2-dim. Positioning and Identification Antenna Outdoor

HG 98860ZA

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1 Introduction

The described antenna is designed to be used for positioning and/or trackguiding vehicles in rough outdoor environment, as all electronic components are fully sealed as well as equipped with an extended temperature range. All important parameter settings, calibration and updates are carried out via an integrated serial interface.

Figure 1 Examples of automated vehicles using transponder systems

Antenna HG 98860ZA utilizes a completely new antenna concept, which has a large reading area with a linear transponder positioning function. The antenna is so-called 2-dimensional, meaning that it outputs the Transponder code as well as the linear deviation rectangular to the direction of travel, in direction of travel and in addition the information “Crossing of the transponder“.

NOTE! The accuracy of the measured value for the position X (in direction of travel) only meets the specified accuracy (see Table 14 on page 48) for travelling speeds of up to 1 m/s! For higher speeds the positioning pulse has to be used as the reference which has an accuracy within the millimeter range.

NOTE! The point at which the positioning pulse is generated is not exactly the same point at which the position X is equal to zero (X = 0) since these points are calculated using different procedures.

For the above described antenna, the use of Transponders of the type HG 70653ZA (Read Write – RW) is mandatory.

The transponder antenna has an output format, which enables the user to configure additional system information. This additional information, for example, may be used by an external visualization system (e.g. vehicle control unit with display) and enables statements regarding the condition and availability of antennas and transponders.

This system description refers to Transponder Positioning Antenna HG 98860ZA with the firmware 98860MA1.0 or higher (also refer to Figure 17 on page 33).

1.1 System Components

The 2-dimensional Positioning and Identification System using the antenna HG 98860ZA consists of up to four different components:

Figure 2 System components (optional extras in brackets)

1. Transmitter-receiver antenna HG 98860ZA incl. interpreter
   (refer to section 4.2 on page 15)
2. Transponder HG 70653ZA
   (within the track; refer to section 4.1.1 on page 15)
3. Connection cable HG 09240DB
   (not in this picture; refer to section 4.2.5 on page 28)
4. Washer set for mounting
   (not in this picture, refer to section 2.2 on page 8)
5. Optional Read / Write Unit HG_81830YA
   (not in this picture; refer to separate data sheet)

1.2 Function

As the antenna passes over the Transponder, it energizes the latter with an energy field of 128 kHz. The transponder transmits its code back at half this frequency.

The relative Transponder position is measured. This relative position does not provide the knowledge of the heading of the vehicle, as the field of the Transponder is rotation-symmetric to the longitudinal axis of the Transponder. Via a cable with the max. length of 20 meters (RS 422, CAN) Antenna HG 98860 is connected to the vehicle control electronic.

The internal interpreter unit decodes the Transponder code and interpolates the Transponder position rectangular to the direction of travel and in direction of travel from the measured values.

Each coordinate axis crossing in direction of travel generates a positioning pulse of adjustable duration.

In addition, various parameters of the antenna, such as current consumption and power supply voltage are measured and may be added to the serial output protocol.

1.3 Application Example

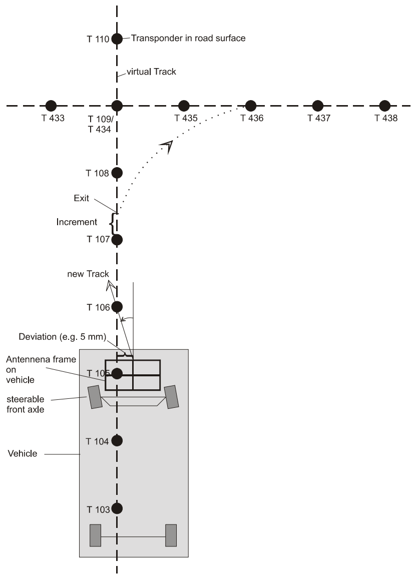


Figure 3 Track guiding a vehicle with one antenna

The figure shows a vehicle with an antenna frame for track guidance. With the aid of the transponder (T 105) the deviation from the predetermined track is determined. With this information, an external computer is able to determine the new direction required to return to the predetermined track as soon as possible (the external computer is not part of the system). Rotary encoders enable changing the direction of travel whenever necessary. Thus it is possible to switch tracks at predetermined points. Again, the vehicle corrects its position independently upon reaching the next transponder.

1.4 Definitions

The definitions and signatures used for this system and in this user´s manual are defined according to the following drawing:

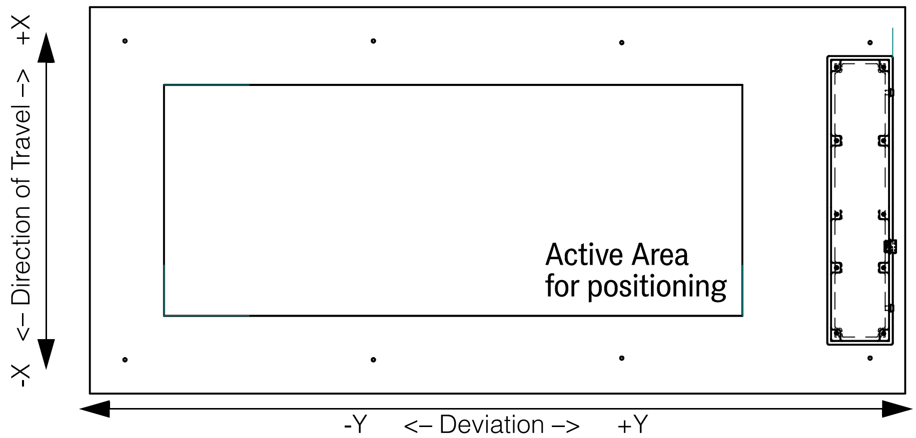


Figure 4 Polarity of the deviation

2 Installation

2.1 Transponder HG 70653ZA

Pay attention to the required minimum distances from metal, as the influence on positioning accuracy and range is dependent upon size and distance of metal parts. For the same reason, the transponder should be mounted as vertically aligned as possible. Please refer to the data sheet/mounting instructions for the transponder.

2.2 Antenna HG 98860ZA

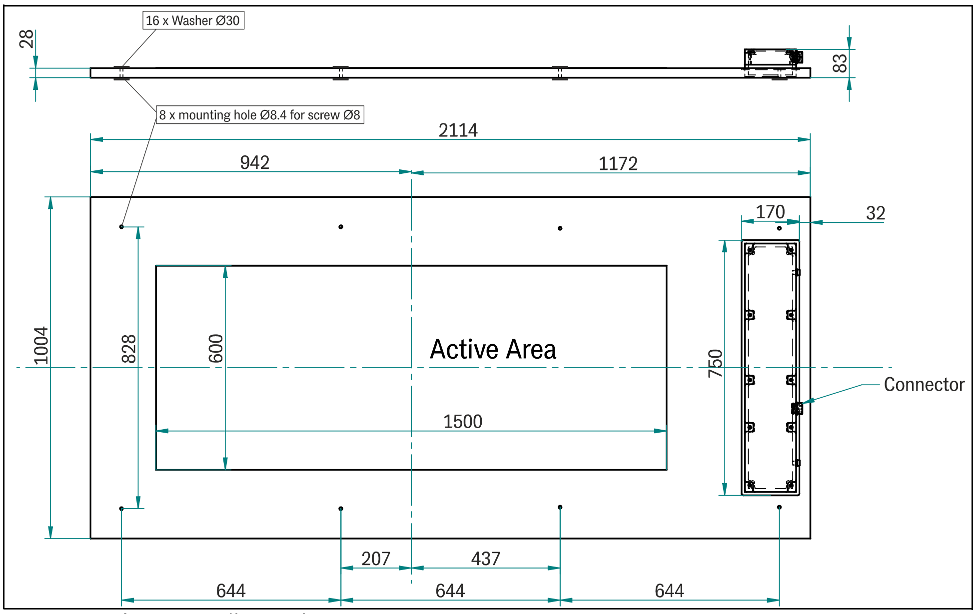


Figure 5 Antenna dimensions

ATTENTION! When mounting the antenna, the washers that are part of the scope of supply have to be used on both sides of each mounting hole (see picture and text below)!

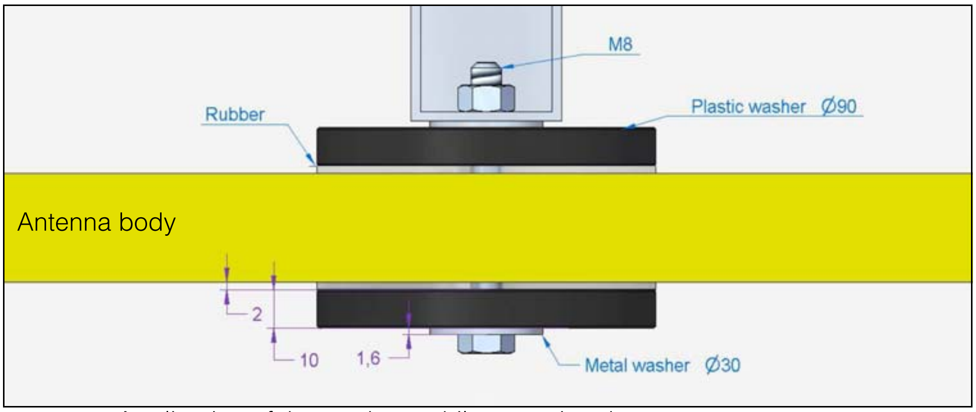


Figure 6 Application of the washers while mounting the antenna

To preserve the antenna body and especially avoid any dents or cracks in the area of the mounting holes we would strongly recommend the following steps:

1. Apply the combined **rubber / plastic washers** with approx. 90 mm diameter to secure a better distribution of the pressure. Place the rubber side on the antenna to avoid surface damages.
2. Apply **metal washers** with approx. 30 - 40 mm diameter under head of screw/ nut.
3. Use **self-locking nuts** or **screw locking varnish** to fix screw fittings.

ATTENTION! Do not exceed **maximum torque of 10 NM**.

To prevent any adverse effects on the system:

- The Antenna itself may not be mounted directly onto metal, on each side of the Antenna, a minimum distance of 300 mm to any larger electrically conductive structures must be maintained (essential cabling and special mounting struts excluded). The influence of metal behind the antenna is shown in the appendices, see section C on page 52.
- For perfect operation of the transponder system, it is essential that there are no interfering signals in the frequency range of 64 ±4 kHz (e. g. chopped engines, etc.)!
- Steel reinforcement structures located very close to the surface of the runway may transform the Antenna energy in the ground to deviating locations in such a way that the measured Transponder position is a faulty one, see section E on page 53.

3 Installation / Commissioning

NOTE! Check the operating voltage before connecting! Although the RS 422 / CAN interface is largely insensitive to interferences, the cable should not lie directly next to power supply cables.

Connect the antenna with the vehicle control unit using the delivered cable.

Connect a laptop to the antenna using the serial interfaces of both devices. The aid of a suitable RS 422 to RS 232 converter may be necessary for this step (the interface converter is not part of the scope of supply). Then start the monitor program as described in section 5.3 on page 31.

Default Values The standard setting of the system is „Monitor only“ as listed in section 5.3.1 on page 31 at 38400 bd. Thus it will start without the need for the user to download a command file. However, please pay attention to the fact that these may have been altered by a different user!

1. If the antenna is mounted next to metal, it must be re-calibrated (also refer to section 2.2 on page 8). In order to set the positioning threshold (refer to section 5.3.2.3 on page 37), it is useful to record a complete test run over the set track. The serial interface of antenna HG 98860ZA may be used accordingly (refer to section 5.3.2.6 on page 40). In addition to this you can use the TxD 232 debug interface (section 4.2.3.4 on page 27).
2. Move a transponder into reception range.
   The voltage S should increase considerably. The code must be detected immediately and the number of readings must be continuously counted up to 255.
3. Remove the transponder again from the reception range.
   While no transponder is located within the antenna field, the voltage S must decrease to a very small value. The display of the code and the number of readings, if applicable, remains identical. If this is not the case, interferences in the frequency range of 64 kHz are being induced.

As long as no errors have occurred, save any altered parameters and exit the monitor program. If certain parameters are altered, a system reset is necessary (turn off and reactivate the antenna) as described in the corresponding section of the monitor program (section 5.3). Now the system has been correctly put into operation.

The following diagrams show examples of logged system data:

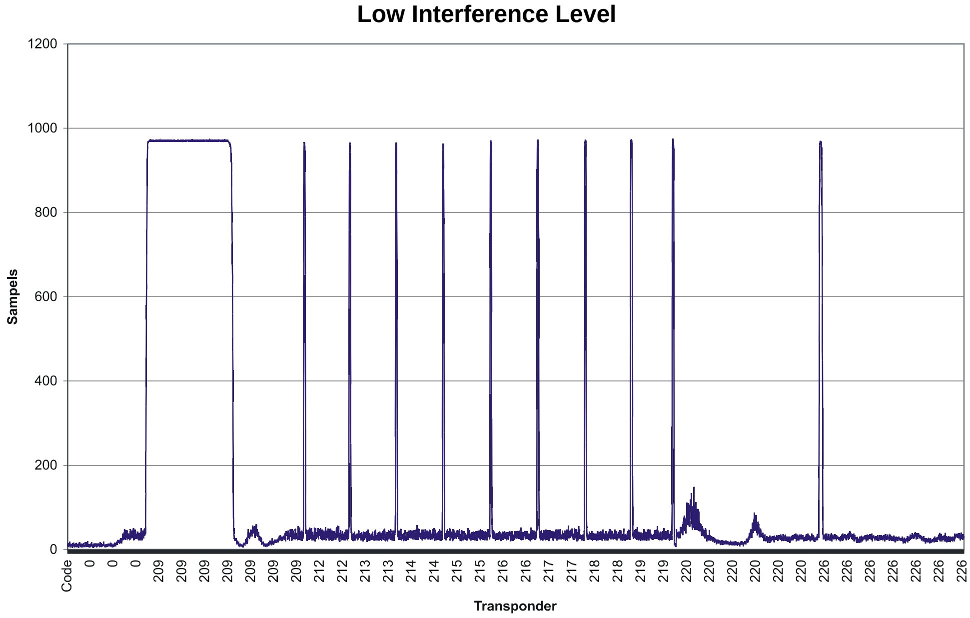


Figure 7 Diagram: Commissioning Protocol / insignificant interference level; shown is the sum voltage over the travelled distance

The above diagram shows the sum voltage (in units) over the travelled distance. The noise is in this case approx. 50 units, the transponder signal approx. 950 units. The Transponder decoding is perfect, as also shown in the following diagram:

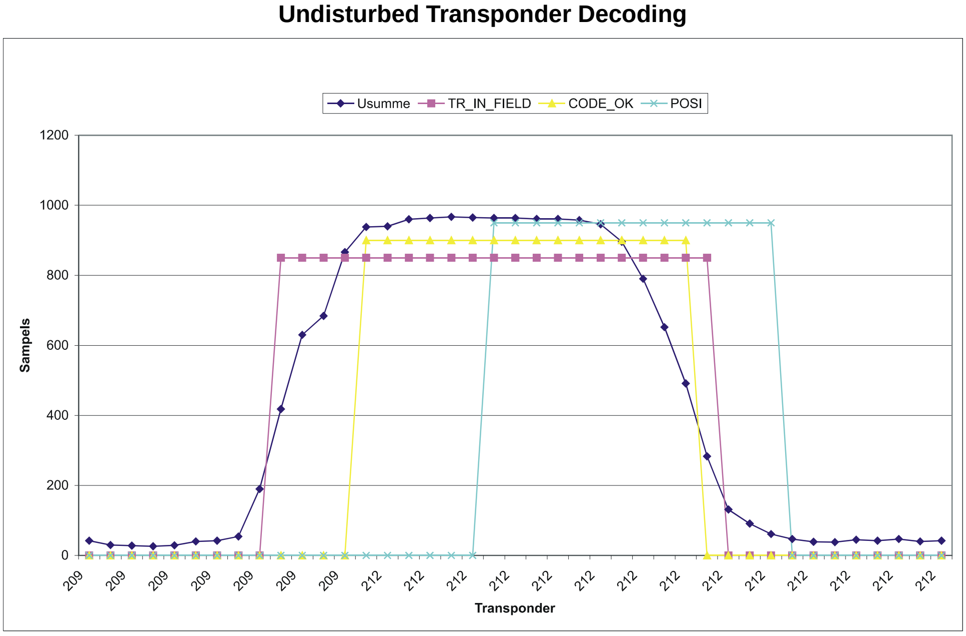


Figure 8 Diagram: Commissioning Protocol / undisturbed Transponder decoding

During each Transponder crossing, the sum voltage increases initially. Once the threshold `Threshold for Decoding` has been exceeded, the bit `TRANS_IN_FIELD` is set. Following 4 x 8 ms (= 4 data points) the Transponder code is decoded. The duration depends on the setting for `Number of Equal Codes` within the menu `Time & Code`. In this example, this parameter is = 2, i. e., the newly received code is compared to 2 already received codes.

Once the center of the Antenna has been crossed, the `POSI-Puls` is generated. Its duration is adjustable. The bits `TRANS_IN_FIELD` and `CODE_OK` are deleted, whenever the sum voltage decreases under the value for `Threshold for Decoding`. In the shown example there is spare time of 6 x 8 ms for the generation of the `POSI-Puls`.

The following protocols show the influences of high interference levels on the Antenna performance.

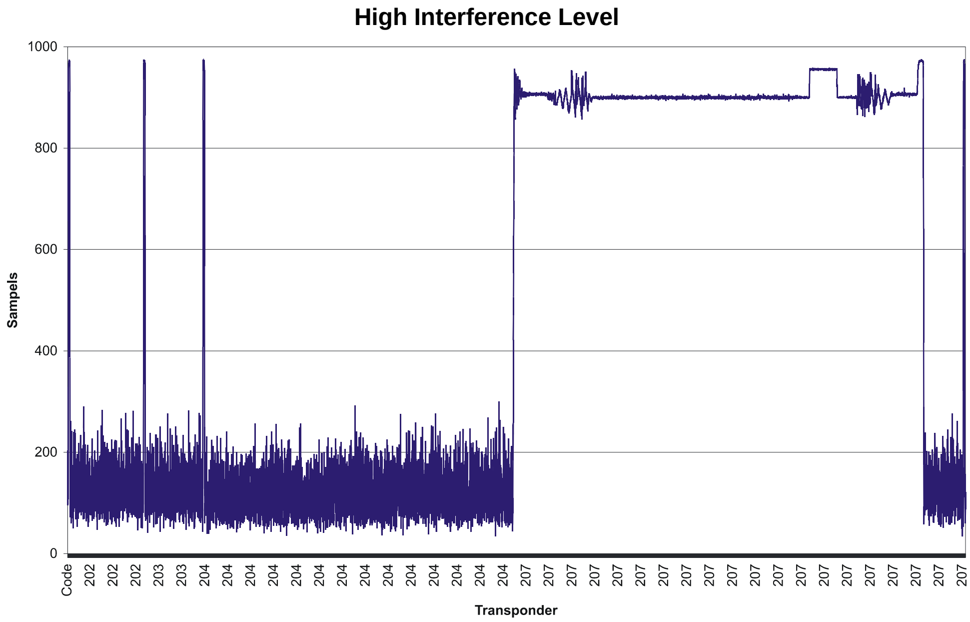


Figure 9 Diagram: Commissioning Protocol / high interference level; shown is the sum voltage over the traveled distance

The interference level reaches up to 300 units. At Transponder 207 the noise is at such a level that it even influences the Transponder signal. As a result it takes 9 x 8 ms until the Transponder 207 has been decoded (refer to Figure 10 on page 13). For the slow crossing speed 9 x 8 ms is still sufficient for generating a `POSI-Puls`, but at high speed it would no longer be possible to decode this Transponder.

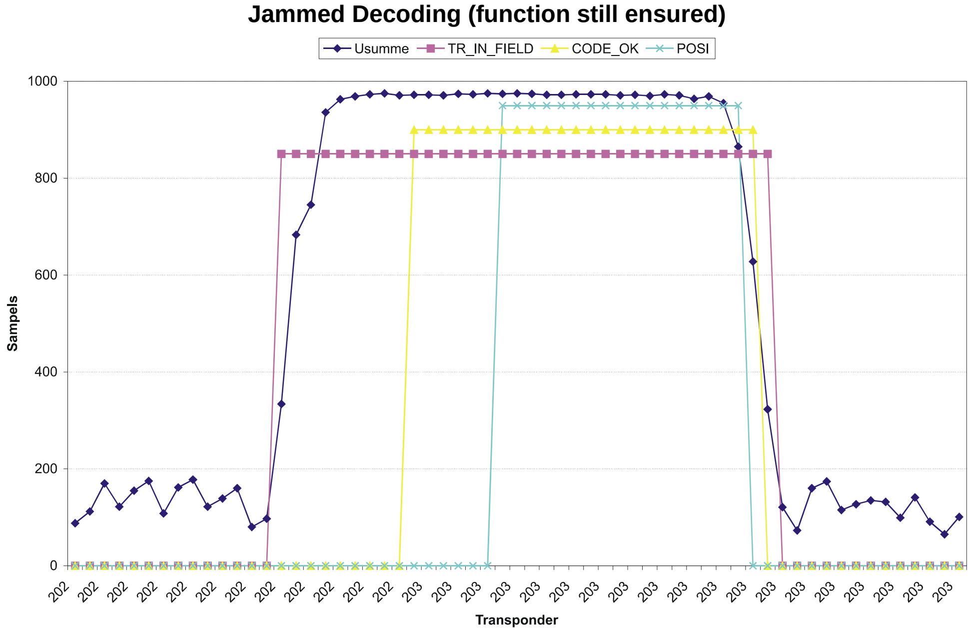


Figure 10 Diagram: Commissioning Protocol / jammed decoding (function still ensured)

The following diagram shows a case in which false `POSI-Pulses are generated through wrongly set parameters for Threshold for Decoding` and/or `Threshold for Positioning`.

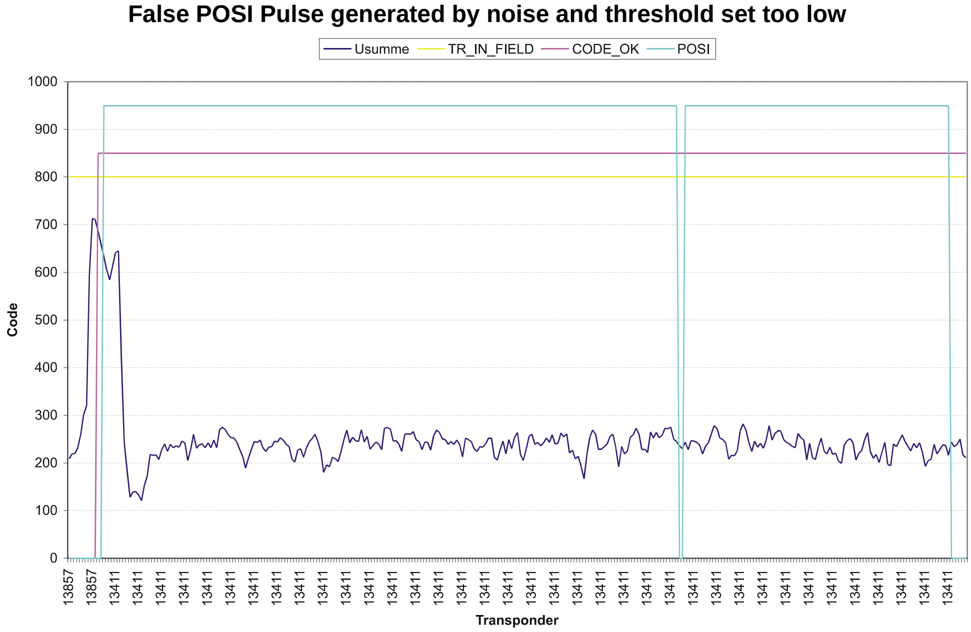


Figure 11 Diagram: Commissioning Protocol / false POSI Pulse generated through noise and threshold set too low

For this example, the thresholds are set to 100 units. The bit `TRANS_IN_FIELD` is permanently set. Following a successful Transponder decoding, initially a correct `POSI-Puls` is generated. However, as the software does not realize that the Transponder leaves the Antenna field (the noise is stronger than the set 100 units for the threshold), each zero crossing of the difference voltage (not shown in the diagram) will generate another `POSI-Puls`.

4 Components and Operation

4.1 Components in the Ground

4.1.1 Transponders

As reference markers only transponders of the type HG 70653ZA can be used. These are special high signal types due to the large reading distance possible with this antenne. Please refer to the separately available data sheet for HG 70653ZA for further information about the transponder.

Range and accuracy of positioning are influenced by:

- any large metal pieces (sheets) on the ground.
- proximity of any floor reinforcement
- inductive loops, as they are created e. g. by steel building mats, have a greater influence. Individual metal poles have little effect. Those may partially be within the metal-free area.

The following environmental conditions have no effect on the system:

- snow, ice, water.
- oil, tar, earth, dirt, etc.

4.2 Transmitter-Receiver Antenna HG 98860ZA

This antenna has RS 422 and CAN interfaces.

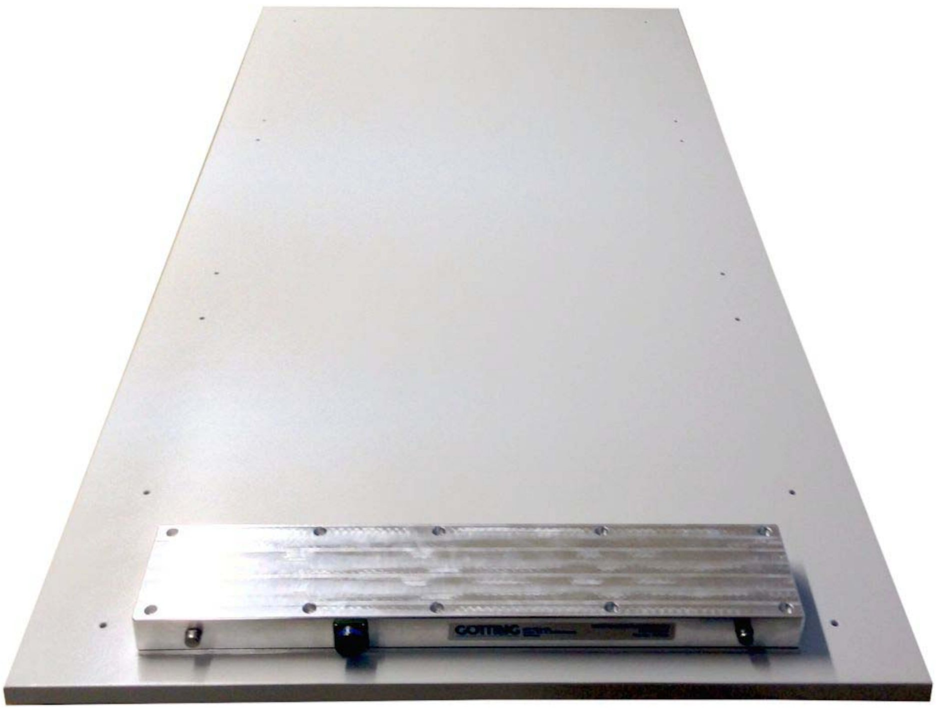


Figure 12 Photo Transmitter-Receiver Antenna HG 98860ZA

The antenna systems and the pre-amplifiers are housed in a casing with the below given dimensions. In order to limit the weight, the casing has been filled with construction foam, which serves as sealing compound as well as the stabilizing elements. The cable (the connecter) exits at one side of the antenna.

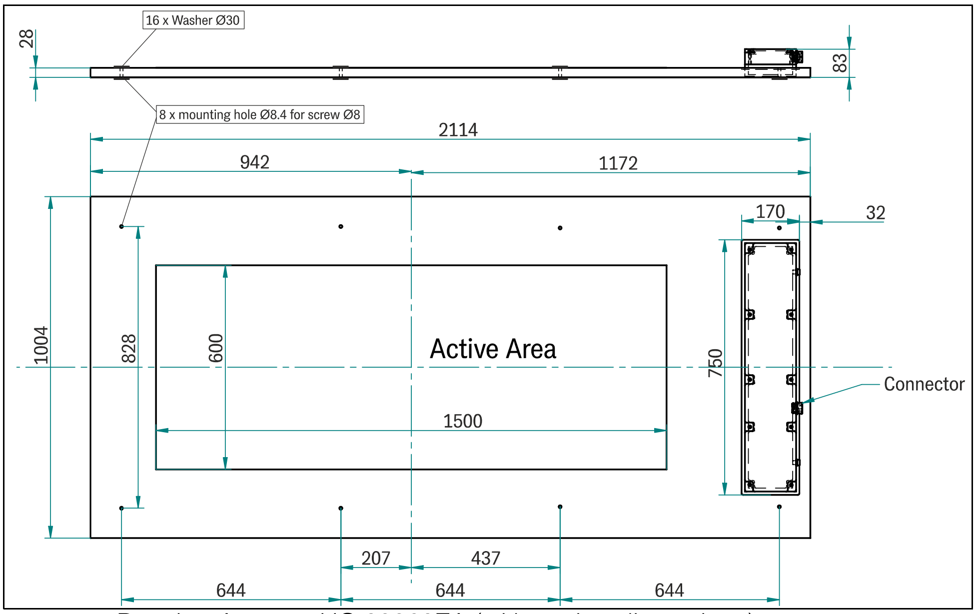
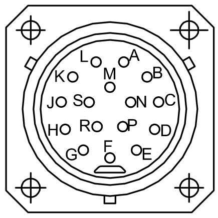


Figure 13 Drawing Antenna HG 98860ZA (with casing dimensions)

The interpreter is integrated in the antenna casing. The electronics are varnished. A thermostat controlled heater is included.

4.2.1 Connection

Figure 14 16-pin Antenna connection socket



Socket (pin)
front view

The antenna is equipped with a 16 pin connection socket. The pin allocation is as follows:

Contact	HG 98860ZA (RS 422)
A	+24 V (antenna)
B	GND (antenna)
C	n.c.
D	SL Rx
E	Rx 422+ *)
F	Rx 422- *)
G	Tx 422+ *)
H	Tx 422- *)
J	+20 mA Positioning Pulse
K	-20 mA Positioning Pulse
L	CAN_H
M	CAN_L
N	Signal Ground
P	SL TX
R	Tx RS 232 output for data logging
S	Casing
Casing	shield
*) = Rx and Tx are related to the antenna.	

Table 1 Allocation of the 16 pin Antenna Connection Socket

The two positioning pins are lead through separately and internally neither connected to +24 V nor to GND, as in some applications it is essential that strict potential separation is maintained. For security reasons, a 20 mA current limitation for these outputs is implemented within the Antenna. Thus if, e. g., a 24 V voltage output is required it is possible to connect pin 9 with +24 V and pin 10 via a 1 KOhm resistance with GND.

4.2.2 Turn-on characteristics

Upon applying the operating voltage, the antenna requires 10 seconds startup time. During this period, it is possible to start a firmware update (also refer to section 5.4 on page 44).

Following this period of time, the actual program starts. If configured accordingly (also refer to Figure 21 on page 38), the transmission coils will be automatically tuned. This procedure takes another 16 seconds.

4.2.3 Interfaces

4.2.3.1 Serial (RS 422)

The serial output may be configured in various ways. The transmission rate is adjustable at 19200 or 38400 Bd, the output protocol may be chosen as either „transparent" or „3964R". Apart from that, the content of the output telegrams is configurable. From a parameter list the required parameters may be selected.

4.2.3.1.1 List of the system data which can be output

One Telegram consists of max. 21 user bytes. The minimum update rate at 38400 Bd is then calculated as follows:

$$21\frac{\text{Byte}}{\text{Telegram}} \times 11\frac{\text{Bit}}{\text{Byte}} \;/\; 38400\frac{\text{Bit}}{\text{s}} = 6\frac{\text{ms}}{\text{Telegram}}$$

Figure 15 Formula: Minimum update rate

As the transmission is binary, it is possible to add further (DLE) characters to the procedure when using the 3964R-procedure.

All multiple-byte variables are output either with the highest byte or the lowest byte first (adjustable)!

The 8 bit check sum is only output when using the transparent protocol and includes the start pulse. The start pulse, as well as the check sum (protocol transparent), cannot be removed from the data block.

Table of the data words of a telegram with 21 byte length.

Byte #	Length	Value	Type	Description
1	1 Byte	0x0000.0001	ASCII-061 : „=“	Start pulse (Default: „=“)
2,3	2 Byte	0x0000.0002	signed short	Y-Position: Y [mm] (lateral deviation) within the range of -750 .. 0 .. +750 In case of an invalid value (no Transponder detected) = 32767 *)
4,5	2 Byte	0x0000.0004	signed short	X-Position: X [mm] (longitudinal deviation) within the range of -300 .. 0 .. +300 In case of an invalid value (no Transponder detected) = 32767 *)
6,7	2 Byte	0x0000.0008	unsigned short	16 bit Transponder code
8,9	2 Byte	0x0000.0010	signed short	Voltage generated by the transponder in the reference coils in [units]
10,11	2 Byte	0x0000.0020	unsigned short	voltage generated by the Transponder in the positioning coils in [units]
12	1 Byte	0x0000.0040	unsigned char	operational voltage for the Antenna [100 mV]
13	1 Byte	0x0000.0080	unsigned char	power consumption [10 mA]
14	1 Byte	0x0000.0100	signed char	temperature within the antenna [^{o}C]
15	1 Byte	0x0000.0200	unsigned char	number of readings during the latest Transponder crossing
16,17	2 Byte	0x0000.0400	unsigned short	receiver frequency [10 Hz]
18,19	2 Byte	0x0000.0800	unsigned short	transmitter frequency [10 Hz]
20, 21	2 Byte	0x0000.1000	unsigned short	system status in binary encoding
(22)	1 Byte		unsigned char	check sum, only in transparent protocol! XOR operation of all bytes including the start character.
*) = In case that either the position for x or y exceeds its valid range, **both** values are set to 32767.				

Table 2 Data words in a telegram with 21 byte length

In the following table you will find a list of the binary codes used to describe the system status (for byte # 20 and 21 in Table 2):

Value	Name	Description
0x0001	DEC_HW_ERROR	code decoder hardware error
0x0002	CODE_PAR_ERR	reception of transponder code with parity error or Hi-Nibble received
0x0004	RX_NOISE	Set whenever TRANS_IN_FIELD was set but no codes were received
0x0008	NO_SLAVE_COM	No communication with slave processor
0x0010	EEPROM_ERROR	parameter E^2Prom not addressable
0x0020	PARAM_CRC_ER	parameter block not safe
0x0040	POT_ERROR	IIC-Bus Potis not addressable
0x0080	F_ERROR	Transmitting or receiving oscillator not tuned to the set frequency
0x0100	ESTIMATE	If the exact Transponder Position cannot be determined due to wrong reading distances or e. g. steel reinforcements in the ground, an estimated value with the accuracy of ±46 mm is determined and this bit is set
0x0200	TRANS_IN_FIELD	transponder is being detected *)
0x0400	CODE_OK	Code decoded without errors *)
0x0800		
0x1000	POSIPULS	Transponder has crossed the Antenna center
0x2000		
0x4000		
0x8000	HEATER_ON	Internal heating active

Table 3 Possible system status messages

*) These bits are deleted as soon as the Transponder leaves the Antenna reception range.

Example:

System status `0x0018`
Description NO_SLAVE_COM and EEPROM_ERROR.

This status message `0x0002` may also occur during an ordinary transponder crossing, if the code transmission is aborted due to decreasing output level.

The connection between „number of readings“ and „system status“ is as follows:

The antenna approaches a transponder:

- voltages S and D increase
- once the voltages S or D exceed the set „Threshold Decoding/Calculation“
  1. the counter „number of readings“ is reset to 0
  2. the status bit „TRANS_IN_FIELD“ (0x200) is set
- codes are decoded and the counter „number of readings“ is incremented
  1. if the value is larger than „number of equal codes“, the status bit „CODE_OK“ (0x400) is set and the code output.
  2. each decoded code now increases the counter „number of readings“
  3. if the value of „number of equal codes“ is = 0, each received code is output
  4. if the value of „number of equal codes“ is not = 0, the detected code is not renewed

The antenna departs from a transponder:

- voltages S and D decrease
- once the voltages S or D fall below the set „Threshold Decoding/Calculation“, the status bits „CODE_OK“ (0x400) and „TRANS_IN_FIELD“ (0x200) are reset

The counter „code readings“ stops, either whenever the line or column parities of the code are wrong or no startsyncs were received. However, the bit „CODE_OK“ is cleared only when the voltages U_s and U_d fall below the defined thresholds.

Normally, the value for „number of equal codes“ is set to a value > 0. In this case, the code is only updated once, when the required number of equal codes was successfully decoded and then output without amendments until a new code is decoded at the next transponder.

4.2.3.1.2 List of commands

A command telegram always consists of four bytes, including the actual command and the parameters. When using the procedure „transparent“ it is, in addition, necssary to transfer one start character and a check sum (XOR operation of all bytes including the start character).

There are 19 predefined commands:

NOTE! The table below is valid for 'High Byte First'-transmission. For 'Low Byte First'-transmission the order of command and parameter bytes has to be changed.
The duration of 'Tune Antenna Once'-command is maximal 10 seconds for 16 tuning steps.
The monitor mode should not be used during normal operation (e. g. from a PLC), as the following signal output is not according to a 'transparent' or '3964R' protocol but only suitable for output on a VT52-terminal and used for the alteration of parameters.

No.	Procedure		Start	Command Bytes	Parameter Bytes	Check Sum	Description
1	3964R	HEX		$4D_{16}4F_{16}$	$4E_{16}49_{16}$		Switch to monitor mode
		ASCII		MO	NI		
	trans-parent	HEX	$3D_{16}$	$4D_{16}4F_{16}$	$4E_{16}49_{16}$	38_{16}	
		ASCII	=	MO	NI	8	
2	3964R	HEX		$54_{16}55_{16}$	$4E_{16}45_{16}$		Tune antenna once
		ASCII		TU	NE		
	trans-parent	HEX	$3D_{16}$	$54_{16}55_{16}$	$4E_{16}45_{16}$	37_{16}	
		ASCII	=	TU	NE	7	
3	3964R	HEX		$53_{16}54_{16}$	$30_{16}31_{16}$		Set tuning value to 1
		ASCII		ST	01		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$30_{16}31_{16}$	38_{16}	
		ASCII	=	ST	01	8	
4	3964R	HEX		$53_{16}54_{16}$	$30_{16}32_{16}$		Set tuning value to 2
		ASCII		ST	02		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$30_{16}32_{16}$	$3B_{16}$	
		ASCII	=	ST	02	;	

Table 4 List of the system commands (part 1 of 3)

No.	Procedure		Start	Command Bytes	Parameter Bytes	Check Sum	Description
5	3964R	HEX		$53_{16}54_{16}$	$30_{16}33_{16}$		Set tuning value to 3
		ASCII		ST	03		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$30_{16}33_{16}$	39_{16}	
		ASCII	=	ST	03	9	
6	3964R	HEX		$53_{16}54_{16}$	$30_{16}34_{16}$		Set tuning value to 4
		ASCII		ST	04		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$30_{16}34_{16}$	$3E_{16}$	
		ASCII	=	ST	04	>	
7	3964R	HEX		$53_{16}54_{16}$	$30_{16}35_{16}$		Set tuning value to 5
		ASCII		ST	05		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$30_{16}35_{16}$	$3F_{16}$	
		ASCII	=	ST	05	?	
8	3964R	HEX		$53_{16}54_{16}$	$30_{16}36_{16}$		Set tuning value to 6
		ASCII		ST	06		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$30_{16}36_{16}$	$3C_{16}$	
		ASCII	=	ST	06	<	
9	3964R	HEX		$53_{16}54_{16}$	$30_{16}37_{16}$		Set tuning value to 7
		ASCII		ST	07		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$30_{16}37_{16}$	$3D_{16}$	
		ASCII	=	ST	07	=	
10	3964R	HEX		$53_{16}54_{16}$	$30_{16}38_{16}$		Set tuning value to 8
		ASCII		ST	08		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$30_{16}38_{16}$	32_{16}	
		ASCII	=	ST	08	2	
11	3964R	HEX		$53_{16}54_{16}$	$30_{16}39_{16}$		Set tuning value to 9
		ASCII		ST	09		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$30_{16}39_{16}$	33_{16}	
		ASCII	=	ST	09	3	
12	3964R	HEX		$53_{16}54_{16}$	$31_{16}30_{16}$		Set tuning value to 10
		ASCII		ST	10		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$31_{16}30_{16}$	$3B_{16}$	
		ASCII	=	ST	10	;	

Table 4 List of the system commands (part 2 of 3)

No.	Procedure		Start	Command Bytes	Parameter Bytes	Check Sum	Description
13	3964R	HEX		$53_{16}54_{16}$	$31_{16}31_{16}$		Set tuning value to 11
		ASCII		ST	11		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$31_{16}31_{16}$	$3A_{16}$	
		ASCII	=	ST	11	:	
14	3964R	HEX		$53_{16}54_{16}$	$31_{16}32_{16}$		Set tuning value to 12
		ASCII		ST	12		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$31_{16}32_{16}$	39_{16}	
		ASCII	=	ST	12	9	
15	3964R	HEX		$53_{16}54_{16}$	$31_{16}33_{16}$		Set tuning value to 13
		ASCII		ST	13		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$31_{16}33_{16}$	38_{16}	
		ASCII	=	ST	13	8	
16	3964R	HEX		$53_{16}54_{16}$	$31_{16}34_{16}$		Set tuning value to 14
		ASCII		ST	14		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$31_{16}34_{16}$	$3F_{16}$	
		ASCII	=	ST	14	?	
17	3964R	HEX		$53_{16}54_{16}$	$31_{16}35_{16}$		Set tuning value to 15
		ASCII		ST	15		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$31_{16}35_{16}$	$3E_{16}$	
		ASCII	=	ST	15	>	
18	3964R	HEX		$53_{16}54_{16}$	$31_{16}36_{16}$		Set tuning value to 16
		ASCII		ST	16		
	trans-parent	HEX	$3D_{16}$	$53_{16}54_{16}$	$31_{16}36_{16}$	$3D_{16}$	
		ASCII	=	ST	16	=	
19	3964R	HEX		$53_{16}50_{16}$	0 ... $3E8_{16}$		Set postioning level (0 <= level < 1024)
		ASCII		SP	*)		
	trans-parent	HEX	$3D_{16}$	$53_{16}50_{16}$	0 ... $3E8_{16}$	**)	
		ASCII	=	SP	*)	*)	
	*) No ASCII-coded values **) Depending on the parameters used. Examples: - Level should be set to 1000 ($3E8_{16}$) The transparent telegram is: $3D_{16}53_{16}50_{16}03_{16}E8_{16}\mathbf{D5_{16}}$ - Level should be set to 300 ($12C_{16}$) The transparent telegram is: $3D_{16}53_{16}50_{16}01_{16}2C_{16}\mathbf{13_{16}}$						

Table 4 List of the system commands (part 3 of 3)

4.2.3.1.3 System Monitor

The system may be configured via menus in monitor mode. Refer to section 5.3 „System Monitor“ on page 31.

4.2.3.2 CAN Bus

4.2.3.2.1 Description of the CAN Protocol

It possible to configure the Basic or the Full-CAN-Mode. The CAN parameters are set via the system monitor. The internal CAN module is based on the CAN specifications V2.0 part B. Standard or Extended frames are transmitted (to be configured). It is also possible to configure the bit timing as well as the identifier within the system monitor.

Different CAN message objects can be output. In addition it is to be set whether telegrams are to be output permanently at the set update rate or only as long as a Transponder is within range. Remote operation is also possible. Objects are activated within the CAN menu, through the input of an address unequal 0. Message Object 3 is used for the analysis of the system behavior.

4.2.3.2.2 CAN Bus Infrastructure

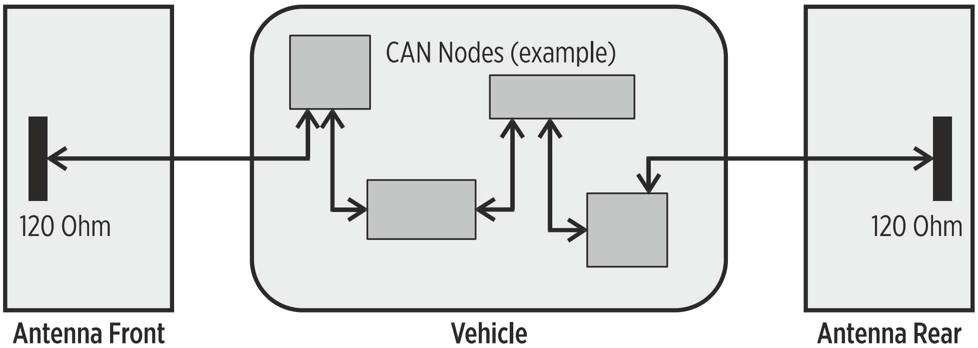


Figure 16 CAN Bus Infrastructure (Example)

The terminating resistors (120 Ohm) are integrated within the antennas. The antennas thus have to be at both ends of the CAN network.

4.2.3.2.3 CAN Message Object 1 (Transmission Object)

Byte #	Length	Type	Description
1,2	2 Byte	unsigned short	System status information according to Table 3 on page 20
3,4	2 Byte	unsigned short	16 Bit Transponder code
5,6	2 Byte	signed short	Deviation X [mm] *
7,8	2 Byte	signed short	Deviation Y [mm] **
* X = Direction of travel ** Y = Lateral deviation			

Table 5 Structure of the CAN Message Object 1

4.2.3.2.4 CAN Message Object 2 (Transmission Object)

Byte #	Length	Type	Description
1,2	2 Byte	unsigned short	Voltage within the sum antenna generated by the Transponder
3,4	2 Byte	signed short	Voltage within the difference antenna generated by the Transponder
5	1 Byte	unsigned char	Number of code readings during the last valid Transponder crossing
6	1 Byte	unsigned char	Operational voltage for the Antenna [100 mV]
7	1 Byte	unsigned char	Power consumption [10 mA]
8	1 Byte	signed char	temperature within the antenna [^{o}C]

Table 6 Structure of the CAN Message Object 2

4.2.3.2.5 CAN Message Object 3 (Transmission Object)

Byte #	Length	Type	Description
1,2	2 Byte	unsigned short	System status information according to Table 3 on page 20
3,4	2 Byte	unsigned short	the lower 16 Bit of the Transponder code
5,6	2 Byte	unsigned short	Voltage of the frame antenna generated by the Transponder [in units]
7	1 Byte	unsigned char	Number of code readings during the last valid Transponder crossing
8	1 Byte	unsigned char	Number of code reading errors during the last valid Transponder crossing

Table 7 Structure of the CAN Message Object 3

4.2.3.2.6 CAN Message Object 4 (Reception Object)

It is possible to send commands to the antenna. For this it is necessary to send a Message Object with the same address as Message Object 1 and a length of 6 bytes.

Byte #	Length	Type	Description
1,2	2 Byte	Unsigned short	Command (see Table 9 below)
3,4,5,6	4 Byte	Unsigned long	Parameter (see Table 9 below)

Table 8 Structure of the CAN Message Object 4

Command	Meaning	Parameter
0000_{16}	No command	–
0001_{16}	Tune antenna once	–
0002_{16}	Set tuning value	Tuning value 0000.0001_{16} to 0000.0010_{16}
0004_{16}	Set position level	Positioning level 0000.0000_{16} to $0000.03E8_{16}$

Table 9 Coding of commands

4.2.3.3 Positioning Pulse

The digital positioning output indicates the antenna center crossing in direction of travel. Its duration can be set within a millisecond pattern. Furthermore it is possible to limit it to one pulse per crossing.

It is possible to 'freeze' the content of the serial telegrams at the time of the positioning pulse for an adjustable number of telegrams (refer to section 5.3.2.2 „(S)erial Output“ on page 35 and 5.3.2.5 „C(A)N-Parameters“ on page 39).

4.2.3.4 Analysis Interface

This interface (pin „R“ of the connection socket, see Table 1 on page 17) enables recording important system data independently of the serial data traffic. The interface parameters are:

57600 Baud, 8 Data bit, no parity

The following values are output as ASCII characters, separated by commas. Each line is terminated with CR LF.

- Code (decimal)
- Sum voltage (decimal)
- Dif voltage (decimal)
- Deviation X (mm)

- Deviation Y (mm)
- TRANS_IN_FIELD (Bit)
- ESTIMATE (Bit)
- COILSEL (Bit)

It is, for example, possible to record this data with the terminal program Hyperterm, save it as *.csv file and interpret it accordingly (refer to section 5.3.2.6 on page 40).

4.2.4 Software Download

If necessary, the Antennas may be updated via the serial interface. Please refer to section 5.4 „Software Update (Antenna Software)“ on page 44.

4.2.5 Connection Cable HG 09240DB

The connection cable included in the scope of supply will be fitted with the corresponding connector on the antenna side, while the vehicle side will be open. The necessary length (max. 20 m) is to be stated in the purchase order. The cable is a HELUKABEL F-C-PURÖ-JZ grey, 12x 1 mm² (for further information refer to http://www.helukabel.de/). The cable consists of a shield, 11 black wires of 1 mm² (numbered 1 through 11) and one green-and-yellow wire. The shield is connected to the connector housing. The pin allocation is as follows:

Contact	Wire no. / Color	Allocation
A	1	+24 V (antenna)
B	2	GND (antenna)
C	–	n. c.
D	–	n. c.
E	5	Rx 422+ *
F	3	Rx 422- *
G	7	Tx 422+ *
H	4	Tx 422- *
J	9	+20 mA Positioning connection
K	10	-20 mA Positioning connection
L	6	CAN_H
M	8	CAN_L
N	green-yellow	signal ground
* = Rx and Tx relative to the antenna.		

Table 10 Connection cable pin allocation (part 1 of 2)

Contact	Wire no. / Color	Allocation
P	–	n. c.
R	11	RS 232 TxD for data logging
S	◄────	Shield
* = Rx and Tx relative to the antenna.		

Table 10 Connection cable pin allocation (part 2 of 2)

NOTE! In order to achieve cable lengths of up to 100 m (for RS 422, CAN), it is essential to use a cable with shielded twisted pairs!

5 Software

The system can be configured via an antenna internal software. To enter the program, you have to connect the serial interface of an ordinary PC to the serial interface of the antenna. For the antenna type HG 98860ZA either the Götting adapter cable HW CAB00113 (see section 5.4.2 on page 44) or an interface converter RS 422 -> RS 232 is necessary. Once all the connections have been set up, start a terminal program on the PC.

NOTE! The interface converter is not part of the system´s scope of supply! However, it is available from several well-known distributors, as e. g. RS components http://www.rs-components.com/. Please refer to the section „Industrial Interface Converters“ of the RS components catalogue.

5.1 Terminal Program

In the following we will refer to the program **HyperTerminal®** (`Hypertrm.exe`), which was part of the scope of supply of Microsoft® Windows® up until version XP. We prefer the use of this program because it is easily available for many users and, due to the supplied configuration files, it is very easy to use.

Nevertheless, any other terminal program can be utilized, provided that it enables VT52 emulation. If you should use a different program, please read its documentation carefully and adjust it to the values given in section 5.2 on page 30.

5.2 Parameter Settings

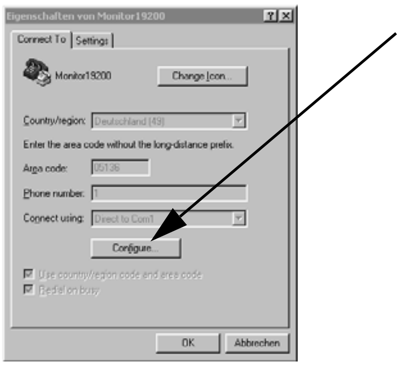
Depending upon what you want to do (starting the monitor program or the software update), different parameters are necessary. If you are using HyperTerminal, you do not need to enter these settings and can go straight on to section 5.3 on page 31.

Terminal settings monitor program (refer to section 5.3)	
baud rate	19200 or 38400 Bd depending on the system configuration
terminal emulation	VT52
parity	even
data bits	8
stop bits	1
character delay	1 ms
line delay	0 ms
PC interface (port)	COM1 can alter depending on the PC (see below)

Table 11 Terminal settings for the monitor program

If you are using a different port than `COM1` with HyperTerminal, then adjust the port as follows:

1. Select Properties from the menu file (or click the Icon). The following window appears:



2. Choose the direct connection to the respective port via the submenu `direct connection`. Confirm with . Save the altered values if you are asked for it while exiting HyperTerminal.

5.3 System Monitor

In monitor mode the system can be configured using the corresponding menu. To use the monitor mode you need to know which protocol is set in your antenna.

5.3.1 How to start the monitor program

The command for switching to monitor mode should be input directly via a PC. For the startup, a set of configuration files is necessary (small text files and HyperTerminal configuration files). These files are accessible always in the latest version from our internet server at http://www.goetting-agv.com/components/transponderconf for download. On that page you'll find the individual text files.

Start your terminal program. If you are using HyperTerminal (section 5.1) it can now be started directly by double clicking the respective *.ht file (`Monitor19200.ht` at 19200 Bd and `Monitor38400.ht` at 38400 Bd). If necessary, adapt the COM-port (see section 5.2).

Following the switching on and a minimum period of 10 (respectively 26) seconds, you may transfer the required *.txt file from the disc using the terminal program. The following four files are on the disc:

1. `Mon3964r.txt`
   Transfer if the system is adjusted to procedure **3964R** with "**HighByte first**". The file contains the characters: `0x02 0x4D 0x4F 0x4E 0x49 0x10 0x03 0x16 in hexa-decimal notation`

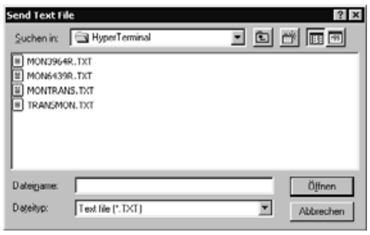
2. `Mon6439r.txt`
   Transfer if the system is adjusted to procedure **3964R** with "**LowByte first**". The file contains the characters: `0x02 0x4F 0x4D 0x49 0x4E 0x10 0x03 0x16in hexa-decimal notation`

3. `Montrans.txt`
   Transfer if the system is adjusted to procedure **Transparent** with "**HighByte first**". The file contains the characters: `0x3D 0x4D 0x4F 0x4E 0x49 0x38 in hexa-decimal notation.`

4. `Transmon.txt`
   Transfer if the system is adjusted to procedure **Transparent** with "**LowByte first**". The file contains the characters: `0x3D 0x4F 0x4D 0x49 0x4E 0x38in hexa-decimal notation`

Using HyperTerminal the file is transferred as follows:

1. Select `Send Text` file in the menu `Transfer`. The following window will appear:



2. Switch to disc drive (in our example, the files are located on the hard disc) and select the respective *.txt file.

3. Click Öffnen . The file will be transferred and (once the corresponding file has been selected) the monitor program will be started. The menus will then appear directly within the HyperTerminal Window. First, the main menu from Figure 17 on page 33 will appear.

5.3.2 How to work with the monitor program

ATTENTION! Effect only alterations on values for the system interface as positioning accuracy will decrease if the calculation coefficients are altered!

Any change to the interface parameters will be only activated after a system reset (turn antenna off and on). Afterwards it may be necessary to use a different file from the four given *.txt documents to start the monitor!

After the transfer of the *.txt file (refer to section 5.3.1) the monitor program starts with the main menu. If it does not, you have either based your settings on a wrong system configuration, or you are using a different terminal emulation and did not adjust the character delay to 1 ms, or you did not wait at least 10 s (26 s) after activating the Antenna.

5.3.2.1 Main menu

```
S:0005  D:+005   D_Y:+32767   D_X:+32767   Code: 0000  Read:   0: N:   1
Frx[/Hz]:61280  Ftx[/Hz]:127990  CSEL: 1
U[/mV]:24200  I[/mA]: 340  T[Grd.C]:+14  S_MA: 8002  S_SL: 0000  Noise    0


    (S)erial Output
    (T)ime & Code
    (F)requency & Antenna tuning
    Basic C(A)N-Parameters
    CA(N)-Open-Parameters
    (D)isplay Systemstatus
   Cs(v) [38,4 KB Code,Us,Ud,X,Y,Tr,Co,Pos,N,E,Cnt<crlf>]  (abort with <a>)
    display Histogram: (X) AbsValues, (-)SignedValues
    display Histogram: (Y) AbsValues, (+)SignedValues

    [L]oad Userparameters to EEProm
    [U]pdate Firmware
    (1) Import User Parameter from Host to Antenna
    (2) Export User Parameter from Antenna to Host
    P(r)int Parameters
    {3} Service Menu


    Software Version  98860MA1.02 / 15.NOV.2013    Serial Number: 123456
```

Figure 17 Main menu of the monitor program

Each of the monitor menu windows contains important system variables in the upper four lines (also refer to Table 12), as they also appear in the output telegram (described in section 4.2.3.1.1 on page 18). The bottom line on the screen contains possible status messages, e. g. if allowed values ranges were not obeyed during input.

Description of the system variables	
S	Measured voltage of the sum coil in units (max. 1023)
D	Measured voltage of the positioning coil in units (max. 1023)
D_Y [mm]	Transponder position rectangular to the direction of travel in millimeters (max. ±750, 32767 when position invalid)
D_X [mm]	Transponder position in direction of travel in millimeters (max. ±300, 32767 when position invalid)
Code	The 32 data bits of the Transponder in hexa decimal coding. The code is recorded as soon as voltage S exceeds the `Threshold for Positioning` (refer to Figure 20 on page 37)
Read	The number of code readings per Transponder crossing (max. 255). This value is being stored until a new Transponder code has been detected. May be deleted by noise
N	Number of reading errors per Transponder crossing. This value is stored until a new Transponder has been detected

Table 12 Description of system variables (monitor program) (part 1 of 2)

Description of the system variables	
Frx [Hz] and Ftx [Hz]	Display of important system frequencies for transmission and reception. These frequencies are permanently monitored and are included in the system status word E (see below)
CSEL	Determins from which channel the code is detected
U [mV]	Supply voltage of the processor board measured with an accuracy of 100 mV. This voltage is, due to various safety measures, always a little lower than the connected overall supply voltage
I [mA]	Current consumption of the positioning unit measured with an accuracy of 10 mA
T [Grd.C]	Average temperature measured in steps of 5^o C
S_MA	Hexadecimal system status from master. The description of the individual bits is included in Table 4 „List of the system commands“ on page 22
S_SL	Hexadecimal system status from slave.
Noise	Output of one counter: - Whenever the sum voltage S exceeds the `Threshold for Decoding` the counter is increase every 8 ms until it has reached the value 1.000. - Whenever S falls under this threshold, the counter counts backwards until it has reached 0 again. When a code is decoded, the counter is immediately set to 0. This mechanism checks whether a Transponder or a foreign signal is received. Every time this counter exceed an adjustable value (refer to section 5.3.2.3 „(T)ime & Code“ on page 37), the system status bit RX_NOISE is set.

Table 12 Description of system variables (monitor program) (part 2 of 2)

Further menus are activated via input of the (characters in brackets). Before altered values are transferred into the permanent memory, the pass word **815 has to be entered** by first entering P. This prevents unwanted alterations of values. With L the values are saved after alteration and input of the password.

Input of D enables reading the description of a possibly occurring system status message. If the procedure is „transparent or „3964r“ input of Q will exit this menu.

The following section describes the submenus

- (S)erial Output (section 5.3.2.2 on page 35)
- (T)ime & code (section 5.3.2.3 on page 37)
- (F)requency & Antenna tuning (section 5.3.2.4 on page 38)
- Basic C(A)N Parameters (section 5.3.2.5 on page 39)
- CA(N)-Open-Parameters. This interface is part of another documentation.

- Cs(V) (section 5.3.2.6 on page 40)
- display Histogram (X/-) (section 5.3.2.7 on page 41)
- display Histogram (Y/+) (section 5.3.2.8 on page 42)
- (L)oad Userparameters to EEProm (section 5.3.2.9 on page 43)
- (1) Import / (2) Export User Parameter (section 5.3.2.11 on page 43) and
- (U)pdate Firmware (section 5.3.2.10 on page 43) and
- P(R)int Parameters (section 5.3.2.12 on page 43).

5.3.2.2 (S)erial Output

Any changes effected to this sub menu are activated only after a system reset (switching the antenna off and on again). Depending on the alterations made, it may become necessary to use a different baud rate / different text document for the startup of the monitor (section 5.3.1 on page 31).

```
S:0007  D:-007  D_Y:+32767   Code: 00000000  Read:   0: N:   1
Frx[/Hz]:66760  Ftx[/Hz]:127990 Csel:1
U[/mV]:23100  I[/mA]: 530  T[Grd.C]:+24     E: 0002  Noise    0



    (B)audrate:                                19200
    (O)rder of Data Transfer (0= HiByte first):    0

    (T)elegram Content Mask [0..1FFF]:   00001fff
    (D)isplay Telegram Content
    (C)har-Delaytime            [1..220ms]:      220
    (P)rocedure                           Transparent

    Co(n)tinous Telegrams                          1
    (S)erial Data Period        [4.500mS]:         8
    (F)reeze Values for n Telegrams:[0..10]:       0


    (Q)uit Menue
```

Figure 18 Menu: (S)erial Output

Pressing B switches between 19200 and 38400 Bd. Pressing O selects between high byte first and high byte last. When using this system together with a Siemens PLC it is essential, that this parameter is 0 (High Byte first).

T enables influencing the structure of the output telegram. The telegram length is set automatically.

According to the values given in Table 2 „Data words in a telegram with 21 byte length“ on page 19, it is possible to set the customized contents of the telegram T using hexadecimal addition. The parameter sequence cannot be influenced. It is always the same sequence as shown in the table!

Example Only the `Displacements X and Y`, the `Code` and the `System Status` are to be output.
Add, according to the table the values 0x0000.0001, 0x0000.0002, 0x0000.0004, 0x0000.0008 and 0x0000.1000. The result is 0x0000.100F. Therefore the input for the “(T)elegram Content Mask“ is 0x100F.

Using “(D)isplay Telegram Content“ it is possible to check the review telegram (also refer to Figure 19). The shown case has a mask value of 0x0000.1fff. Pressing any key generates the return to menu `Serial Output`.

```
S:0005  D:+005   D_Y:+32767   D_X:+32767   Code: 0000  Read:   0: N:   1
Frx[/Hz]:61280  Ftx[/Hz]:127990  CSEL: 1
U[/mV]:24200  I[/mA]: 340  T[Grd.C]:+19  S_MA: 8000  S_SL: 0000  Noise    0


    STX         1 Bytes from Position: 1
    Delta_Y     2 Bytes from Position: 2
    Delta_X     2 Bytes from Position: 4
    CODE        2 Bytes from Position: 6
    Usum        2 Bytes from Position: 8
    Udif        2 Bytes from Position: 10
    Vcc         1 Bytes from Position: 12
    Current     1 Bytes from Position: 13
    Temp.       1 Bytes from Position: 14
    CodesRd     1 Bytes from Position: 15
    Rx-Freq     2 Bytes from Position: 16
    Tx-Freq     2 Bytes from Position: 18
    STATUS      2 Bytes from Position: 20




    (esc) to quit
```

Figure 19 Menu: „(D)isplay Telegram Content“

Parameter „(C)har Delaytime“ is the so-called Character Delay Time for procedure 3964R (refer to appendix, section A „Procedure 3964R“ on page 50) and the timeout time for incoming characters transparent mode (refer to appendix, section B „Procedure „transparent““ on page 51).

Pressing P generates the selection of the corresponding telegram procedure – 3964R or transparent. For procedure 3964R it is also possible to set the acknowledgement delay time.

N enables choosing between the permanent output according to the set `Serial Data Period` (`1`), or output only whenever a Transponder is decoded within the reading range (`0`).

F enables ’freezing’ the serial output for 0 to 10 telegrams, i. e. the values at the time of the positioning pulse output are preserved.

5.3.2.3 (T)ime & Code

This menu offers the option setting the values for the Transponder decoding, the position calculation and the positioning pulse.

```
S:0006  D:+005   D_Y:+32767   D_X:+32767   Code: 0000  Read:   0: N:   1
Frx[/Hz]:61280  Ftx[/Hz]:127990  CSEL: 1
U[/mV]:24200  I[/mA]: 350  T[Grd.C]:+19  S_MA: 8002  S_SL: 0000  Noise    0



    (B)Level to Noise Error             [0..1000]:   1000
    (H)igh-Nibble of RW-Code            [0..F,>F]:     10
    (N)umber of equal Codes               [0..15]:      1
    (T)hreshold Decoding-X/Calculation  [20.1023]:    256
    Thr(e)shold /Calculation-Y          [20.1023]:    400

    PosiPulse (a)fter Decoding                          1
    (L)evel for Positioning             [20.1023]:    500
    (P)osi-Pulse Time                     [n*1ms]:    100
    (O)ne Positioning Pulse per Crossing                0
    (X) Timed Positioning Pulse                         1

    Th(r)eshold MAX-Detection-X         [10.1023]:    400
    Thre(s)hold MAX-Detection-Y         [10.1023]:    400


    (esc)to quit
```

Figure 20 Menu: (T)ime & Code

[B] enables setting the threshold for generating the bit RX_NOISE of the system status word as described in Table 12 on page 33 under 'Noise'.

As the Trovan technology secures the code transmission only via a simple parity check, two additional security strategies were implemented:

1. It is possible to verify the four highest bits via a preset value (0-F). [H] enables setting this value, which then has to be programmed into the transponders together with the code. For entries larger F, this verification is switched off.

2. It is possible to choose the number of codes to be compared between 0 and 15 by pressing [N]. Input of `0` generates the immediate output of the received code, input of `1` generates the comparison of the received code with the very last code received just before this one, etc. Note, that this procedure reduces the maximum crossing speed, because the necessary transmission time increases accordingly with (n+1) x 8 ms.

With [T] it is possible to determine the voltage threshold `S` at which the decoding is started, in order to suppress decoding cycles with a too weak signal, and the X-position calculation generated.

With [E] it is possible to determine the voltage threshold `S` at which the Y-position calculation is generated.

[A] releases the output of a positioning pulse only after the decoding of a Transponder. In an interference laden environment this will avoid false positioning pulses. For high speed crossing this item should be set to `0`.

L enables setting the voltage value S which is the threshold for releasing the positioning pulse output in order eliminate false statements due to antenna side lopes.

The duration of the positioning pulse is adjustable by pressing P within a 1 ms pattern. With O it is possible to set whether with each crossing of the center axis of the Antenna, a positioning pulse is to be generated (e. g. during a back-and-forth movement directly above a Transponder). If not, only one pulse per Transponder crossing is output. For a re-newed triggering it would then be essential that the voltage S falls again under the `Threshold for Calculation-Positioning` (refer to section 5.3.2.3 on page 37).

With X you can choose whether the Posi Pulse and its corresponding bit are turned off in the system status after the time persiod set with P or after the voltage S has fallen below the threshold set with L.

R enables setting the the threshold value which has to be succeeded in order to activate the use of the measured voltages in X direction for the calculation. S does the same for the Y direction. The actual threshold value is determined by the maximum of a scan cycle minus the input value.

5.3.2.4 (F)requency & Antenna Tuning

```
S:0006  D:+005   D_Y:+32767   D_X:+32767   Code: 0000  Read:   0: N:   1
Frx[/Hz]:61280  Ftx[/Hz]:127990  CSEL: 1
U[/mV]:24200  I[/mA]: 270  T[Grd.C]:+19  S_MA: 0002  S_SL: 0000  Noise    0



    (R)x_Frequency [/Hz]:       1575000   ( 61250 Hz)

    A(u)to-Tune                      0
    (A)ntenna-Tuning [0..15,+,-]:   15
    switch (T)ransmitter:            1






    (esc)to quit
```

Figure 21 Menu: (F)requency & Antenna Tuning

The **receiver frequency** „(R)x“ is calculated with F_{ZF} = 455 kHz and the bandwidth B = 5.5 kHz according to the following formula:

$$F_{rx} = 4 \times \left(F_{ZF} - 64\text{ kHz} +- \frac{B}{2}\right)$$

Figure 22 Formula: Calculation of the receiver frequency

As this is a SSB-reception, according to the above mentioned formula the upper sideband should be set to 1553000 Hz and the lower sideband to 1575000 Hz.

With A or with the + or - keys you may tune the transmitting antenna by switching the power consumption to max. (resulting in the largest reception range). T enables switching the transmitter on (1) or off (0) for control reasons. T is automatically set to 1 upon leaving the monitor.

U enables activating auto tuning. Following each system switch on, the transmitter cycle is retuned. This procedure takes approx. 16 sec. After that, every 10 sec. the tuning is re-checked (as long as there is no transponder within the field) and re-tuned if necessary.

5.3.2.5 C(A)N-Parameters

This menu enables setting the various CAN Bus parameters. Before being able to use the CAN bus interface it is essential to activate it by pressing C.

```
S:0006  D:+005   D_Y:+32767   D_X:+32767   Code: 0000  Read:   0: N:   1
Frx[/Hz]:61280  Ftx[/Hz]:127990  CSEL: 1
U[/mV]:24200  I[/mA]: 270  T[Grd.C]:+19  S_MA: 0000  S_SL: 0000  Noise    0

SR = 00:        NO ERROR    /      /      /      /

    (C)AN active                                NO
    E(X)tended CAN                       STANDARD
    (I)dentifier:    TX  [0..2047]:            10
    (A)-Identifier:  TX  [0..2047]:             0
    (D)-Identifier:  TX  [0..2047]:             0
    CAN-(B)aud [20,50,125,250,500,1000 kB]: 1000.0
        or
        B(R)P Baudrate Prescaler [0..63]:       0
        (S)JW Sync Jump Width     [0..3]:       0
        Tseg(1)                  [2..15]:       6
        Tseg(2)                   [1..7]:       1
                 resulting sample point:               70 %
    (P)eriod                      [4.500mS]:    8
    Co(n)tinous Telegrams                       1
    CAN on Re(m)ote Request                     0
    (F)reeze Values for n Telegrams [0..20]:    0

    (esc) to quit
```

Figure 23 Menu: C(A)N-Parameters

Entering X enables the generation of telegrams either as standard frames according to CAN2.0A or as extended frames according to CAN2.0B. Correspondingly it is possible to either set the Identifier I (CAN address) as 11 bit value (0-2047) or as 29 bit value (0-536870911).

The identifier selectable under I corresponds to the transmitted frames for the Message Object 1 (refer to Table 5 on page 25). The identifier selectable under A refers to the Message Object 2 (refer to Table 6 on page 26), D refers to the Message Object 3 (refer to Table 7 on page 26). Input of 0 deactivates the corresponding Message Object.

With B it is possible to change the CAN baudrate.

N enables either the activation of a permanent output of the `Clock for Sampling` which can be set by pressing P (1), or the activation of an output that is only generated whenever a Transponder is within the reception range (0).

[M] activates the remote operation. In this case (independent of the settings of `Continuos Telegrams`) telegrams are no longer generated, but only remote frames with the corresponding address are answered.

[F] offers the option to 'freeze' the output for 0 to 20 telegrams, i. e. the values at the time of the positioning pulse output are preserved.

The CAN status register is displayed in the uppermost line of the menu. This information may be used for simple diagnosis.

5.3.2.6 Cs(v)

For diagnosis, it is possible to start the output of the values `Code`, U_{Sum}, U_{Dif}, `Y-Pos`, `X-Pos`, the states `Transponder within range`, `Code OK`, `Positioning pulse` (also refer to Table 3 on page 20), number of code readings (`Read`), number of code reading failures (`N`) and in addition a telegram counter in **CSV format** (Comma Separated Values; especially for processing text files with programs for table calculation). Data output is carried out with 38.400 Bd, 8 bit and even parity, until it is terminated by pressing any key. Following the pressing of a key, a reset is generated and the Antenna is re-set to its original condition (not monitor mode) including the saved parameters.

The CSV output could e. g. be saved using the program HyperTerminal® (also refer to section 5.1 on page 30). To do so, use the function `record text ...` of menu `Transmission` and insert a file name (this file name should have the ending `.csv`, in order to enable the table calculation program to automatically detect this file later). Once the file has been recorded and closed under HyperTerminal®, it may be loaded into a table calculation program (e. g. Microsoft® Excel®, Sun® StarCalc®, ...).

When opening the file, the table calculation program prompts various options. Select the option that indicates that this file consists of comma separated values. Then the data may be processed as diagrams or recorded as native table calculation file for transmission.

5.3.2.7 Display (X)Histogram / (-)

This submenu displays the voltages induced by a Transponder in X-direction as absolute or signed values.

```
X_Histogram, press any key to return



    > 1000.....................
    > 900:.....................
    > 800:.....................
    > 700:.........OoOoo.......
    > 600:.......oOOOOOOo......
    > 500:o.....oOOOOOOOOOoo..O
    > 400:OooOoOOOOOOOOOOOOO.OO
    > 300:OOOOOOOOOOOOOOOOOOOOO
    > 200:OOOOOOOOOOOOOOOOOOOOO
    > 100:OOOOOOOOOOOOOOOOOOOOO
          ---+---+---+---+---+-
          1  4   8  12  16  20
              <<<<<<<M>>>>>
    55      57      60
     5


X_Histogram, press any key to return

    > 900:.....................
    > 800:.....................
    > 700:.....................                 (M)ux [0..3,END = 9]
    > 600:.....................
    > 500:O...................O
    > 400:O................O..O
    > 300:OOOO.............OO.O
    > 200:OOOO.............OO.O
    > 100:OOOO.............OO.O
    >   0:OOOO.............OO.O
    >-100:....OOOOOOOOOOOOO..O.
    >-200:....OOOOOOOOOOOOO..O.
    >-300:....OOOOOOOOOOOOO..O.
    >-400:.....OOOOOOOOOOOO..O.
    >-500:.......OOOOOOOOO.....
    >-600:........OOOOOO.......
    >-700:.........O.O.........
    >-800:.....................
    >-900:.....................
              <<<<<M>>>>>>>
    55      59      59
     4
```

Figure 24 Menu: display (X)Histogram

Each column represents a location. A voltage value is represented by a row of Os.

Directly underneath the histogram, the values used for the respective position calculation are marked as `<<<<M>>>>`. Below this row, the calculated position with minimum, actual, and maximum values is displayed. Pressing any key returns to the main menu.

NOTE! The `(M)ux` item is for test purposes only.

5.3.2.8 Display (Y)Histogram / (+)

This submenu displays the voltages induced by a Transponder in Y-direction as absolute or signed values.

```
Y_Histogram, press any key to return



    > 1000........................................
    > 900:........................................
    > 800:...................oOOOo................
    > 700:..................OOOOOOOo..............
    > 600:.................OOOOOOOOOO.............
    > 500:................OOOOOOOOOOOo............
    > 400:..........o.o...OOOOOOOOOOOO....o.......
    > 300:O..oooOOOOOOOO.OOOOOOOOOOOOOO.oOOOOoOo.O
    > 200:OOOOOOOOOOOOOOoOOOOOOOOOOOOOO.OOOOOOOOoO
    > 100:OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
          ---+---+---+---+---+---+---+---+---+---+
          1  4   8  12  16  20  24  28  32  36  40
                          <<<<<<M>>>>>
   101     103     105
     4





Y_Histogram, press any key to return

    > 900:........................................
    > 800:........................................
    > 700:........................................
    > 600:........................................
    > 500:........................................
    > 400:........................................
    > 300:....O.OOOOOOO..................OOOO..O.O
    > 200:O.OOOOOOOOOOOO................OOOOOOOO.O
    > 100:O.OOOOOOOOOOOO...............OOOOOOOOO.O
    >   0:O.OOOOOOOOOOOO...............OOOOOOOOO.O
    >-100:.O............OOOOOOOOOOOOOOO.........O.
    >-200:...............OOOOOOOOOOOOOO...........
    >-300:...............OOOOOOOOOOOOO............
    >-400:................OOOOOOOOOOOO............
    >-500:................OOOOOOOOOOO.............
    >-600:.................OOOOOOOOOO.............
    >-700:..................OOOOOOO...............
    >-800:.....................OO.................
    >-900:........................................
                          <<<<<<M>>>>>
   101     103     105
     4
```

Figure 25 Menu: display (Y)Histogram

Each column represents a location. A voltage value is represented by a row of Os.

Directly underneath the histogram, the values used for the respective position calculation are marked as `<<<<M>>>>`.

Below this row, the calculated position with minimum, actual, and maximum values is displayed. Pressing any key returns to the main menu.

5.3.2.9 (L)oad values to EEProm

This submenu enables saving the parameters within a non-volatile memory once the corresponding pass word has been entered. This is necessary in order to accept the current changes as permanent settings.

5.3.2.10 (U)pdate Firmware

This submenu offers the option of a software update without having to disconnect and re-connect the power supply. However, first it is necessary to install the update program as described in section 5.4 on page 44.

Then press [U] within the main menu. A display with the following instructions will appear:

1. Close the COM-Port in Hyperterm using the icon .
2. Open the flash program `ST10-Flasher 2.exe` on your PC.
3. In `ST10-Flasher 2.exe` select the COM-Port, via which the antenna is currently connected to your PC.
4. Select the hex file to be programmed in `ST10-Flasher 2.exe`.
5. Now return to Hyperterm, re-connect the COM-Port via the icon and press any key.
6. Within the next 20 sec. close the COM-Port using the icon , in Hyperterm, switch back to `ST10-Flasher 2.exe` and start programming.

Once the programming is completed, return to Hyperterm, wait 10 sec. and re-connect the COM-Port (e. g. via the icon). Then re-start the monitor mode (also refer to section 5.3.1 on page 31).

5.3.2.11 Import (1) / export (2) User Parameter

It is possible to store or load all user parameters on or from a host via XMODEM file transfer protocol:

- With [1] you can import a parameter file from a host. After pressing that key you should start an XMODEM file transfer within 50 seconds. When using Hyperterm go to *Transfer* > *Send file* > *XMODEM* > *File name*. If the message `Success` is displayed the file has been checked and loaded in the parameter RAM. To preserve the loaded values you should transfer them into the EEPROM (see 5.3.2.9 on page 43).
- With [2] you can export user parameters to a host. After pressing that key you should start an XMODEM file transfer. When using Hyperterm go to *Transfer* > *Receive file* > *XMODEM* > *Folder* and then specify a file name. The file is transferred and the message `Success` should be displayed.

5.3.2.12 P(r)int Parameters

Enables writing the system parameters into terminal program file (e. g. Hyperterm).

5.4 Software Update (Antenna Software)

It is possible to update the software of the integrated interpreters via the serial interfaces using a portable PC. Following switching-on, the integrated download unit will check for approx. 10 seconds whether a download is to be carried out. In case a download is not generated, the units will return to the normal operating program. Data received during this period of 10 seconds are examined for their validity.

NOTE! Only the update program described below may be used for the software update!

5.4.1 Installation of the ST10-Flasher Program for Software Update

The program for the antenna software update is a 32-bit application for Microsoft® Windows®. Upon request, this program is sent by email. Please address your requests to the email, phone, fax or mailing address given on the cover of this manual.

In order to install the program follow these steps:

1. Save the file `ST10-Flasher2_setup.exe` from the email to your hard disk, then open the Windows Explorer and navigate to the file.
2. Double click `ST10-Flasher2_setup.exe` in order to start the installation process. The installation routine allows you to adjust the installation path but usually the defaults should work.
3. In order to start the software update program, use the Windows start menu, where you can find `ST10-Flasher 2.exe`. Then you can proceed with the update of the antenna software as follows.

5.4.2 Software Update

While the software update is carried out, no other programs may occupy the used serial interface (COM-Port). Thus, terminate any such connections in your Terminal program (e. g. Hyperterm). Then connect the antenna to your PC. Unless you use the Götting Adapter HW CAB00113 (see below) you have to use an appropriate interface converter (not included in the antenna scope of supply; refer to the note on the top of page 30). Then start the update program on your PC as described above.

The antenna HG 98860ZA contains 2 microprocessors. The master processor is programmed via the serial interface (see section 4.2.3.1 on page 18). The slave processor can be controlled with the same program `ST10-Flasher 2.exe`. The connection to this processor however is to be made via the slave interface (RS 232, see pins D and P in Table 1 on page 17). The connection parameters can be chosen in `ST10-Flasher 2.exe`. The Baudrate should not be set to values above 57600 Baud.

NOTE! The Programming-/Service-Adapter HW CAB00113 by Götting can be used to connect the antenna socket to the PC. The adapter cable is fitted with two DE9 sockets that are used alternately for the master and slave connection.

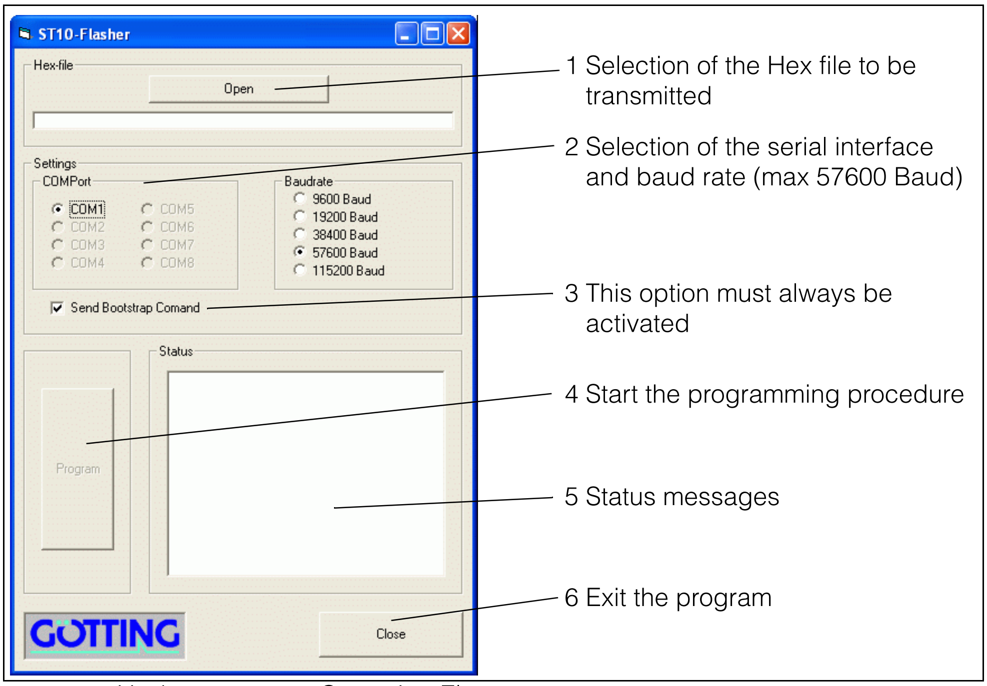
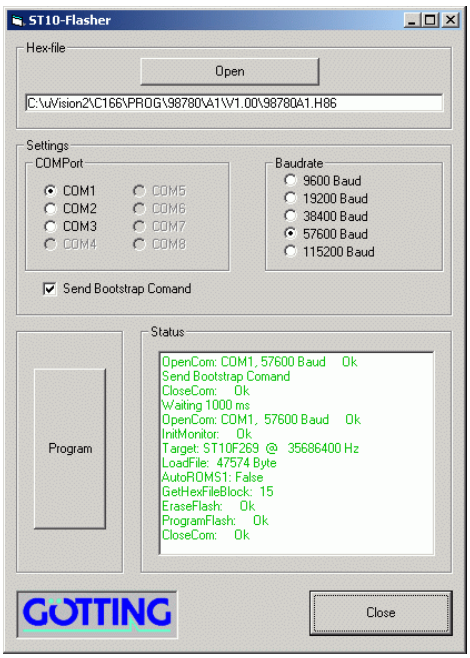


Figure 26 Update program: Operating Elements

Start the programming process by switching on the antenna and then click `Program` within a period of 10 seconds afterwards. A device reset follows and after a short period of time, the file is being transmitted.



If an error occurs during the transmission, red colored status messages are shown. As long as green colored messages are output, the software update is correct.

The last 2 messages of a normal update procedure are: `ProgramFlash: Ok` and `CloseCom: Ok`

Figure 27 Update program: programming procedure

Once the programming process is completed, the program can be closed (`close`). The interpreter is restarted automatically and uses the new program.

6 Maintenance

The system is largely maintenance free. Any maintenance is limited to:

- visual examination of the antennae (ensuring all screws, cables and plugs are correctly fastened).

Document regularly the power consumption and power supply of each antenna. These values can be obtained from any menu in the monitor program.

If necessary, effect an update of the system software as described above (section 5.3.2.10 on page 43 or 5.4 on page 44). Date and version of the current antenna software can be obtained from the main menu.

7 Trouble Shooting

The following table contains a list of errors that might occur. For each error, a symptom description is given. In the third column you will find a description of how to locate and possibly correct the error.

If you should not be able to correct an occurring error, please use the table to locate the source of the error as exactly as possible (nature of malfunction, at which point of time did the error occur, etc.) before consulting us.

Error	Possible cause	Diagnosis/Correction
No system function Even though a transponder is located within reception range, all outputs remain inactive	Power supply is not sufficient	Measure the voltage at the respectively labeled clamps.
No contact is possible, only unintelligible characters are sent.	1. RS 422 T+ (R+) exchanged with RS 422 T- (R-) by mistake 2. Signal ground not connected, a too high potential difference between antenna and receiver. 3. Wrong setting of transfer parameters 4. Wrong procedure.	1. Check the connections 2. Connect signal ground 3. Choose only 19200 or 38400 Bd, 8 bit, even parity. 4. Choose the correct procedure with the PC and the system monitor.
Inaccurate values at low temperature.	System needs a certain warm-up time in order to operate at sufficient accuracy in low ambient temperature.	Wait until the system has warmed up (approx. 5 minutes at -20^{o} C).
Output values are not reproducible, lack of accuracy	Radio interference	Check value for S in the monitor mode. If these are over ca. 50, there could be interference in the range of 64 kHz.
Transponders are detected unreliably / no reliable positioning pulses	1. Interfering frequencies 2. The corresponding thresholds (refer to Figure 20 on page 37) are not correctly set	1. refer to above paragraph 2. Carry out the commissioning as described in section 3 on page 10

Table 13 Trouble shooting

8 Technical Data

8.1 Transmitter-Receiver Antenna

Antenna HG 98860ZA	
Casing	see Figure 13 on page 16
Weight	approx. 36 kg
Effective antenna area	1500 x 600 mm (function range positioning)
Power supply antenna	24 V -20 % +50 %, max. 1.3 A @ 24 V
Operating temperature	-25 to +50 ^{o}C heat-up time 5 minutes
Mechanical stability	5 g 11 ms / 2 g 10 to 55 Hz
Metal free area	see description for Figure 5 on page 8, and section C on page 52
Protection	IP 65
Cabling	max. 20 m cable
Max. pass-over speed	10 m/s tested
Reading distance (distance transponder - underside reading antenna)	150 to 350 mm (with transponder HG 70653)
Nominal reading distance	200 to 250 mm (with HG 70653)
Width of the active Antenna reading area	±750 mm (Y) x ±300 mm (X)
Static positioning accuracy (Vx & Vy < 1 m/s)	±15 mm @ nominal reading distance (with HG 70653; also refer to section F on page 54)
Connection	16-pin Amphenol connector gold-plated contacts
Signal processing time	8 ms
output RS 422 / CAN	The output requires 19200 or 38400 Bd. The telegram content may be configured. 3964R or “transparent“ selectable
Output positioning pulse	20 mA current source, potentially separated

Table 14 Technical Data Antenna HG 98860ZA

8.2 Connection Cable

Connection Cable HG 09240DB	
Length	according to purchase order, max. 20 m
Diameter	approx. 10.9 mm
Type	HELUKABEL F-C-PURÖ-JZ grey, 12x 1 mm², EMC preferred type, tear resistant, coolant resistant, Cu screened, without inner sheath Weight: 262 kg/km Cop. Weight: 187 kg/km (also refer to http://www.helukabel.de/)

Table 15 Technical Data Connection Cable HG 09240DB

9 Appendix

A Procedure 3964R

For the computer interconnection between antenna <–> SPS a 3964R-Protocol may be used. As the antenna outputs data cyclical, this results in some simplifications during implementation of the 3964R. The following diagrams describe the procedure.

The following settings need to be observed:

- Transponder system has lower priority
- Data transfer is set to 1 start bit, 8 Data bit, parity even, 1 stop bit, Baudrate 19200 Bd (default) or 38400 Bd.

A.1 Data direction antenna -> SPS

In this direction the antenna data is transmitted cyclically. The data sentence always starts with an „="-character (hex 0x3d). The cycle time is parameterizeable and should take a complete part, or multiple thereof, of the transponder code´s transmission line. In the present system, the duration for the transponder code transmission is 32 ms. The minimum cycle duration depends upon the telegram length, the Baudrate and the chosen telegram content.

In the diagram

T_ZVZ stands for the programmable character delay and

T_QVZ for the programmable acknowledgement delay.

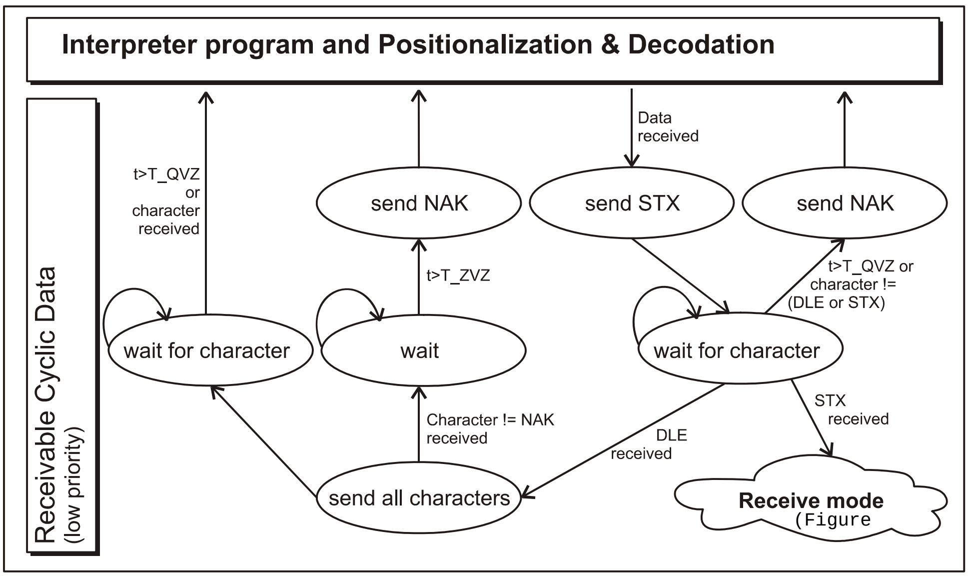


Figure 28 Diagram procedure 3964R; antenna –> SPS

A.2 Data direction SPS -> Antenna

In this direction commands are transmitted only when required (by now the command for starting the monitor program is implemented; see section 4.2.3.1.2 on page 22). To overcome the frequent cyclical data output of the antenna, the 3964R of the antenna has a lower priority (see Figure 28).

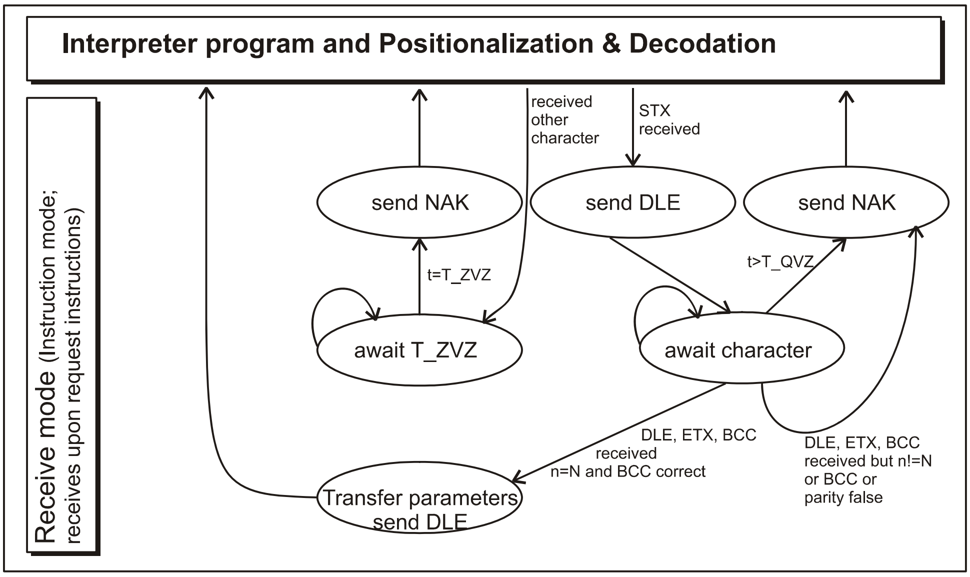


Figure 29 Diagram procedure 3964R; SPS –> antenna

B Procedure „transparent“

For the interconnection antenna <–> SPS a transparent protocol can be used. The following settings have to be observed for the data transmission:

- 1 start bit, 8 data bit, parity even, 1 stop bit, Baudrate 19200 Bd (default) or 38400 Bd.

B.1 Data direction antenna -> SPS

In this direction, cyclical antenna data is transmitted. The duration is parameterizeable, it should take an integral part or multiple of the transponder code transmission. The minimum cycle duration depends upon the telegram length, the Baudrate and the chosen telegram content.

The data sentence always starts with an „=“-character (hex 0x3d). Then the parameters chosen from the respective menu follow. The telegram is to be quit with an 8 bit check sum over all characters. The characters are sent without delay.

B.2 Data direction SPS -> antenna

Commands are transmitted into this direction if necessary. Each command must start with a „=“-character (hex 0x3d). The format of the commands is described in Table 3 „Possible system status messages“ on page 20. The telegram is to be quit with a 8 bit check sum over all characters. The characters are sent without delay. The characters must be received within the parameterizeable character delaytime. Otherwise the telegram will be chopped.

C Influence of a metal plate on the antenna

1 mm thickness of the plate

Distance (metal <–> antenna) [mm]	Transponder HG 70653 @ 250 mm [S /units]		antenna current [mA]	
	without	with retuning	without	with retuning
150	5	180	240	320
200	5	480	250	810
300	385	650	300	900
400	490	650	420	900
∞	650		900	

Table 16 Influence of metal on the antenna

Measurements have been carried out with a steel plate above the antenna in variable distances. The transponder was positioned at nominal reading distance (250 mm) underneath the antenna. Current consumption was retuned to maximum value, see section 5.3.2.4 on page 38. The measured displacement signal of the transponder is not influenced through metal as long as the surface of the antenna is covered evenly.

D Influence of a metal frame on the antenna

Size of frame: 1600 mm x 800 mm, 30 mm hollow profile, 1 mm wall thickness

Distance (metal <–> antenna) [mm]	Transponder HG 70653 @ 250 mm [S /units]		antenna current [mA]	
	without	with retuning	without	with retuning
150	215	520	290	800
200	340	540	350	830
300	510	585	580	880
400	595	605	840	900
∞	640		900	

Table 17 Influence of metal on the antenna

Measurements have been carried out with a steel frame above the antenna in variable distances. The transponder was positioned at nominal reading distance (250 mm) underneath the antenna. Current consumption was retuned to maximum value, see section 5.3.2.4 on page 38. The measured displacement signal of the transponder is not influenced through metal as long as the surface of the antenna is covered evenly.

E Influence of reinforcement steel mesh below the transponder

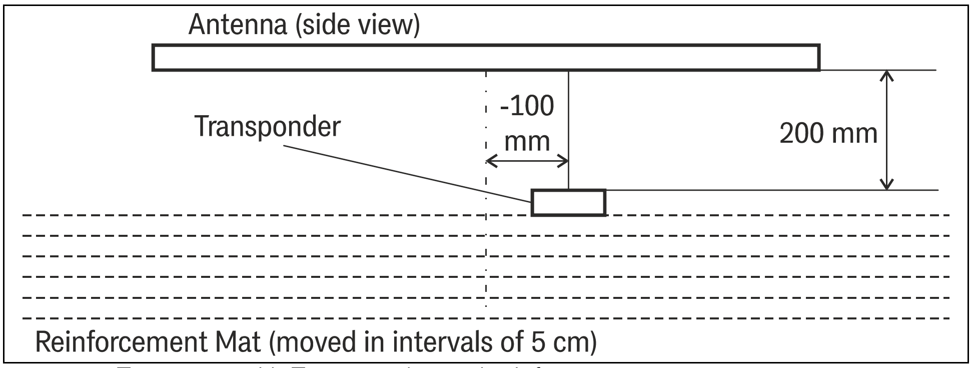


Figure 30 Test setup with Transponder and reinforcement mat

The measurement was performed with a reinforcement mat with the meshes sized at 90 x 240 mm. The measured parameters were: Tuning value, current consumption, value of reference coil Us, value of positioning coil Ud and whether the antenna is able to decode the Transponder code. The position of the transponder was X = -100 mm, Y = 0 mm.

The transponder was located in a distance of 20 cm below the antenna, and the mat was lowered in intervals of 5 cm.

Distance between mat and transponder / cm	Tuning value antenna	Current consumption antenna / mA	Us / units	Ud / units	decoding
Without mat	4	980	850	920	yes
25	6	920	750	830	yes
20	6	890	700	780	yes
15	7	860	640	710	yes
10	8	780	460	530	yes
5	9	770	400	460	no
0	12	660	0	0	no

Table 18 Influence of reinforcement steel mesh on the transponder

F Accuracy of the deviation calculation

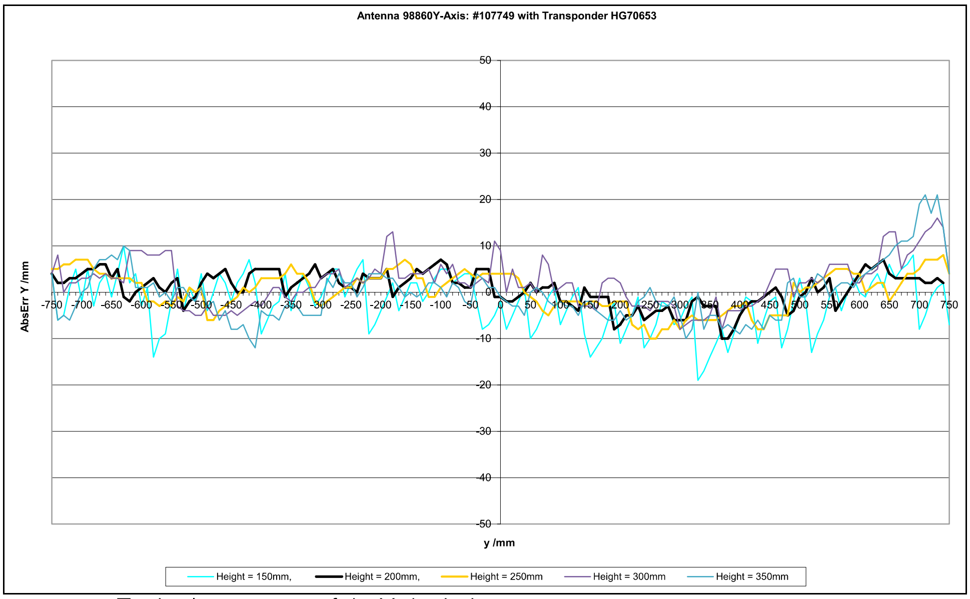


Figure 31 Typical accuracy of theY-deviation

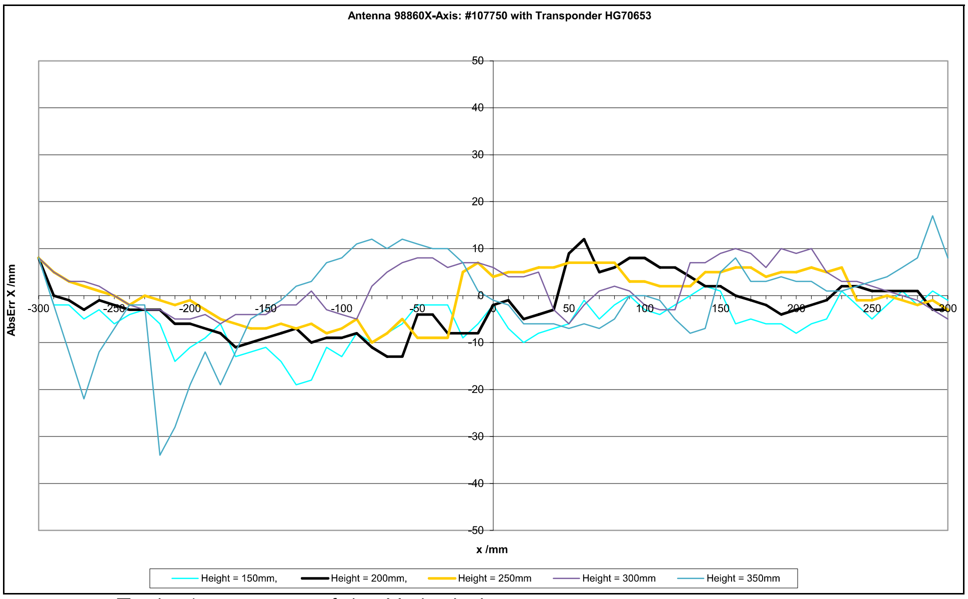


Figure 32 Typical accuracy of the X-deviation

10 List of Figures

11 List of Tables

12 Index

13 Handbook Conventions

In documentations of Götting KG the following symbols and assignments are being used at the time of printing this manual:

- Security advices have the following symbols, depending on the emphasis and the degree of exposure:

NOTE!

ATTENTION!

CAUTION!

WARNING!

- Continuative information and tips are identified as follows:

Tip!

- Program texts and variables are highlighted by using the `font 'Courier'`.
- Whenever input of key combinations is required for the operation of programms, the corresponding Keys are Highlighted (in Götting KG programs it is usually possible to use small and capitalized characters equally).
- Sections, figures and tables are automatically numbered consecutively throughout the entire document. In addition, each document has an index listed behind the front page, including pages and - whenever the document has more than 10 pages - following the actual system description a figure and table index in the back. In certain cases (for long and/or complicated documents) a subject index is added.
- Each document provides a table block with metainformation on the front page, indicating the system designer, author, revision and date of issue. In addition, the information regarding revision and date of issue are included within the footer of each page, enabling the exact allocation of the information with a date and certain system revision.
- Online-Version (PDF) and printed manual are generated from the same source. Due to the consistent use of Adobe FrameMaker for the generation of documentation, all directory entries (including page numbers and subject index) and cross references in the PDF file can be clicked on with the mouse and will lead to the corresponding linked contents.

14 Copyright and Terms of Liability

14.1 Copyright

14.2 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.

14.3 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.