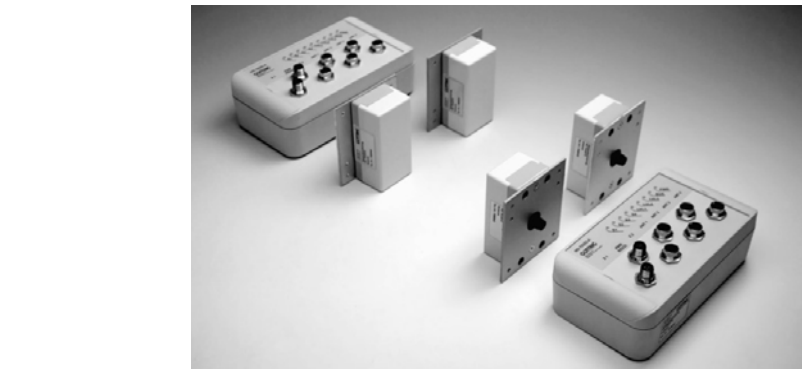

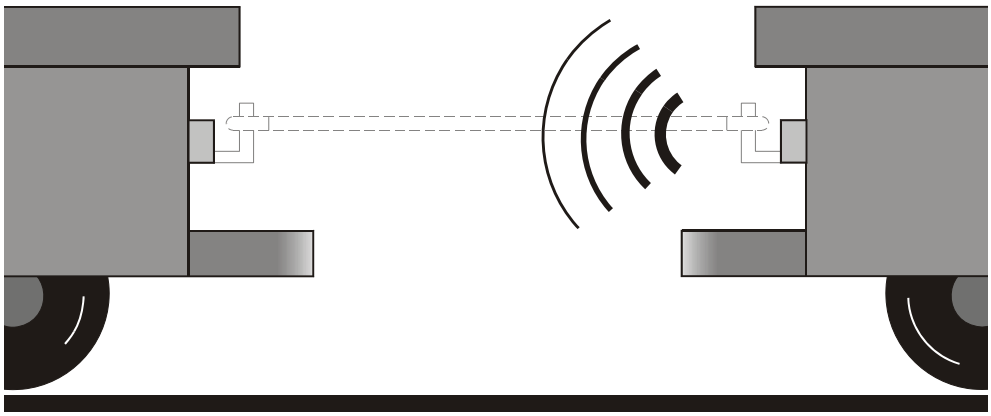

Inductive Proximity Warning System

S 70323-A

English, Revision 01	Dev. by: L.M.
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Contents

1 General System Description

To ensure an undisturbed operation it is necessary to avoid collisions between driverless vehicles (Automated Guided Vehicles / AGV). Generally this function is implemented by a (master) route coordinating computer, provided that the current position of each AGV is known. Should this not be the case, e.g. over long distances or in queues, the safe distances between the vehicles must be secured by an appropriate sensor system.

The principle of the proximity warning system is based on the attenuation of electromagnetic signals along a track. Sinus signals are transmitted from one vehicle and received by another one via ferrite antennas. Transmission frequency can be chosen within a range from 10 kHz to 90 kHz. The magnetic field attenuation between the vehicles is a measurement of their separation distance. To make sure that vehicles on two parallel tracks (e.g. return journey) do not interfere with one another, two different frequencies can be allocated to each of the tracks. Due to the system the difference between the frequencies is always 300 Hz.

Figure 1 Inductive Proximity Warning System

The Proximity Warning System of Götting is suitable for almost all areas in which production and transportation processes are to be automated. The system offers a substantial simplification of the system control by transferring the monitoring and control tasks from the routing (master) computer to the vehicle.

1.1 System Properties

The system of Götting has a modular structure. A combination of individual building blocks (components) results in an application-specific and ideally matched system. Customized versions require only minor production and development effort.

This is mainly due to the application of a processor- based control unit, communicating with the vehicle controller using an appropriate software.

1.2 System Variants

The system has different variants, depending on the control unit applied.

Variant	Number of Antennas	Interface	Frequencies
G 70323**S**A	4	Analog / Digital - 0 to 20 mA - 0 to 10 V - Additional 3 adjustable switching inputs (24 VDC)	When ordering customer-specific as well as plant-specific configuration is possible
G 70323**T**A	2		
G 70323**U**A *)	4	Serial (RS 232)	
G 70323**V**A *)	2		
G 70323**W**A	4	CAN-Bus	
G 70323**X**A	2		
G 70323**Y**A	4	Profibus	
G 70323**Z**A	2		
*) In preparation			

Table 1 System Variants

For the analog types SA/TA the distance value is available as a current output (0 to 20 mA)

and voltage output (0 to 10 V). Additionally 3 switching outputs (24 VDC) allocated to the three free selectable thresholds can be used. For versions with a RS-232 interface, CAN- bus or Profibus the threshold is numerically available in the digital data stream.

NOTE! If required the connection cable is available as an accessory.

NOTE! During parallel operation the proximity warning systems and inductive track guidance systems / or systems with inductive energy transfer may experience interferences - especially if the basic frequencies or their harmonic waves are part of the receive spectrum of the proximity warning system. This has to be considered right from the start and might be verified in preliminary tests (s. section 6.5 on page 21).

1.3 Typical applications for automation

Fields of application are:

- Stacker cranes

- Proximity protection of track guided vehicles (AGV, rack feeders, mono rail transportation systems)
- Positioning aid for track guided transportation vehicles

1.4 Design of a proximity warning system

The proximity warning system consists of:

- Microprocessor control unit
- 2 - or 4 antenna system
- Connection cable between antenna and control unit

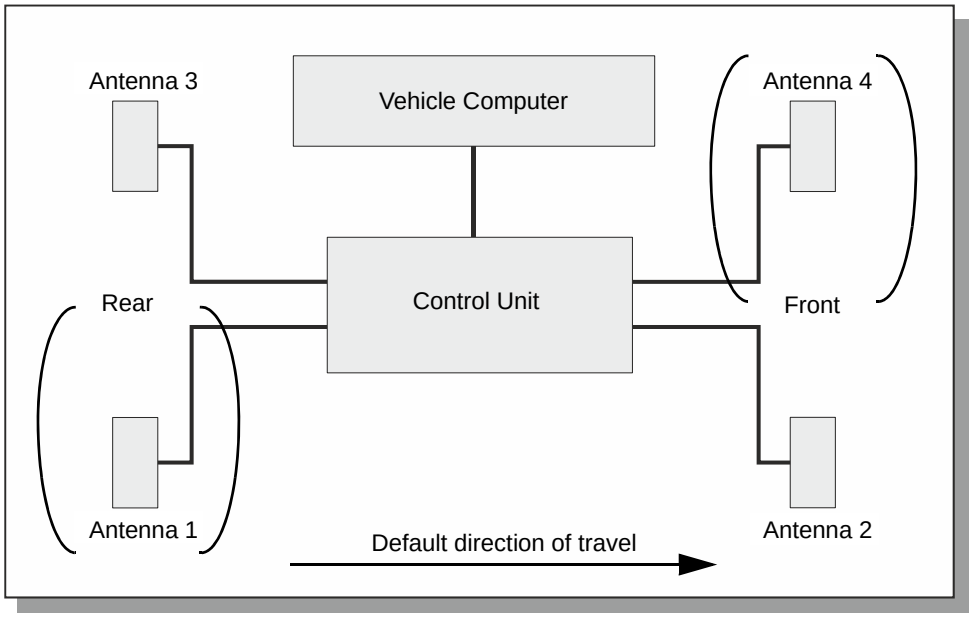


Figure 2 Block diagram of the proximity warning system with 2 or 4 antennas

1.5 Functional Description

Due to its modular design the proximity warning system can be utilized in a number of different variations according to individual requirements. Thus the following is intended to explain its principle function by means of a standard configuration.

It is possible to connect two or four antennas to the system (see above). Antenna 2 and 3 are able to transmit and receive (each antenna), antenna 1 and 4 are only able to transmit (each).

1.5.1 Proximity detection with 2 antennas

The vehicle equipment comprises a control unit and a transmitter / receiver antenna - each mounted at the front- and rear sides of the vehicle. They are connected with the control unit via cable.

Antenna 2, mounted in direction of travel (see Figure 2 on page 6), receives an alternating magnetic

field from the preceding vehicle. Antenna 3 mounted at the rear side (see Figure 2) accordingly transmits an alternating field that will be received by any following vehicle.

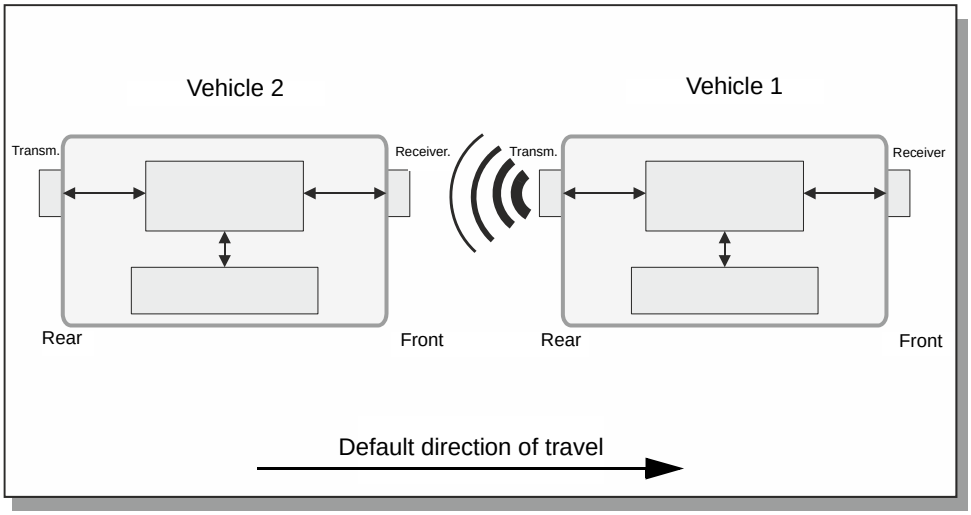


Figure 3 Configuration with 2 vehicles and 2 antennas each

1.5.2 Proximity detection with 4 Antennas

If no reliable distance protection can be guaranteed with two antennas due the size of the vehicle, an application of 4 antennas is recommendable.

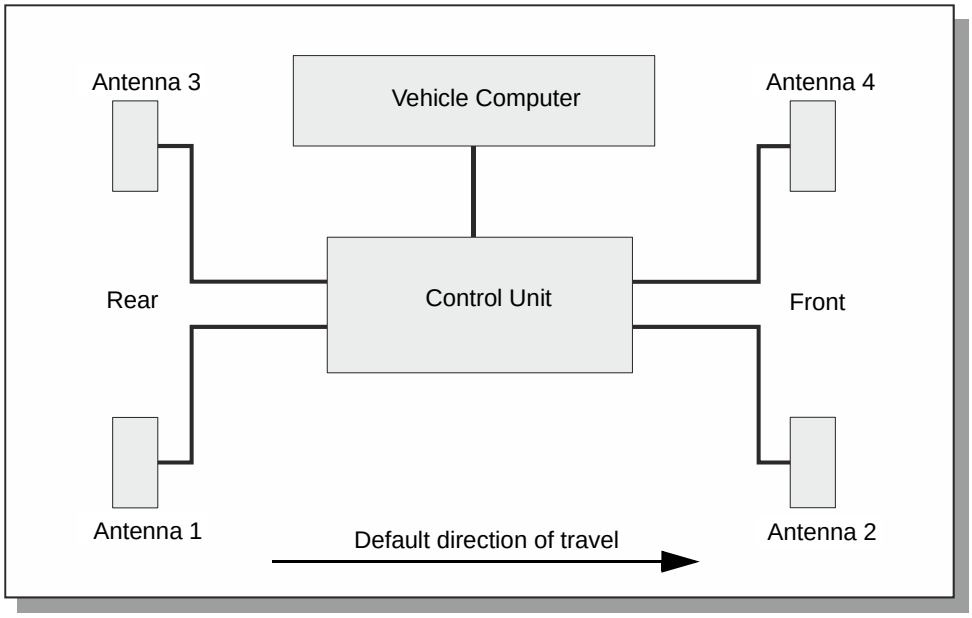


Figure 4 Configuration with 4 antennas

It provides two further operational modes in comparison to the 2-antenna solution: omnidirectional protection and a transverse / crosswise movement / driving.

1.5.2.1 Omnidirectional Protection

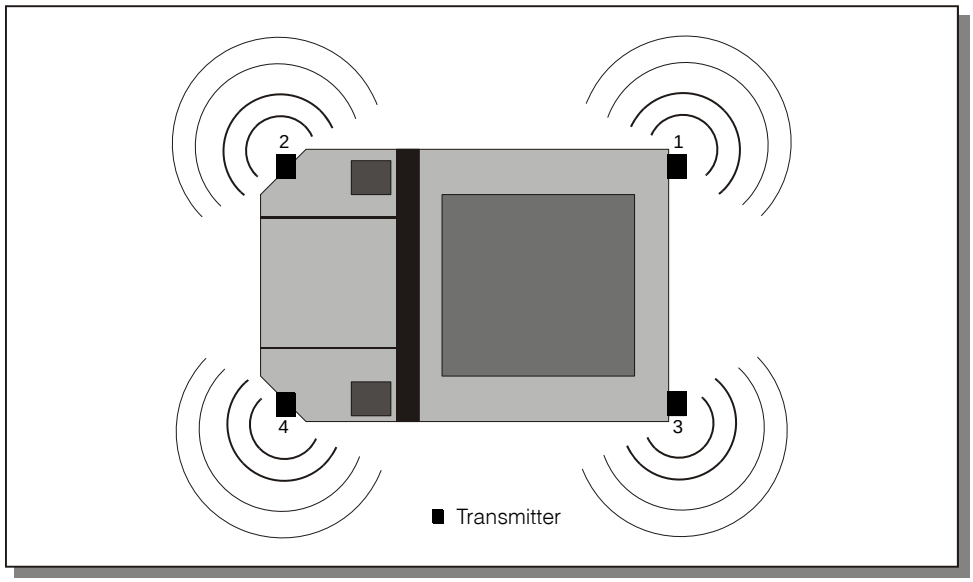


Figure 5 Omnidirectional protection

With the digital input of the control unit it is possible to set the vehicle to a complete protection mode during standstill (e.g. emergency stop). In this mode all 4 antennas will transmit simultaneously. This enables the other vehicles to detect the stationary vehicle from all directions.

1.5.2.2 Crosswise Driving

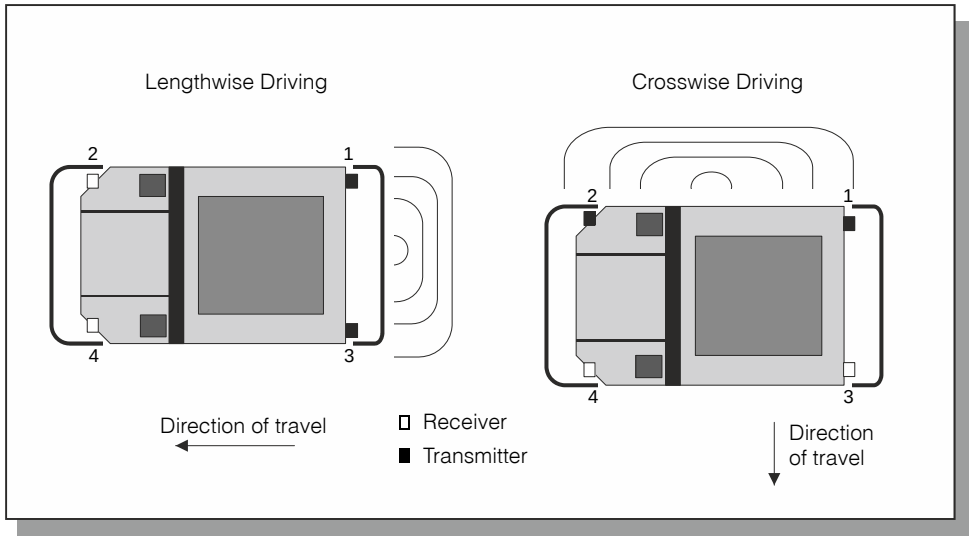


Figure 6 Crosswise driving

By means of a digital input the antenna configuration can be switched in such a way that each antenna pair, mounted at both sides of the vehicle, will be activated instead of those located at the vehicle's front and rear side. This allows a smooth operation of the proximity warning system both for lengthwise and crosswise driving.

2 Profibus (HG 70323YA/ZA)

The device operates as a slave at Profibus-DP V0 according to DIN E 19245 T3.

Adjustable baud rates: 9600 Baud to 12 Mbaud

Profibus address: 0 to 126 adjustable via 2 Hex switches
(addresses higher than 126 are not allowed!)

Output bytes: 2 (see Table 2)

Input bytes: 1 (see Table 3)

2.1 Input and output bytes

Output byte	Data
1	Lowbyte distance [cm]
2	Highbyte distance [cm]

Table 2 Profibus output bytes

Input byte	Data
1	Control byte (see chapter 4 on page 11)

Table 3 Profibus input byte

2.2 GSD-File

The specific configuration of the GSD file con be found in the appendix in section A on page 27.

3 CAN (HG 70323WA/XA)

Adjustable baud rates: 50 kBaud, 125 kBaud, 250 kBaud, 500 kBaud and 1 MBaud

3.1 Transmission Data

Byte	Data
1	Lowbyte distance [cm]
2	Highbyte distance [cm]
3	–
4	–
5	–
6	–
7	–
8	Telegram counter Incremented each time a new message is generated

Table 4 CAN transmission data

3.2 Received Data

Byte	Data
1	Control byte (see chapter 4 on page 11)
2	Lowbyte range [cm]
3	Highbyte range [cm]
4	–
5	–
6	–
7	–
8	Telegram counter Each new message has to be incremented by the sender in order to add / apply all new data.

Table 5 CAN received data

If the user adds a new transmission range value to the system it will replace the parameterized squelch value (see section 5.3.2 on page 14).

4 Control byte

The following control byte will be transferred via interfaces Profibus and CAN.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	crosswise driving	direction	omnidirec-tional	frequency

Table 6 Bit assignment control byte

Frequency: Selection of transmit frequency in oncoming traffic.
0 –> send with F1
1 –> send with F2

Omnidirectional: Simultaneous transmission for omnidirectional protection on all antennas connected
0 –> deactivated
1 –> activated

Direction: Selection of direction of travel
0 –> forward
1 –> backward

Crosswise driving: Switching to lateral distance measurement in crosswise driving mode (may only be used in connection with a 4 antenna system).
0 –> deactivated
1 –> activated

5 Service Interface

For diagnosis and parameterization purposes a serial RS 232 interface located on connector ST3 is available.

NOTE! For connection to a PC and for 24V supply the adapter HG 01933 ZA (M12x1 on Sub-D- socket - 9pin) which can be ordered as an accessory.

5.1 Terminal Program

In the following we refer to the program **HyperTerminal®** (`Hypertrm.exe`), which is part of the scope of supply of Microsoft® Windows® 95/98/NT/2000®. We refer to this program as it is widely used by most Windows users. Furthermore it is possible to download the program from the internet site of Hilgraeve under http://www.hilg-raeve.com/.

However, any arbitrary terminal program can be applied capable of ANSI emulation. If you prefer any other program, please read the documentation provided together with the program and adjust the following values

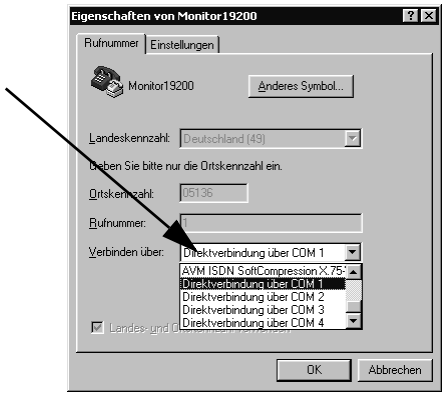
5.2 Parameter Settings

The following parameter settings are required.

Terminal settings monitor program	
Baud rate	57.600 Baud
Terminal emulation	ANSI
Parity	None
Data bits	8
Stop bit	1
Character delay time	1 ms
Line delay time	0 ms
PC interface (Port)	COM1 May vary depending on individual computer set-ups (see below)

Table 7 Terminal settings for the monitor program

If you want to apply a port other than COM1 when using Hyper terminal, proceed as follows:



1. Select properties from the file menu or click the icon . The adjacent window (German screenshot) will open:
2. In the submenu select the dialogue establish direct connection, choose the corresponding port and confirm with OK. When terminating Hyper terminal, save the modified values if you receive a corresponding message.

5.3 Monitor Program

5.3.1 Profibus (HG 70323YA/ZA)

Once the connection with the control unit has been established, the following screen will appear in Hyper Terminal.

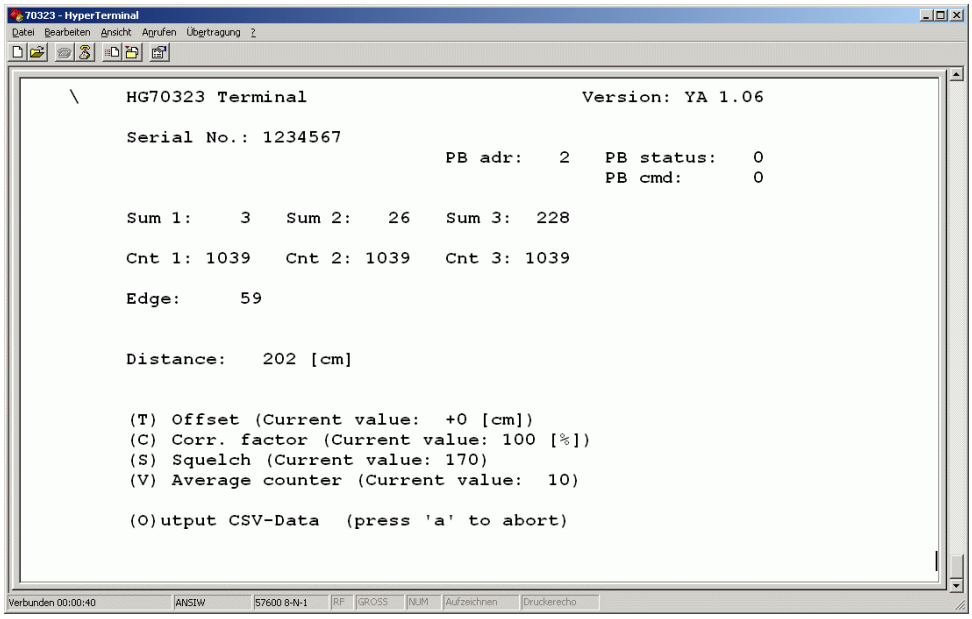


Figure 7 Screenshot Monitor program Profibus (HG 70323YA/ZA)

The values `Sum 1-3`, `Cnt 1-3` and `Edge` are internal intermediate values of the distance calculation.

By entering the character in brackets the following parameters can be changed:

- (T) Offset
  The entered offset will be added to the calculated distance. The sum is finally output as the result. The offset can be set in the range from -100 to +100 cm.
- (C) Corr. factor
  The correction factor will be multiplied with the calculated distance (offset included). The correction factor can be set in the range from 50 to 200%.

- (S) Squelch
  Selectable threshold. Values exceeding this specified value will be used for the distance calculation. Higher squelch values ensure reduced transmission interferences. However, an increased sensitivity or a higher squelch value will lead to an increase of the threshold value and therefore to an increase of the maximum distance of the distance calculation.
- (A) Average counter
  Number of measured values to calculate the mean distance value.
- (O) Output CSV-Data
  Selecting this menu item allows the values Sum1, Sum2, Sum3 and Distance to be recorded as a CSV file. These values can be displayed in a text file via Hyper terminal. Subsequently the file can be evaluated, e.g. in Microsoft Excel.

5.3.2 CAN (HG 70323WA/XA)

After the connection to the control unit has been established the following screen will be displayed in Hyper Terminal.

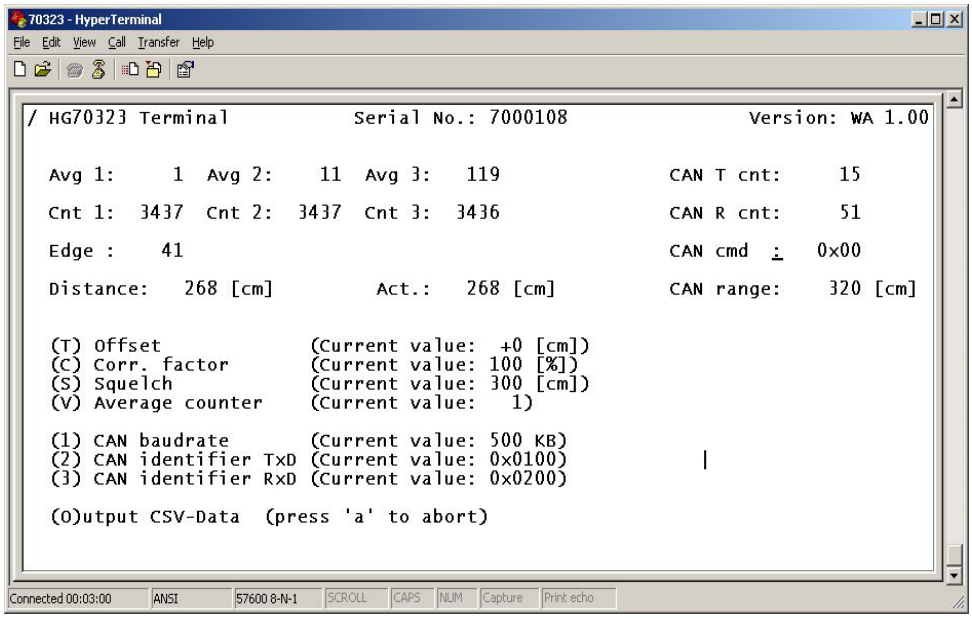


Figure 8 Screenshot Monitor program: CAN (HG 70323WA/XA)

The values `Avg 1-3`, `Cnt 1-3` and `Edge` are internal intermediate values for distance calculation. `CAN T cnt` is the telegram counter for transmission data, `CAN R cnt` for the received data. `CAN cmd` shows the content of the control byte (see chapter 4 on page 11). `CAN range` displays the range (see Table 5 on page 10).

The following parameters can be modified by entering the character (in parenthesis):

- (T) Offset
  The entered offset will be added to the calculated distance. Subsequently the sum will be output as the measurement result. The offset can be set in the range from -100 to 100 cm.

- (C) Corr. factor
  The correction factor will be multiplied with the calculated distance (offset included). The correction factor can be set in the range from 50 to 200%.
- (S) Squelch
  Selectable threshold. Values exceeding this specified value will be used for the distance calculation. Higher squelch values ensure reduced transmission interferences. However, an increased sensitivity or a higher squelch value will lead to an increase of the threshold value and therefore to an increase of the maximum distance of the distance calculation.
- (V) Average counter
  Number of measured values to calculate the mean distance value.
- (1) CAN baud rate
  Baud rate of the CAN interface
- (2) CAN identifier TxD
  CAN identifier for transmission data
- (3) CAN identifier TxD
  CAN identifier for received data

5.3.3 Analog/Digital (HG 70323SA/TA)

When a connection to the control unit is established, the following screen automatically appears in HyperTerminal.

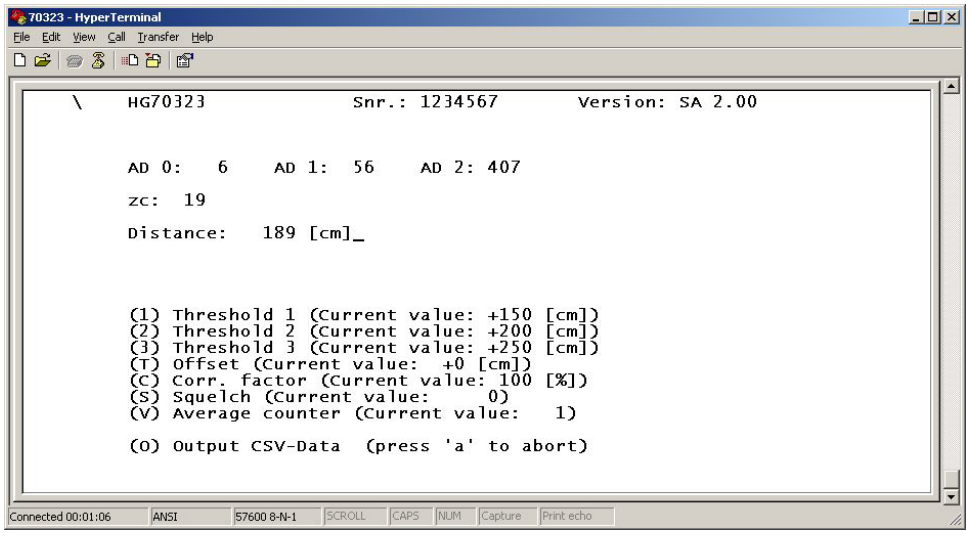


Figure 9 Screenshot Monitor program: Analog/Digital (HG 70323YA/ZA)

The following parameters can be modified by entering the character (in parenthesis):

- (1) Threshold 1
  If the value falls below the adjusted threshold, the corresponding output will be switched to `low`.

- (2) Threshold 2
  If the value falls below the adjusted threshold, the corresponding output will be switched to `low`.
- (3) Threshold 3
  If the value falls below the adjusted threshold, the corresponding output will be switched to `low`.

It is possible to change the sequence of the 3 thresholds as desired, thus it is possible to enter a smaller distance value for threshold3 than for threshold 1.

- (T) Offset
  The entered offset will be added to the calculated distance. Subsequently the sum will be output as the measurement result. The offset can be set in the range from -100 to 100 cm.
- (C) Corr. factor
  The correction factor will be multiplied with the calculated distance (offset included). The correction factor can be set in the range from 50 to 200%.
- (S) Squelch
  Selectable threshold. Values exceeding this specified value will be used for the distance calculation. Higher squelch values ensure reduced transmission interferences. However, an increased sensitivity or a higher squelch value will lead to an increase of the threshold value and therefore to an increase of the maximum distance of the distance calculation.
- (V) Average counter
  Number of measured values to calculate the mean distance value.
- (O) Output CSV-Data
  Selecting this menu item allows the values Sum1, Sum2, Sum3 and Distance to be recorded as a CSV file. These values can be displayed in a text file via Hyper terminal. Subsequently the file can be evaluated, e.g. in Microsoft Excel. Entering A (= abort, 'a' and 'A' work) terminates the storage process and causes a return to the main menu.

6 Mounting and Operating Instructions

6.1 Mounting the Antennas

General Information

The inductive proximity warning system is based on a magnetic alternating field, transmitted and received via the antennas. To avoid any disturbances of the magnetic field, the following instructions should be observed:

- We recommend not placing the antenna on any metal surfaces (it should be attached to a plastic mounting plate); reduced operating range. Metal-free areas around the antenna have to be obeyed for a reading distance of 40 mm.
- A maximum distance to on- board interfering transmitters (e.g. engine, motor cable (lead), frequency converter, switching power supply, etc.) should be kept.
- The antennas must form the outermost point of the vehicle contour.

When ordering it should be noted that the antennas have to correspond to each system frequency pair of the control unit (see Table 1 on page 5).

It is recommended to install the antennas vertically. A horizontal mounting position is possible as well, but it might affect the operational / driving behavior in curves (might lead to a limited cornering ability).

NOTE! It has to be ensured that the markings of all antennas will point in the same direction (upwards or downwards). The position of the markings is shown in Figure 10 (Type HG 70330YC) and Figure 11 on page 18 (Type HG 70330ZC).

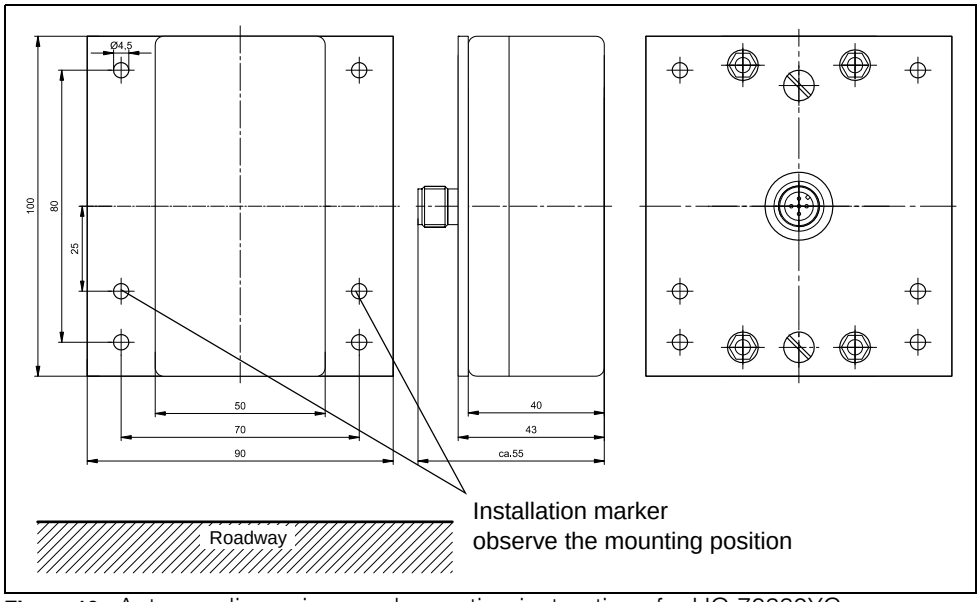


Figure 10 Antenna dimensions and mounting instructions for HG 70330YC

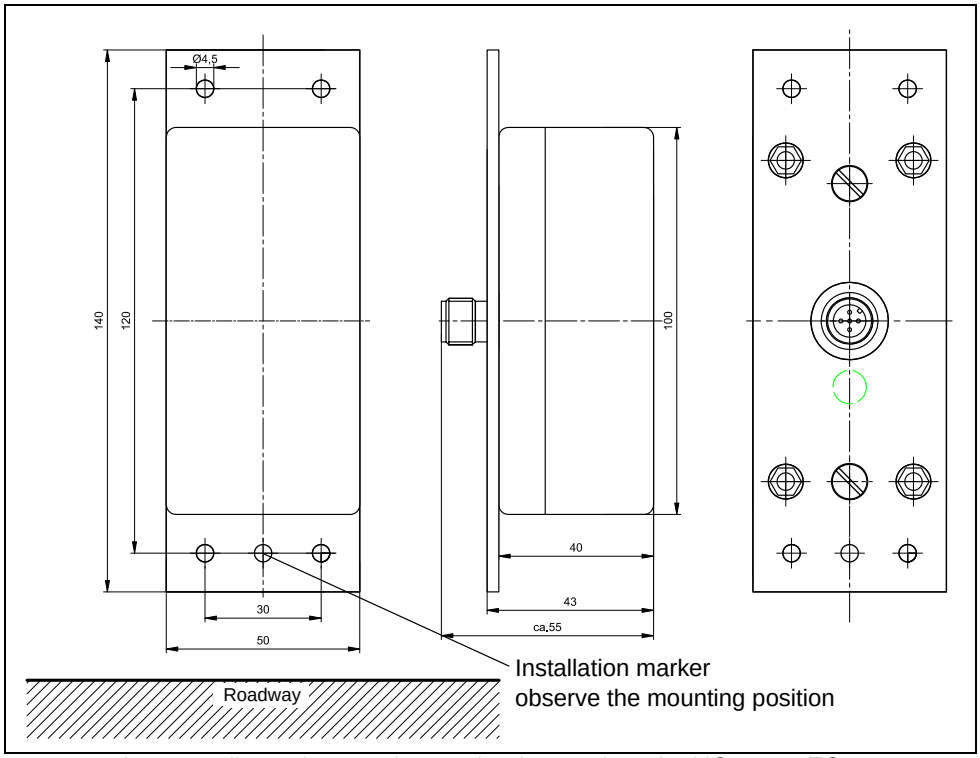


Figure 11 Antenna dimensions and mounting instructions for HG 70330ZC

6.2 Mounting the Control Unit

Due to the high sensitivity of the control unit's evaluation circuit it is advisable to keep a sufficient distant to potential sources of interferences such as high- energy interfering transmitters (engine control, DC/DC converter).

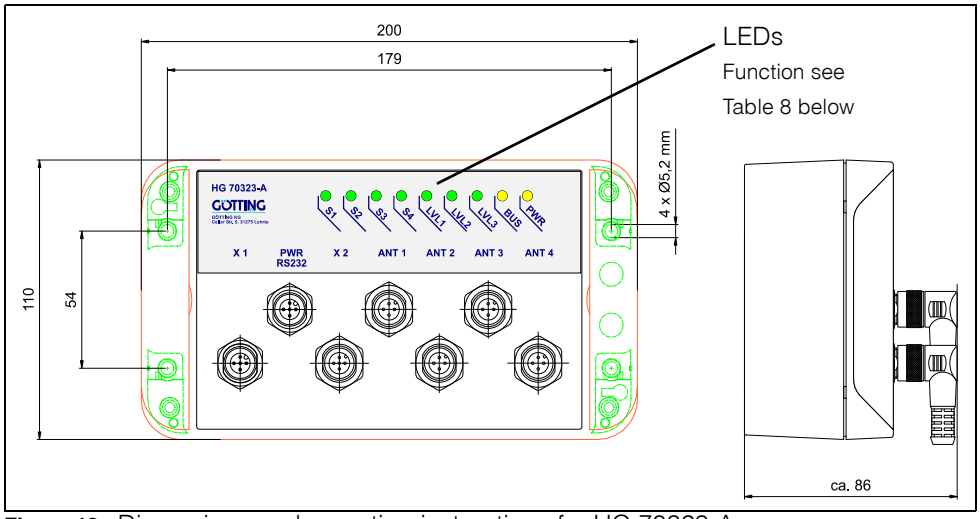


Figure 12 Dimensions and mounting instructions for HG 70323-A

6.3 Display Elements (LEDs)

LED	Function			Color
	Profibus (HG 70323YA/ZA)	**CAN (HG 70323WA/XA)**	**Analog/Digital (HG 70323SA/TA)**	
PWR	Operating voltage +UB			yellow
BUS	Profibus online	– (not used)		yellow
LVL3	Crosswise driving active		off: value below threshold 3	green
LVL2	Reversal of direction active		off: value below threshold 2	green
LVL1	Frequency switching F1 –> F2 active		off: value below threshold 1	green
S4	Front transmitter active			green
S3	Reception front			green
S2	Reception rear			green
S1	Rear transmitter active			green

Table 8 Display elements (LEDs)

6.4 Minimum distance between vehicles during parallel driving

Despite switching to a second frequency during parallel driving there is a minimal mutual coupling between both frequencies. Therefore a minimum distance of 1m should be observed.

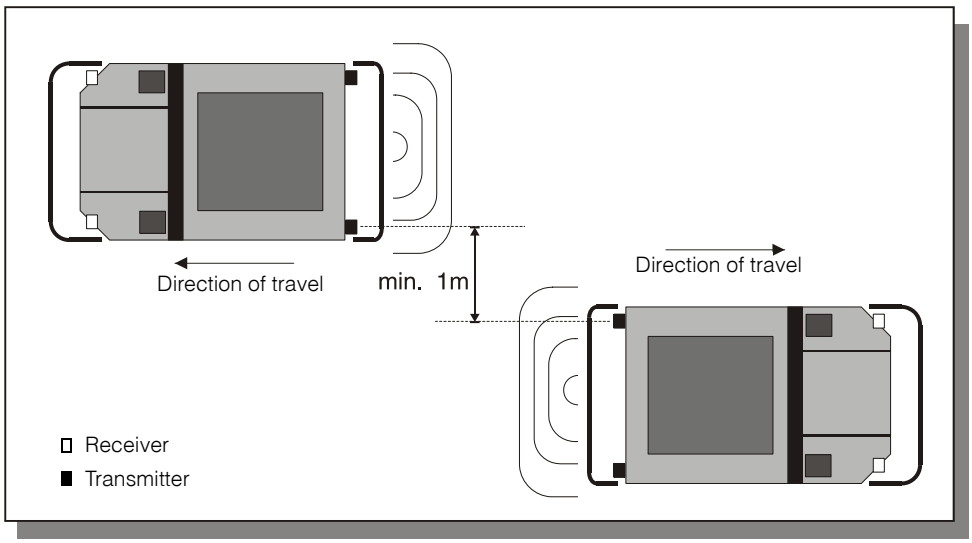


Figure 13 Minimum distance between vehicles during parallel driving

6.5 Vehicle mounting instructions for applications with inductive energy supply systems

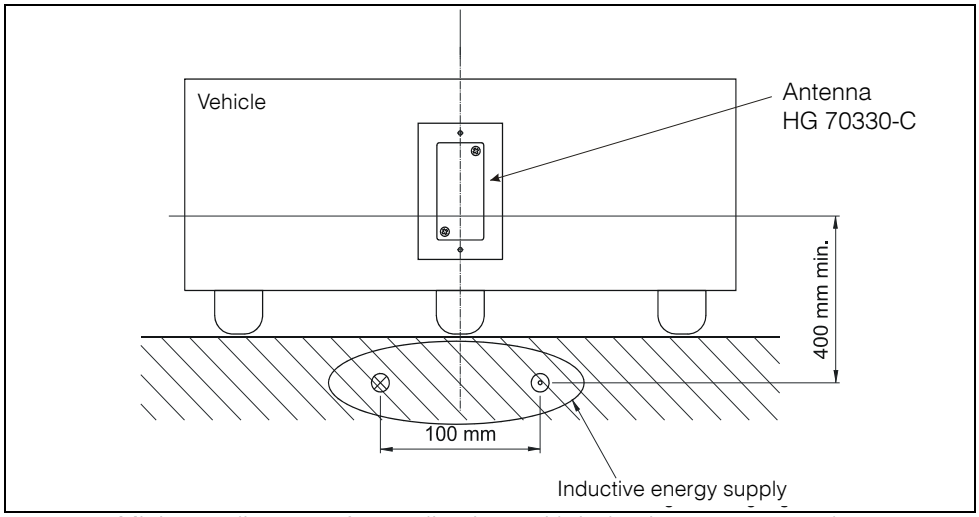


Figure 14 Minimum distances for applications with inductive energy supply

NOTE! The components of inductive energy supply may cause interferences within the frequency range of the proximity warning system. For this reason before proceeding make sure that an undisturbed operation of both systems will be ensured.

7 Technical Data

7.1 General Information

Measurement range	400 to 4000 mm max. (dependent on the selected sensitivity of the Squelch; refer to Figure 7 on page 13 and the explanatory notes)
Absolute accuracy	±5 % of the measured value *)
Repeatability	±1 % of the measured value *)
Frequency range	10 to 90 kHz
Standard system frequencies	10,600 / 10,900 kHz (a different customized configuration of frequency pairs is available on request - please state when ordering)
Distance of system frequencies	300 Hz
*) = Environmental influences may lead to a poor data quality	

Table 9 General technical data

7.2 Control Unit HG 70323-A

Dimensions	200 x 110 x approx. 86 mm (see Figure 15 on page 23)
Material	plastic ABS (UL 94 V-0)
Weight	650 g
Environmental temperature range	0^{o} C to $+50^{o}$ C
Storage temperature range	-20^{o} C to $+70^{o}$ C
Relative humidity at 25 ^{o}C	95 % (without condensation)
Protection class	IP54
Operating voltage	22 to 30 VDC Residual ripple 0,1 V_{eff}
Power consumption	250 mA
Connector plug	Seven M12 x 1 circular connector (see sections 7.2.1 on page 23 and 7.2.3 on page 25)

Table 10 Technical Data Control Unit HG 70323-A

7.2.1 HG 70323YA/ZA: Profibus

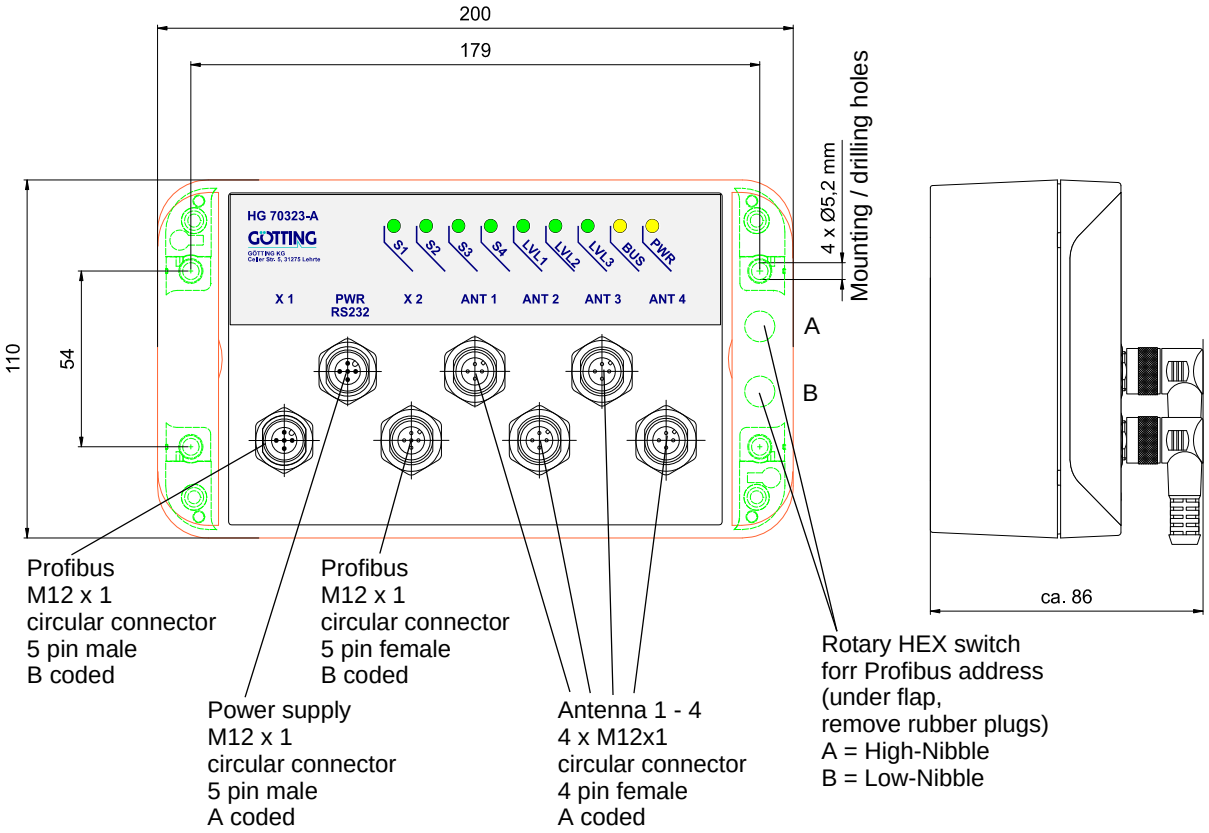


Figure 15 Dimensions HG 70323YA/ZA (Profibus)

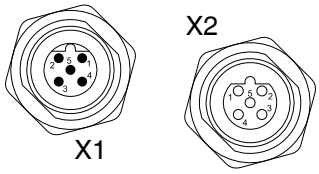
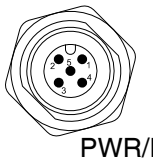
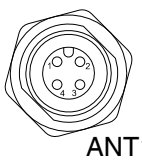
Circular connector		Pin	Signal / Color
Profibus		1	Bus +5 V
		2	Bus A
		3	RTS
		4	Bus B
		5	Bus GND
Power supply		1	+UB
		2	n.c.
		3	TxD
		4	RxD
		5	GND
Antenna 1 - 4		1	brown
		2	white
		3	blue
		4	black
		shielding	connector casing

Table 11 Pin allocations HG 70323YA/ZA (Profibus)

7.2.2 HG 70323WA/XA: CAN

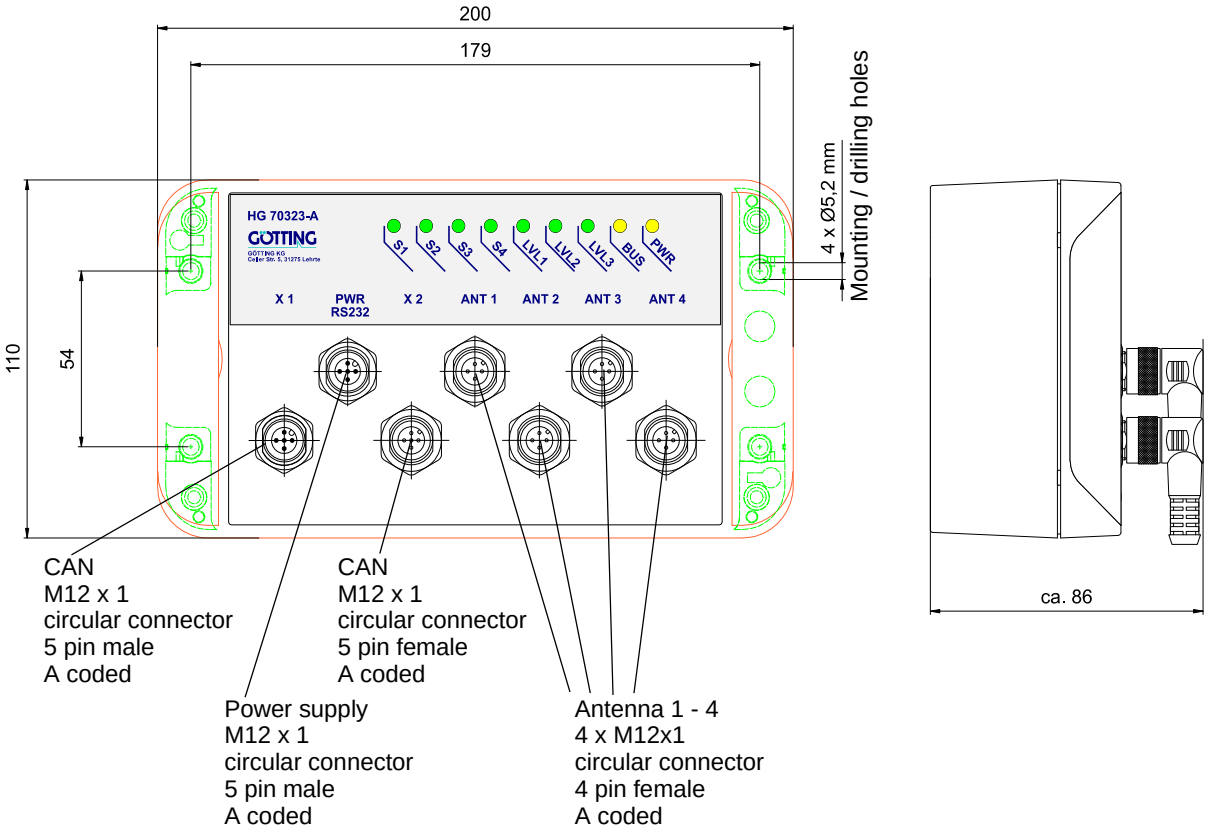


Figure 16 Dimensions HG 70323YA/ZA (Profibus)

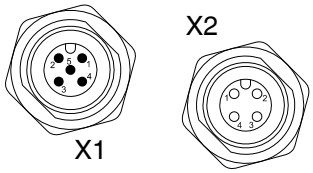
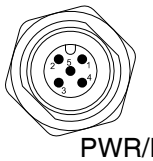
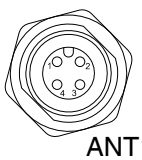
Circular connector		Pin	Signal / Color
CAN		1	–
		2	–
		3	CAN_GND
		4	CAN H
		5	CAN L
Power supply	 PWR/RS232	1	+UB
		2	n.c.
		3	TxD
		4	RxD
		5	GND
Antenna 1 - 4	 ANT1 - ANT4	1	brown
		2	white
		3	blue
		4	black
		shielding	connector casing

Table 12 Pin allocations HG 70323WA/XA (CAN)

7.2.3 HG 70323SA/TA: Analog/Digital

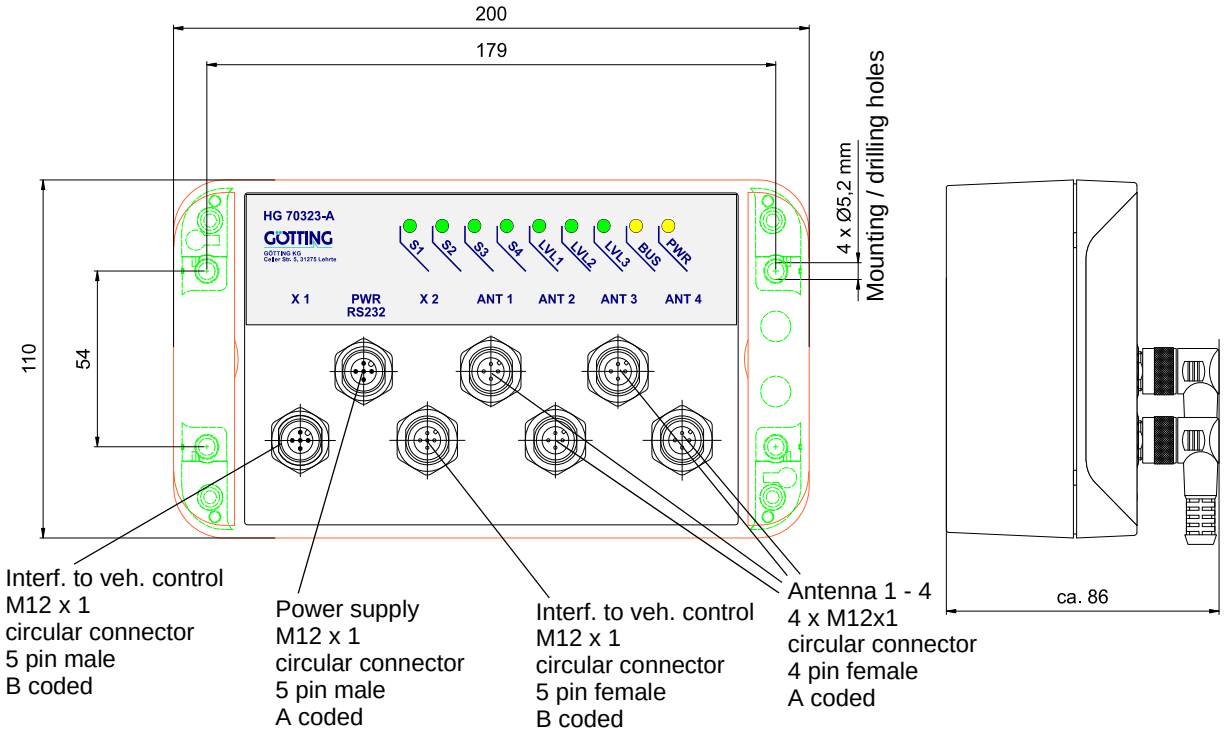


Figure 17 Dimensions HG 70323SA/TA (Analog/Digital)

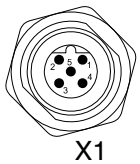
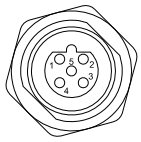
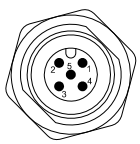
Circular connector		Pin	Signal / Color	Input and output voltages
Interface to vehicle control Analog/Digital	 X1	1	Threshold 3 (OUT)	0 V:Distance ≤ Threshold 3 +24 V:Distance > Threshold 3
		2	Threshold 2 (OUT)	0 V:Distance ≤ Threshold 2 +24 V:Distance > Threshold 2
		3	Threshold 1 (OUT)	0 V:Distance ≤ Threshold 1 +24 V:Distance > Threshold 1
		4	Omnidirectional (IN)	0 V (or open): deactivated +24 V:activated
		5	Direction (IN)	0 V (or open): forwards +24 V:backwards
	 X2	1	Analog Out	0 to 20 mA
		2	GND	
		3	Analog Out	0 to 10 V
		4	f1/f2 (IN)	0 V (or open): f1 +24 V:f2
		5	AUX (IN)	
Power supply	 PWR/RS232	1	+UB	
		2	n.c.	
		3	TxD	
		4	RxD	
		5	GND	

Table 13 Pin allocations HG 70323SA/TA (Analog/Digital) (part 1 of 2)

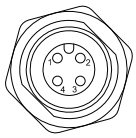
Circular connector		Pin	Signal / Color	Input and output voltages
Antenna 1 - 4	 ANT1 - ANT4	1	brown	
		2	white	
		3	blue	
		4	black	
		shielding	connector casing	

Table 13 Pin allocations HG 70323SA/TA (Analog/Digital) (part 2 of 2)

7.3 Transmission / Reception Antenna HG 70330-C

Two versions of this antenna are available which differ only in the overall dimensions and the length of the antenna cable. Otherwise, both versions are identical in their functionality. Depending on the vehicle type selected users can choose the version that is best suited for the given mounting place.

Dimensions (L x B x H)	- HG 70330YC: 100 x 90 x 55 mm - HG 70330ZC: 140 x 50 x 55 mm See Figure 10 on page 18 and Figure 11 on page 18
Material	plastic ABS
Weight	160 g
Environmental temperature range	0^{o} C to $+45^{o}$ C
Storage temperature range	-20^{o} C to $+70^{o}$ C
Relative humidity 25 ^{o}C	95 % (without condensation)
Protection class	IP54
Connector plug	M12 x 1 circular connector Pin allocations are shown in Table 15 below
Cable (Control unit - antenna)	4 pin with shielding
Cable length	10 m max. with shielded cable LIYCY 4 x 0,25 mm² (for frequencies > 10kHz the max. cable length may decrease)

Table 14 Technical Data Transmission / Reception Antenna HG 70330-C

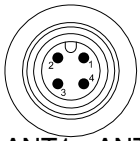
Circular connector		Pin	Color
Antenna 1 - 4	 ANT1 - ANT4	1	brown
		2	white
		3	blue
		4	black
		shielding	connector casing

Table 15 Pin allocations Transmission / Reception Antenna HG 70330-C

8 Appendix

A GSD-File

```
;*************************************************************************
;***                                                                   ***
;***      Götting KG                                                   ***
;***      D-31275 Lehrte-Röddensen                                     ***
;***      Celler Straße 5                                              ***
;***          Tel: 05136/8096-0                                        ***
;***          Fax: 05136/8096-80                                       ***
;***                                                                   ***
;*************************************************************************
;***                                                                   ***
;***      Filename: HG70323A2.GSD                  (c) 2005            ***
;***      GSD file version 2 from  24.06.2005                          ***
;***                                                                   ***
;*************************************************************************
;
;      ATTENTION:
;      ==========
;      Changes in this file can cause configuration or communication problems.
;      This file is compatible to the firmware of the device.


#Profibus_DP

GSD_Revision        = 2
Vendor_Name         = "Götting KG"
Model_Name          = "HG70323A1"
Revision            = "Version 1.01"
Ident_Number        = 0x3005
Protocol_Ident      = 0
Station_Type        = 0
Hardware_Release    = "HG70323"
Software_Release    = "70323 V1.00"
Implementation_Type = "SPC3"
9.6_supp            = 1
19.2_supp           = 1
93.75_supp          = 1
187.5_supp          = 1
500_supp            = 1
1.5M_supp           = 1
3M_supp             = 1
6M_supp             = 1
12M_supp            = 1
MaxTsdr_9.6         = 60
MaxTsdr_19.2        = 60
MaxTsdr_93.75       = 60
```

```
MaxTsdr_187.5       = 60
MaxTsdr_500         = 100
MaxTsdr_1.5M        = 150
MaxTsdr_3M          = 250
MaxTsdr_6M          = 450
MaxTsdr_12M         = 800
Redundancy          = 0
Repeater_Ctrl_Sig   = 0
24V_Pins            = 0
Freeze_Mode_supp    = 1
Sync_Mode_supp      = 1
Auto_Baud_supp      = 1
Set_Slave_Add_supp  = 0
User_Prm_Data_Len   = 0
Min_Slave_Intervall = 11
Modular_Station     = 0
Max_Diag_Data_Len   = 244
Slave_Family        = 3

Module = "1 Byte Output/4 Byte Input" 0x20,0x93
EndModule
```

9 List of Figures

10 List of Tables

11 Handbook Conventions

At the time this manual was printed, the following symbols and marks were used in all Götting KG documentations:

- For security advice, the following symbols stand for different degrees of danger and importance:

NOTE!

ATTENTION!

WARNING!

- Further information or advice are indicated as follows:

TIP!

- Program texts and variables are indicated through the use of the `Script Courier`.
- 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 valid).
- Sections, drawings and tables are subsequential numbers throughout the complete document. In addition, each documents includes a list of contents showing the page numbers following the front. If a document exceeds 10 pages, it also has a drawings list and a list of tables on the last few pages. If required, in case a document is correspondingly long and complex, a index is added in the back.
- Each document shows a small table including meta information, such as developer, author, revision and date of issue, on the front page. The information regarding revision and date of issue are also included in the bottom line on each page of the document. This way it is possible to clear identify the source document for each bit of information.
- Online version (PDF) and printed handbook are always generated from the same source. Due to the consequent use of Adobe FrameMaker for these documentations, it is possible to use the cross hints and content entries (including page numbers of the index) of the PDF file for automatic transfer to the corresponding content.

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