior of the track guidance is random.

- ▶ Switch to a dedicated direction (left/right) before reaching turnoffs.

As shown in Figure 13 at turnoffs the direction should either be set to the direction of the turnoff or the opposite direction. Since there is no turnoff in the opposite direction the sensor then steers the vehicle straight on.

6 Software

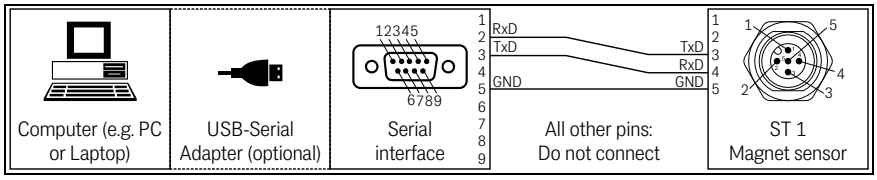
6.1 Switch-On Behavior

Directly after switch-on all 5 LEDs are lit. The boot loader then waits for 5 seconds if a software update is to be carried out. Afterwards the sensor switches to its normal operating mode.

6.2 Connection to a PC via the Serial Interface

The sensor has a serial interface included in the 5 pin ST 1 (s. 5.2.1 on page 20). This interface can be used for its diagnosis, configuration or a software update. A PC with a serial RS 232 interface is needed. For PCs that don't have a serial interface a USB to RS 232 adapter can be ordered from electronics retailers.

Figure 14 *Connection example: Connection with the serial interface of a computer*



The sensor's serial interface has the following communication settings. Those have to be configured in the terminal program on the PS (see below).

Table 10 *Transmission parameters of the serial RS 232 interface*

Setting	
Bits per second	115200
Data bits	8
Parity	None
Stop bits	1
Flow control	None
Terminal emulation	ANSI

6.3 Terminal Program

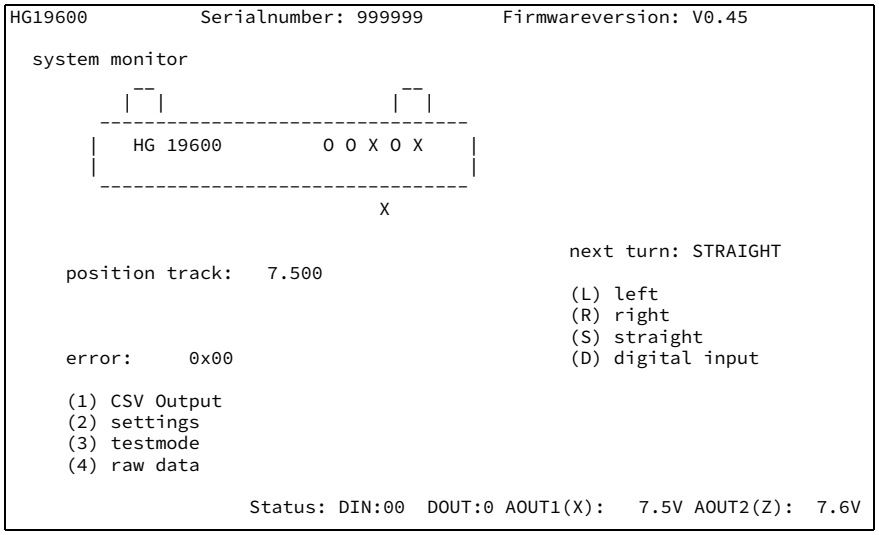
Every terminal program compatible with the transmission parameters shown above can be used, examples are HyperTerminal® or Tera Term®. HyperTerminal has been included in earlier versions of Microsoft® Windows®. Additionally it can be downloaded from the following address:

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

Start the terminal program on the PC and connect the COM port with the pins TxD, RxD und GND of the magnet sensor. When the connection is established successfully the main menu as shown in section 6.4 appears. Sometimes it is necessary to refresh the menu with the key Esc.

6.4 Service Program

Figure 15 *Main menu*



The service program shows the current system status. In its first line the serial number and the software version are output. Below a visual representation of the sensor casing follows that shows the position of detected magnetic tapes,

Table 11 *Status displays in the main menu*

Status display	
position track	position of the chosen track
next turn	selected turnoff direction, for testing purposes this can be manually overwritten with L, R and S, reset with D afterwards (also see following page)
output	output position (equal to the value for *position track*, however a different value can be calculated if the default values for *Amplitude*, *Offset* and *Invert Track* have been changed, s. 6.4.2 on page 27)

The status line lists the following information:

Table 12 *Status line in the main menu*

Status line	
DIN	state of the digital inputs (s. Table 9 on page 21)
DOUT	state of the digital output (detect)
AOUT1 (X)	state of the analog output
AOUT2 (Z)	state of the analog output

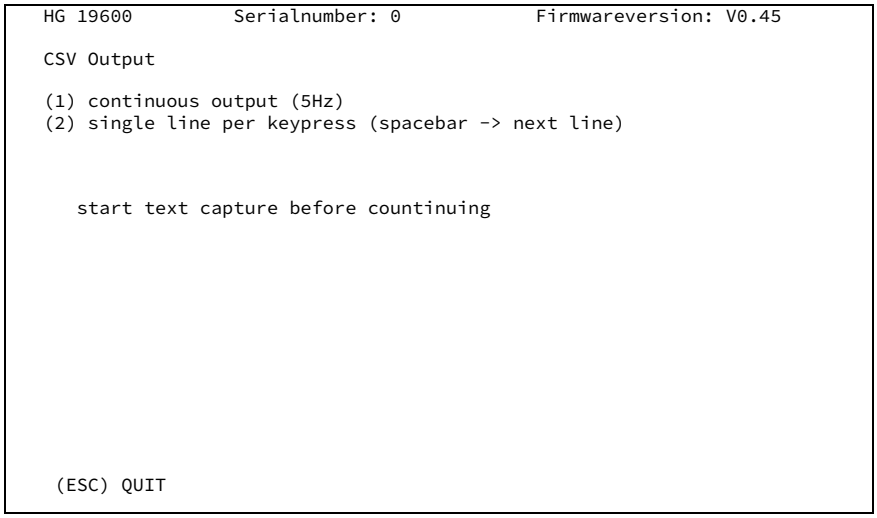
The keys 1, 2, 3 and 4 allow to switch to further menus. With the keys L, R and S the digital inputs for the turnoff selection can be overwritten for testing purposes:

- L chooses the left track) / R chooses the right track.
- S chooses straight-ahead driving (center).

When the digital inputs are overwritten the message `!digital inputs overwritten!` appears. D resets the overwriting.

6.4.1 (1) CSV Output

Figure 16 *Menu CSV Output*



For the purpose of diagnosing the sensor several values are output in the CSV format (Comma Separated Values). This output can be stored on the PC by using a terminal program (e.g. HyperTerminal®, menu transmission, record/save text). Set the file extension of the file to be written to *.csv* and start saving before you start the output in the service program. You have two output options:

- 1 (default): The values are output as a continuous stream.
- 2: A new line is output whenever the space bar is pressed on the PC's keyboard.

In order to end the recording end the transmission in the terminal program, then stop the output stream in the service program with the key Esc. The text file on the PC has the following format:

Figure 17 *Example of a CSV text recording*

```
Counter;System1_X;System1_Y;System1_Z;System2_X;System2_Y;System2_Z;System3_X;System3_Y;Sy
stem3_Z;total_field;PositionTrack1;OutputPosition;AOUT1;AOUT2;DOUT;DIN1;DIN2;Numberof-
Tracks;SYSTEMERROR;SN: 0; SW: V0.40
1; -0.244; -0.001;  0.079;  0.031;  0.008;  0.278;  0.181; -0.021;  0.025;  0.720;  0.514;
0.514;  0.513;  5.564;1;0;0;1;0
2; -0.244; -0.001;  0.079;  0.031;  0.008;  0.278;  0.180; -0.021;  0.025;  0.720;  0.511;
0.511;  0.514;  5.568;1;0;0;1;0
3; -0.243; -0.001;  0.079;  0.031;  0.008;  0.278;  0.180; -0.021;  0.025;  0.720;  0.512;
0.512;  0.512;  5.568;1;0;0;1;0
4; -0.244; -0.001;  0.079;  0.031;  0.008;  0.278;  0.181; -0.021;  0.025;  0.720;  0.512;
0.512;  0.511;  5.568;1;0;0;1;0
5; -0.244; -0.001;  0.079;  0.031;  0.008;  0.278;  0.180; -0.021;  0.025;  0.720;  0.512;
0.512;  0.514;  5.568;1;0;0;1;0
6; -0.244; -0.001;  0.079;  0.031;  0.008;  0.278;  0.180; -0.021;  0.025;  0.720;  0.512;
0.512;  0.512;  5.568;1;0;0;1;0
7; -0.244; -0.001;  0.079;  0.031;  0.008;  0.278;  0.180; -0.021;  0.025;  0.720;  0.514;
0.514;  0.510;  5.568;1;0;0;1;0
8; -0.244; -0.001;  0.079;  0.032;  0.008;  0.279;  0.181; -0.021;  0.025;  0.720;  0.514;
0.514;  0.516;  5.564;1;0;0;1;0
9; -0.243; -0.001;  0.079;  0.031;  0.008;  0.278;  0.181; -0.021;  0.025;  0.720;  0.515;
0.515;  0.513;  5.564;1;0;0;1;0
10; -0.244; -0.001;  0.079;  0.031;  0.008;  0.279;  0.181; -0.021;  0.025;  0.721;  0.510;
0.510;  0.510;  5.573;1;0;0;1;0
11; -0.244; -0.001;  0.079;  0.031;  0.008;  0.278;  0.181; -0.021;  0.025;  0.720;  0.513;
0.513;  0.511;  5.568;1;0;0;1;0
(...)
```

Afterwards the file can be imported into a spreadsheet application (e.g. Microsoft® Excel®) and analyzed.

Figure 18 *CSV recording imported into a spreadsheet application*

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	Counter	System1_X	System1_Y	System1_Z	System2_X	System2_Y	System2_Z	System3_X	System3_Y	System3_Z	total_field	PositionTrack1	OutputPosition	AOUT1	AOUT2	DOUT	DIN1	DIN2	NumberofTracks	SYSTEMERROR	SN: 0	SW: V0.40
2	1	-0.244	-0.001	0.079	0.031	0.008	0.278	0.181	-0.021	0.025	0.720	0.514	0.514	0.513	5.564	1	0	0	1	0		
3	2	-0.244	-0.001	0.079	0.031	0.008	0.278	0.180	-0.021	0.025	0.720	0.511	0.511	0.514	5.568	1	0	0	1	0		
4	3	-0.243	-0.001	0.079	0.031	0.008	0.278	0.180	-0.021	0.025	0.720	0.512	0.512	0.512	5.568	1	0	0	1	0		
5	4	-0.244	-0.001	0.079	0.031	0.008	0.278	0.181	-0.021	0.025	0.720	0.512	0.512	0.511	5.568	1	0	0	1	0		
6	5	-0.244	-0.001	0.079	0.031	0.008	0.278	0.180	-0.021	0.025	0.720	0.512	0.512	0.514	5.568	1	0	0	1	0		
7	6	-0.244	-0.001	0.079	0.031	0.008	0.278	0.180	-0.021	0.025	0.720	0.512	0.512	0.512	5.568	1	0	0	1	0		
8	7	-0.244	-0.001	0.079	0.031	0.008	0.278	0.180	-0.021	0.025	0.720	0.514	0.514	0.510	5.568	1	0	0	1	0		
9	8	-0.244	-0.001	0.079	0.032	0.008	0.279	0.181	-0.021	0.025	0.720	0.514	0.514	0.516	5.564	1	0	0	1	0		
10	9	-0.243	-0.001	0.079	0.031	0.008	0.278	0.181	-0.021	0.025	0.720	0.515	0.515	0.513	5.564	1	0	0	1	0		
11	10	-0.244	-0.001	0.079	0.031	0.008	0.279	0.181	-0.021	0.025	0.721	0.510	0.510	0.510	5.573	1	0	0	1	0		
12	11	-0.244	-0.001	0.079	0.031	0.008	0.278	0.181	-0.021	0.025	0.720	0.513	0.513	0.511	5.568	1	0	0	1	0		

6.4.2 (2) Settings

By using the key 2 in the main menu the *settings* menu of the magnet sensor is opened.

Figure 19 *Menu settings*

```
  HG 19600          Serialnumber: 999999          Firmwareversion: V0.45

settings
                                          Range:
   (1) track polarity : north

   (3) sensitivity    :  0.200 [mT]  0.01 .. 2
   (4) sen. two tracks:  0.800        0.1 .. 4

       AOUT1 (X)
   (5) amplitude      :  10.00 [V]    2.5 .. (10 - offset)
   (6) offset         :   0.00 [V]      0 .. (10 - amplitude)
   (7) invert output  : NO
   (H) hold analog output when detect is lost: NO
       AOUT2 (Z)
   (8) amplitude      :  10.00 [V]      0 .. 10
   (9) multiplier     :   1.00          0 .. 10


   (C) calibration
   (D) load default settings
   (F) firmware update
  (ESC) QUIT
                  Status: DIN:00  DOUT:0 AOUT1(X):   0.0V AOUT2(Z):  0.0V
```

Changed parameters are automatically saved

- 1 changes the polarity of the magnetic tape (`south` = magnetic south pole on the top; `north` = magnetic north pole on the top, default; s. section 3.1 on page 10)
- 3 threshold for the detection of a single magnetic tape
- 4 threshold for the detection of two magnetic tapes
- 5 maximum amplitude of the output voltage AOUT1
- 6 offset of the output voltage AOUT1
- 7 invert output voltage AOUT1 (if the sensor has to be mounted side-inverted)
- H analog output voltage is retained in case the detect signal disappears
- 8 maximum amplitude of the output voltage AOUT2
- 9 scaling factor for the output voltage AOUT2
- C calibration settings, see section 6.4.3 on page 28
- D reset parameters to factory settings
- F software update (see section 6.4.6 on page 29)

6.4.3 (C) calibration settings

By using the key C in the menu *settings* the *calibration settings* are opened.

Figure 20 *Menu calibration settings*

```
HG19600          Serialnumber: 999999       Firmwareversion: V0.45

  calibration settings

     compensated magnetic field

     system 3              system 2            system1
      0.000 [mT]            0.000 [mT]          0.000 [mT]
      0.000 [mT]            0.000 [mT]          0.000 [mT]
      0.000 [mT]            0.000 [mT]          0.000 [mT]


     (1) calibrate for track detection
     (2) calibrate for static magnetic field
     (3) delete static magnetic field detection


    (ESC) QUIT
```

In the middle part of the menu the set magnetic field strength for the compensated magnetic field are listed. Those values are subtracted from the actual detected values.

- 1 calibration of the track detection, see section 4.3 on page 17.
- 2 calibration for a static magnetic field, see section 4.2 on page 16.
- 3 deletion of a calibration for a static magnetic field, see section 4.2 on page 16.

6.4.4 (3) test monitor

The test menu can be used to check the analog and digital outputs:

Figure 21 *Menu test monitor*

```
   HG19600          Serialnumber: 999999       Firmwareversion: V0.45

   test monitor

    (1) toggle digital output (detect)

    (2) Set AOUT1 (X) =   0V
    (3) Set AOUT1 (X) =  10V
    (4) Set AOUT1 (X) = -10V
    (5) Set AOUT1 (X) =   xV   [-10V .. 10V]

    (6) Set AOUT2 (Z) =   0V
    (7) Set AOUT2 (Z) =  10V
    (8) Set AOUT2 (Z) =   xV   [0V .. 10V]









    (ESC) QUIT
                      Status: DIN:00  DOUT:0 AOUT1(X):   0.0V AOUT2(Z):  0.0V
```

- 1 switches the digital output DOUT on/off.
- 2 sets the output voltage AOUT 1 (X) to 0V.
- 3 sets the output voltage AOUT 1 (X) to 10V.
- 4 sets the output voltage AOUT 1 (X) to -10V.
- 5 sets the output voltage AOUT 1 (X) to a self-chosen value between -10 and 10 V.
- 6 sets the output voltage AOUT 2 (Z) to 0V.

- 7 sets the output voltage AOUT 2 (Z) to 10V.
- 8 sets the output voltage AOUT 2 (Z) to a self-chosen value between 0 and 10 V.

6.4.5 (4) RAW data monitor

In this menu raw data of the sub systems is shown. Additionally the value `sum of flux density` is shown. This is needed for the commissioning.

The magnet sensor determines a position with X, Y and Z coordinates. For the track guidance only X and Z are used and output. In the RAW data monitor the internal value for Y is also shown.

Figure 22 *Menu RAW data monitor*

```
   HG 19600          Serialnumber: 999999       Firmwareversion: V0.45

   RAW data monitor
          __                          __
         |  |                        |  |
        ----------------------------------
       |   HG 19600          O O O O X    |
       |                                  |
        ----------------------------------


         system 3             system 2             system 1

    X    -0.015 [mT]           0.011 [mT]           0.028 [mT]
    Y    -0.068 [mT]          -0.041 [mT]          -0.060 [mT]
    Z     0.067 [mT]           0.066 [mT]           0.040 [mT]
 track   No                   No                   No
detect

 sum of flux density:  0.231


     (ESC) QUIT
                    Status: DIN:00  DOUT:0 AOUT1(X):   0.0V AOUT2(Z):  0.0V
```

If the compensation for a static magnetic field is activated the raw data shown in this menu is already calculated with the compensation included (see section 4.2 on page 16).

6.4.6 Software Update (Firmware)

Directly after switching the supply voltage on the following message appears in the terminal program.

Figure 23 *Menu software update*

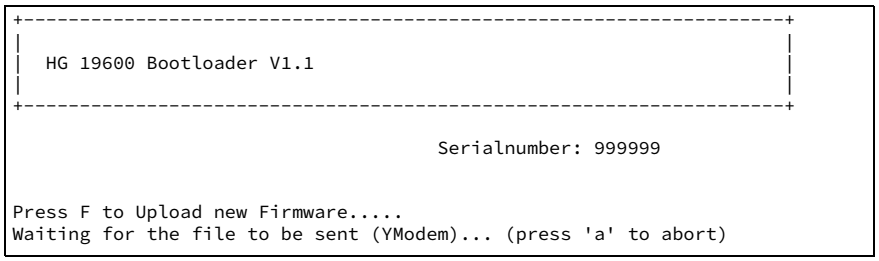
```
+--------------------------------------------------------------------+
|                                                                    |
|  HG 19600 Bootloader V1.1                                          |
|                                                                    |
+--------------------------------------------------------------------+

                                     Serialnumber: 999999


Press F to Upload new Firmware.................
```

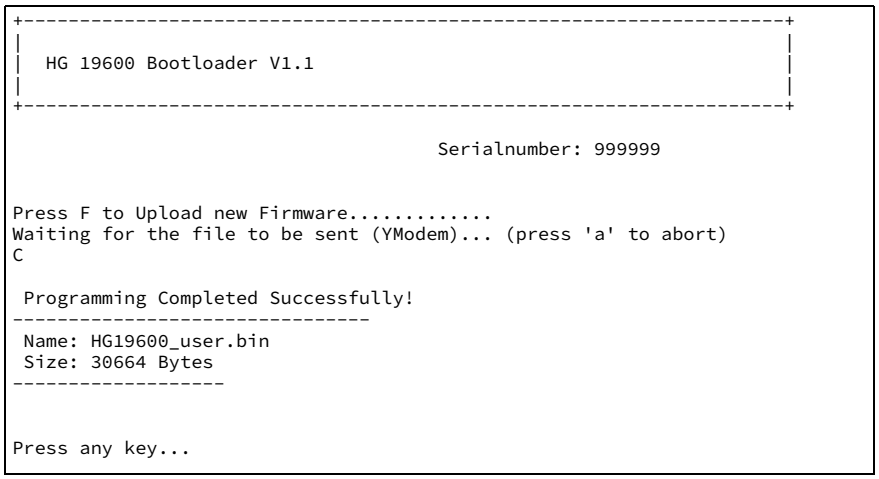
In order to start a software update press the key F within 5 seconds.

Figure 24 *Transfer of a firmware update*



At this point the transfer can be started, the protocol has to be *Y-Modem*. If the transmission is successful the following message appears. Press any key to quit, afterwards the sensor switches to normal operation mode.

Figure 25 *Finishing a software update*



7 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 6.4.6 on page 29). Date and version of the firmware are shown in the main menu (Figure 15 on page 24).

8 Technical Data

Table 13 *Technical Data*

Technical Data Magnet Sensor	
Nominal reading height	60 mm when using the magnetic tape HW MAT00003, see Table 2 on page 10. For different magnetic tape a different reading height might be needed.
Casing dimensions	156 x 31 x 53 mm (W x D x H)
Casing material	Polycarbonate
Weight	150 g
Protection class	IP 54
Relative humidity at 25° C	95% (without condensation)
Operating temperature range	-20° C to +50° C
Storage temperature range	-20° C to +70° C
Supply voltage	+ 24VDC
Current consumption	< 100 mA
Connector	2 Stecker M12 (1x 5 pol. / 1x 8 pol.)
Analog outputs	– AOUT 1 (X): -10 to +10 VDC – AOUT 2 (Z): 0-10 VDC
Digital output	Detect: +24 VDC (+Ub), max. 20 mA
Serial interface	RS 232

9 List of Figures

10 List of Tables

11 Index

T

V

W

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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.

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