1.5-dim. Positioning and Identification Antenna

HG G-98820ZA

English, Revision 10	Dev. by: WM
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1 Introduction

The described antenna is designed to be used for positioning and/or trackguiding vehicles. All important parameter settings, calibration and updates are carried out via an integrated serial interface or CANopen®.

Figure 1 Examples of automated vehicles using transponder systems

Antenna HG G-98820ZA utilizes a completely new antenna concept, which has a larger reading area with a linear transponder positioning function. The antenna is so-called 1.5 dimensional, meaning that it outputs the Transponder code as well as the linear deviation rectangular to the direction of travel as well as the information „Before transponder", „Crossing of the transponder" and „Behind transponder".

Götting transponder antennas have a consistent output format, that also 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 G-98820ZA with the firmware 98820A41.07 or higher (also refer to Figure 12 on page 33).

1.1 System Components

The 1.5-dimensional Positioning and Identification System using the antenna HG G-98820ZA consists of up to four different components:

Figure 2 System components (optional extras in brackets)

1. Transmitter-receiver antenna HG G-98820ZA incl. interpreter
   (also refer to section 4.2 on page 15)

2. Transponder HG 71325XA/HW DEV00095/HW DEV00098 or others
   (within the track; refer to section 4.1.1 on page 14)

3. Connection cables
   (not in this picture; refer to section 4.2.5 on page 28)

4. Optional Read / Write Unit HG G-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 via coils (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).

The internal interpreter unit decodes the Transponder code and interpolates the Transponder position rectangular to the 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 or sent via CAN bus.

1.3 Application Example

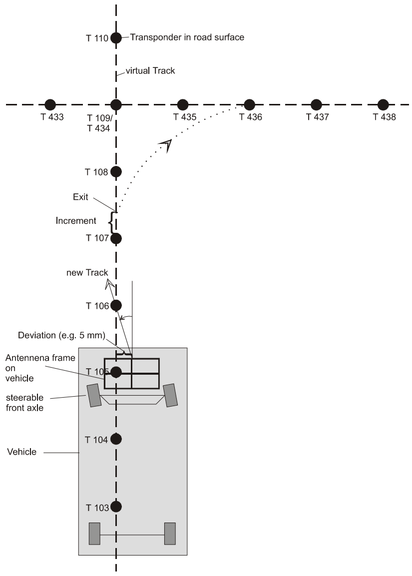


Figure 3 Track guiding a vehicle with one antenna

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 (5 mm). 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, we recommend the Götting Navigation Controller HG G-73650). Rotary encoders enable changing the direction of travel whenever necessary. Thus it is possible to switch tracks at predetermined points (T107). 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:

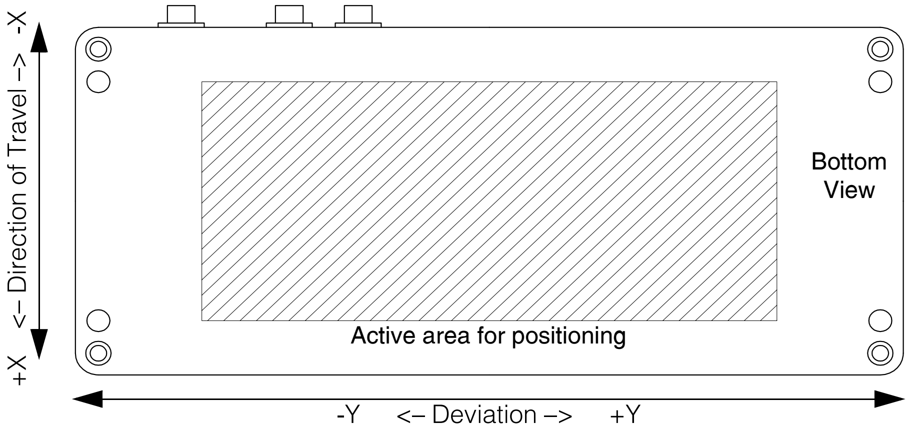


Figure 4 Polarity of the deviation

For definition of bit `Segment` see Table 5 on page 19. This bit is set in the half plane -X.

2 Mounting

2.1 Transponder

Observe 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 observe the data sheets and mounting instructions for the suitable transponders HG 71325XA and HW DEV000950/HW DEV0098.

2.2 Antenna HG 98820ZA

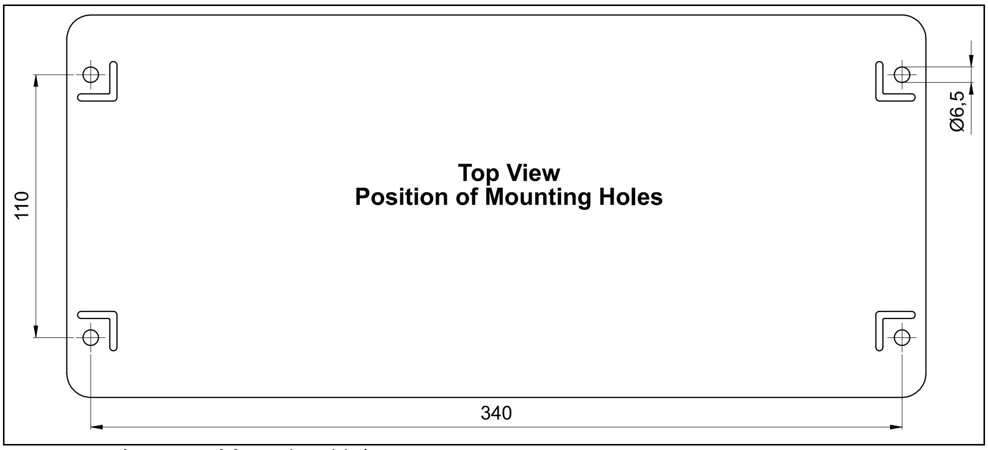


Figure 5 Antenna Mounting Holes

To prevent any adverse effects on the system:

- The Antenna itself may be mounted directly onto metal with its top side (mounting side).
- No closed loop within 300 mm around the antenna, especially around the cover. No metal surfaces nearer than 50 mm (essential antenna connection cabling and special mounting struts excluded).
- 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.)!
- Current-carrying wires have to be far enough away from the antenna (minimum 150 mm) so that their power and frequencies does not influence the antenna too much, its sum voltage in idle mode has to be below 50 and during driving below 100 (guideline: For very high or very small reading distances those values may be higher/lower. The sum voltage without a transponder in the reading area should always be smaller than half the sum voltage that is generated by a transponder within the reading area). The only exception to this rule is the connection cable of the antenna itself.

- Transponder antennas with the same energy field frequency may not be positioned too close to each other since then beat frequencies can change the energy supply to the transponders. This can e.g. be observed when the energy consumption of the antenna is not constant or via unsteady reception voltages. Tests with the antenna HG G-98820ZA showed that gaps of 300 mm (in longitudinal and lateral direction) had no effect. If the distance between two antennas shrinks to 200 mm the sum voltage decreases by up to 6 %. Placing two antennas only 100 mm apart the sum voltage sways by +5% to -15%. Decoding and distance calculation still work under those conditions but there is a risk, that set thresholds are undershot.
- 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.
- For the complete mechanical drawing please see annex G on page 68.

3 Commissioning

NOTE! Check the operating voltage before connecting! The cables should not lie directly next to power supply cables.

Connect the antenna with the vehicle control unit. Connect a laptop to the antenna using the serial interfaces of both devices. Then start the monitor program as described in section 5.2 on page 30.

Default Values As standard setting, the system uses the `Monitor only` setting at 38400 baud. However, please pay attention to the fact that these may have been altered by a different user!

1. Move a transponder into reception range.
   The voltage `S` shown in the monitor program's status bar should increase considerably. The code must be detected immediately and the number of readings must be continuously counted up to 255.
2. Remove the transponder 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.

NOTE! The causes for the interferences should be eliminated as far as possible. If this is not possible it might be possible to avoid the critical frequency area by changing the side band (see section 5.2.2.4 on page 39).

3. In order to adjust the antenna to environmental influences it must be re-calibrated (also refer to section 2.2 on page 8), alternatively activate the function `Auto-Tune` (refer to section 5.2.2.4 on page 39).

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). Where this is applicable is described in the corresponding sections of the monitor program (section 5.2). Now the system has been correctly put into operation. For the correct adjustment of the positioning thresholds the vehicle has to be used in its final operation environment or in a test site that very closely resembles it.

4. In order to set the positioning thresholds position the vehicle over a transponder that is mounted in the track. Initially set the positioning thresholds that a signal that is 50 % weaker than the one received from the transponder still would trigger the generation of a positioning pulse (see section 5.2.2.3 on page 37).
5. In order to set the positioning threshold correctly (refer to section 5.2.2.3 on page 37), it is useful to record a complete test run over the set track. The serial interface of the antenna HG G-98820ZA may be used accordingly (refer to sec-

tion 4.2.4 on page 28). For this function Antenna HG G-98820ZA offers the use of the serial interface (refer to section 4.2.3.1 on page 16) or the CAN bus message object 3 (see section Table 9 on page 25). Afterwards adjust the positioning thresholds so that a safe positioning is possible but that is not triggered by side lobes. Figure 6 shows a corresponding driving situation, for readings like this a reasonable threshold for the decoding and the positioning pulse would be between 400 and 600 units.

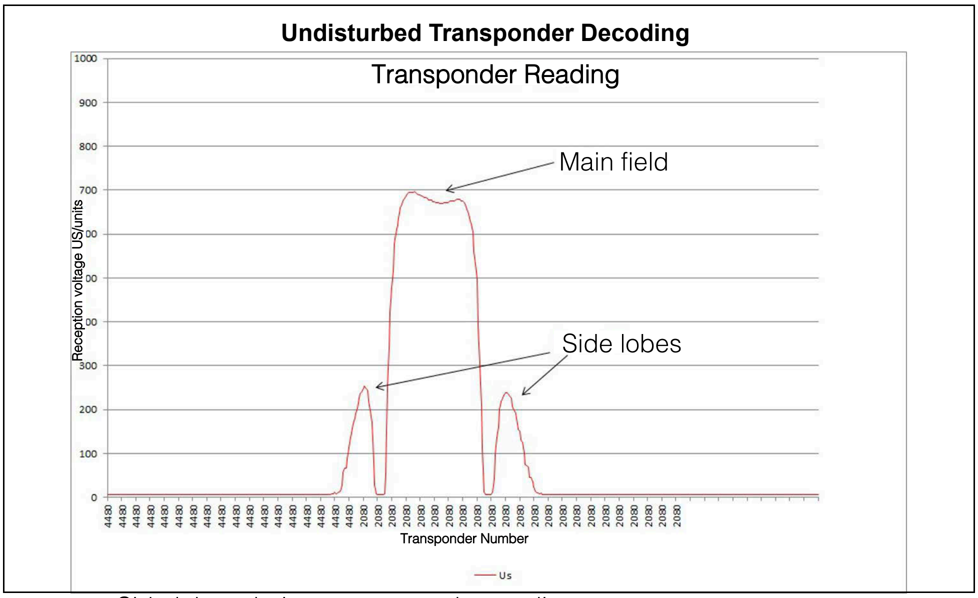


Figure 6 Side lobes during a transponder reading

NOTE! If during the first driving tests a proper track guidance is not possible try changing the positioning thresholds accordingly.

The separately adjustable thresholds are explained in chapter 5 on page 29. In order to explain those thresholds and how to find a proper set-up below the process of a transponder crossing is described.

Every 2 ms a check is performed whether the sum voltage exceeds the value „Threshold for Decoding“. If that is the case the bit `TRANS_IN_FIELD` is set and the `NOISE` counter is incremented. Every 8 ms it is attempted to read a code. If a code is read the `NOISE` counter is reset and afterwards the code is re-read until the `Number of equal Codes` is reached. If this is successful the bit `CODE_OK` is set.

As soon as the `NOISE` counter exceeds the threshold `Level to Noise Error` the bit `RX_NOISE` is set.

The bit `CODE_OK` is held until either the sum voltage falls below the value `Threshold for Decoding` or the bit `RX_NOISE` is set.

A new transponder code can only be read when the bit `CODE_OK` is reset.

This means that if there are high interference voltages in the 64 kHz area the antenna will not read a new transponder code after leaving the reception range of a transponder for the period of 2 ms * `Level to Noise Error`. In case a new transponder enters the reception range during this period the `NOISE` counter is reset but the old code is held.

The following diagrams show examples of recorded data:

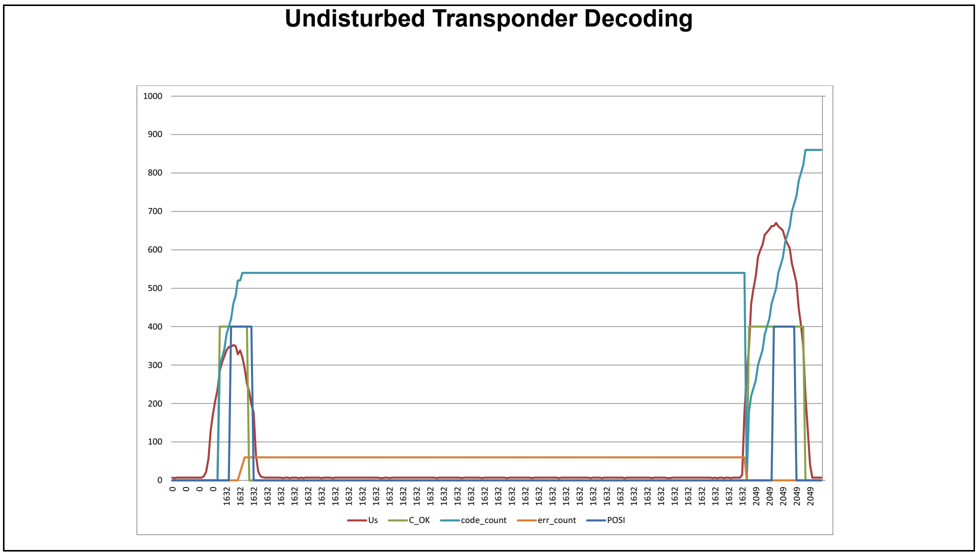


Figure 7 Undisturbed decoding across two transponders

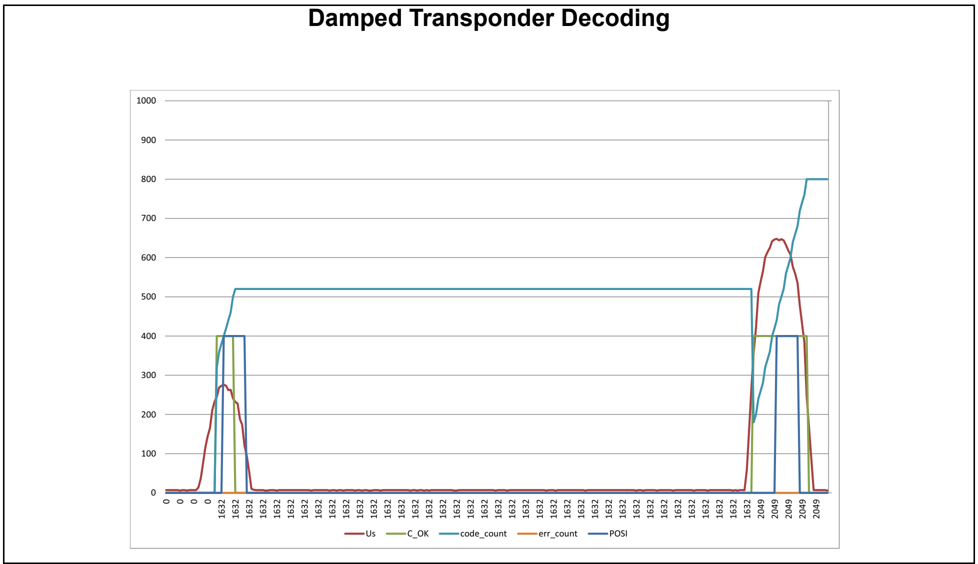


Figure 8 The same driving situations as shown in Figure 7 only with antenna with wrong calibration

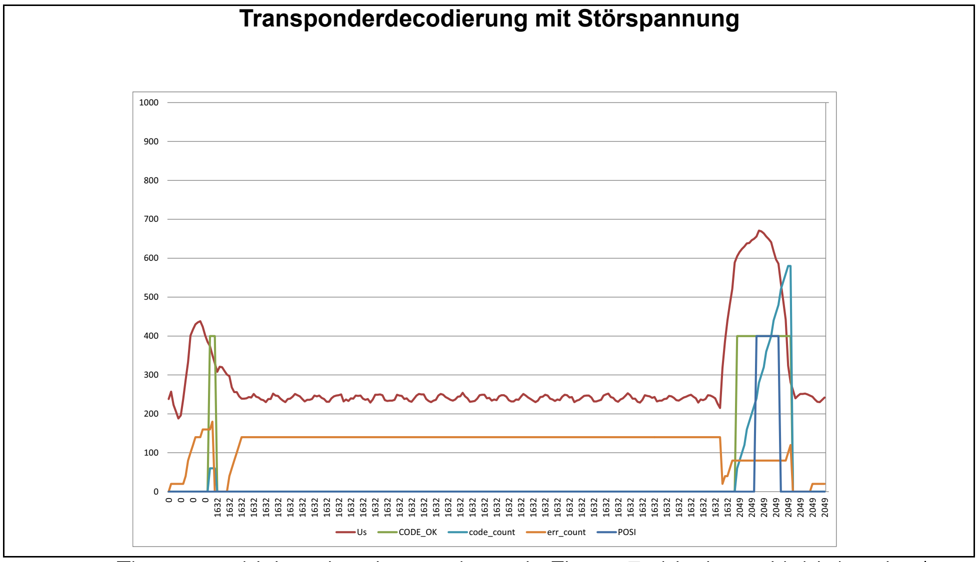


Figure 9 The same driving situation as shown in Figure 7, this time with high noise level

When comparing the diagrams one can see that the wrong calibration shown in Figure 8 on page 12 makes the sum voltage drop and thus the reception periods for `Code_OK` and `POSI` decrease. This can lead to decoding problems for higher crossing speeds.

In Figure 9 on page 13 the code of the weaker transponder is read correctly however the position measuring can no longer be performed correctly.

NOTE! Although sum and difference are called voltages those two values are in fact no voltages but logarithmic derivations of the actual voltages.

For the test runs two transponders with different signal strengths have been crossed shortly one after the other. The settings were:

Variable	Set value
Level to Noise Error	250
Number of equal Codes	2
Threshold for Decoding	256
Level for Positioning/Calculation	256

Table 1 Reference values for the commissioning runs

4 Components and Operation

4.1 Components in the Ground

4.1.1 Transponders

As reference markers, transponders with the trovan® coding are used; e. g. the HG 71325XA transponder or the types HW DEV00095/HW DEV00098 (read write/RW).

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.

4.1.2 Code structure

The antenna HG G-98820ZA is set up to receive only block number two with its 20 bits of user data.

Line (for 3 bits each) and column parities are used for data protection. The transmission time for a complete code telegram is 8 ms.

4.2 Transmission-Reception Antenna HG G-98820ZA

Figure 10 Photo Transmission-Reception Antenna HG G-98820ZA

The antenna systems and the pre-amplifiers are housed in a casing with the dimensions shown in annex G on page 68. The cables (the connectors) exit at one side of the antenna. The interpreter is integrated in the antenna casing. The electronics are varnished. For a mechanical drawing please see annex G on page 68.

4.2.1 Connection

The antenna is equipped with three 5-pin M12 connection sockets. The pin allocations are as follows:

4.2.1.1 Power

Voltage Supply, Serial Interface and Positioning Pulse. 5-pin M12 connector male. The positioning pulse output is fed from +Ub (24 V) and limited to 20 mA.

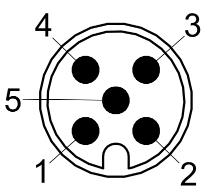
Power	Pin	Signal	Annotation
 M12 5-pin male	1	+Ub (24 V)	Power supply
	2	Posi	Positioning pulse output 20 mA current limited
	3	TxD	RS232 data output
	4	RxD	RS232 data input
	5	GND	Ground (supply)

Table 2 Power Interface

4.2.1.2 CAN Bus

The CAN bus is connected to the device with two 5-pin M12 connectors male/female. They are named CAN1 and CAN2 and are allocated as follows:

ATTENTION! Under no circumstance connect +24V with pin 4 or 5!

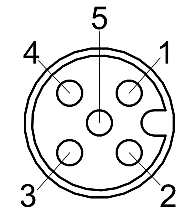
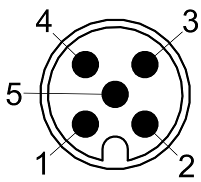
CAN1	CAN2	Pin	Signal
 M12 5-pin female	 M12 5-pin male	1	not used
		2	+Ub (24 V)
		3	Ground supply
		4	CAN_H
		5	CAN_L

Table 3 Pin allocations CAN1 and CAN2

NOTE! The connectors of the inputs CAN1/CAN2 are connected in parallel, i.e. there is no input or output. If the interpreter is installed at the end of the bus line, a CAN terminator has to be installed.

Those terminators can be ordered from different manufacturers and are available for most plugs and jacks. The CAN connectors can also be used as power supply.

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 4.2.4 on page 28).

Following this period, the actual program starts. If configured accordingly (also refer to Figure 16 on page 39), the transmission coils will be automatically tuned. This procedure takes another 16 seconds.

4.2.3 Interfaces

4.2.3.1 Serial (RS 232)

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 „Montir only", „transparent" or „3964R", the content of the output telegrams is configurable for the last two. 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 19200 Bd is then calculated as follows:

$$21\frac{\text{Byte}}{\text{Telegram}} \times 11\frac{\text{Bit}}{\text{Byte}} \,/\, 19200\frac{\text{Bit}}{\text{s}} = 12\frac{\text{ms}}{\text{Telegram}}$$

Figure 11 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 HighByte first or LowByte 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	0x.0001	ASCII-061: „=“	Start sync (Default: „=“)
2,3	2 Byte	0x.0002	signed int	Y-Position: Y [mm] within the range of -125 .. 0 .. +125 In case of an invalid value (no Transponder detected) = 32767
4,5	2 Byte	0x.0004	signed int	Voltage generated by the transponder in the positioning coil in [units] (Udif)
6,7,8,9	4 Byte	0x.0008	unsigned long	20 bit of the Transponder code (R/W Transponder)
10,11	2 Byte	0x.0010	unsigned int	voltage generated by the Transponder in the reference coil in [units] (Usum)
12	1 Byte	0x.0020	unsigned char	operational voltage of the Antenna [100 mV]
13	1 Byte	0x.0040	unsigned char	power consumption [10 mA]
14	1 Byte	0x.0080	signed char	temperature within the antenna [°C]
15	1 Byte	0x.0100	unsigned char	number of code readings during the latest Transponder crossing
16,17	2 Byte	0x.0200	unsigned int	receiver frequency [10 Hz]
18,19	2 Byte	0x.0400	unsigned int	transmitter frequency [10 Hz]
20,21	2 Byte	0x.0800	unsigned int	system status in binary encoding, see Table 6 on page 20
(22)	1 Byte		unsigned char	check sum, only in transparent protocol!

Table 4 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 4):

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		
0x0010	EEPROM_ERROR	parameter E²Prom 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 ±10 mm is determined and this bit is set
0x0200	TRANS_IN_FIELD	transponder is being detected *)
0x0400	CODE_OK	Code decoded without errors *)
0x0800	SEGMENT	The transponder is located within the area marked -X in Figure 4 on page 7 *)
0x1000	POSIPULS	Transponder has crossed the Antenna center
0x2000		
0x4000		
0x8000		

Table 5 Possible system status messages

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

Example:

System status `0x0014` means EEPROM_ERROR and RX_NOISE.

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

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 21 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 manual 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 (description in section 5.2 „System Monitor“ on page 30)
		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 6 List of the system commands (part 1 of 4)

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	

Table 6 List of the system commands (part 2 of 4)

No.	Procedure		Start	Command Bytes	Parameter Bytes	Check Sum *)	Description
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	;	
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	=	

Table 6 List of the system commands (part 3 of 4)

No.	Procedure		Start	Command Bytes	Parameter Bytes	Check Sum *)	Description
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 *) Check sum 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: $3D_{16}53_{16}50_{16}01_{16}2C_{16}\mathbf{13_{16}}$						
20	3964R	HEX		$50_{16}4C_{16}$	Code in the format $tt_{16}tt_{16}$ For code „1234“ e.g. $12_{16}34_{16}$		Supply of the 16 programmable lower bits of the transponder code
		ASCII		PL			
	trans-parent	HEX	$3D_{16}$	$50_{16}4C_{16}$		07_{16}	
		ASCII	=	PL			
21	3964R	HEX		$50_{16}48_{16}$	Code in the format $tt_{16}tt_{16}$ For code „1234“ e.g. $12_{16}34_{16}$		Supply of the programmable higher bits of the transponder code and start of the programming procedure
		ASCII		PH			
	trans-parent	HEX	$3D_{16}$	$50_{16}48_{16}$		03_{16}	
		ASCII	=	PH			

Table 6 List of the system commands (part 4 of 4)

*) XOR operation of all bytes including the start character. Depending on the parameters used.

**) No ASCII-coded values

4.2.3.2 System Monitor

The system may be configured via menus in monitor mode. Refer to section 5.2 „System Monitor“ on page 30.

4.2.3.3 CAN

4.2.3.3.1 Description

The internal CAN module is based on the CAN specifications V2.0 part B. Standard or Extended frames are transmitted (configurable). It is also possible to configure the bit timing as well as the identifier within the system monitor (refer to section 5.2 on page 30).

Different CAN message objects can be output. In addition it is configurable 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 (refer to section 5.2.2.5 on page 40).

Message Object 3 is used for the analysis of the system behavior.

4.2.3.3.2 CAN Message Object 1 (Transmission Object)

Byte #	Length	Type	Description
1,2	2 Byte	unsigned int	System status information according to Table 5 on page 19
3,4,5,6	4 Byte	unsigned long	20 Bit Transponder code (R/W Transponder)
7,8	2 Byte	signed int	Deviation Y [mm]

Table 7 Structure of the CAN Message Object 1

4.2.3.3.3 CAN Message Object 2 (Transmission Object)

Byte #	Length	Type	Description
1,2	2 Byte	unsigned int	Voltage within the sum antenna generated by the Transponder
3,4	2 Byte	signed int	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	Operating voltage (refer to Telegram description in Table 4 on page 18)
7	1 Byte	unsigned char	Operating current (refer to Telegram description in Table 4 on page 18)
8	1 Byte	signed char	Operating temperature (refer to Telegram description in Table 4 on page 18)

Table 8 Structure of the CAN Message Object 2

4.2.3.3.4 CAN Message Object 3 (Transmission Object)

Byte #	Length	Type	Description
1,2	2 Byte	unsigned int	System status information according to Table 5 on page 19
3,4	2 Byte	unsigned int	the lower 16 Bit of the Transponder code
5,6	2 Byte	unsigned int	Voltage in the sum coil 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 9 Structure of the CAN Message Object 3

4.2.3.3.5 CAN Message Object 4 (Reception Object)

It is possible to send commands to the antenna via Message Object 4. It has the same ID as Message Object 1 and a length of 6 bytes.

Byte #	Length	Type	Description
1,2	2 Byte	Unsigned int	Command (see Table 11 below)
3,4,5,6	4 Byte	Unsigned long	Parameter (see Table 11 below)

Table 10 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 positioning level	Positioning level 0000.0000_{16} to $0000.03E8_{16}$
0008_{16}	Program transponder	Transponder code in the range $0x0000.0000_{16}$ to $0x000F.FFFF_{16}$

Table 11 Coding of the commands of CAN Message Object 4

The programming is started by sending 0008_{16} in the command bytes of CAN Message Object 4. The code to be programmed has to be sent in the 4 parameter bytes. All those bytes should be reset after 8 to 100 ms.

The one-time programming process takes 100 to max. 200 ms. Afterwards the new code can be read immediately via the corresponding Message Object.

If the programming process fails it is to be repeated. A new programming is only triggered whenever the command byte is switched from 0000_{16} to 0008_{16}.

4.2.3.4 Data Interface CANopen®

The node ID and the transmission rate have to be selected either according to the above described serial monitor or the corresponding SDOs. The measured values of the system are transmitted via so-called TxPDOs. SDOs are used for parameter setting. The CAN identifiers are derived from the node address (1..127).

4.2.3.4.1 Description of the Process Data Objects (PDO)

Fixed places are allocated within the PDO for the measured values. Dynamical mapping is not possible. It is possible to operate the PDO mode either cyclic, synchronous or asynchronous. In order to avoid excessive bus usage due to frequent changes during asynchronous non-cyclic transmission (Event-Time = 0), it is possible to set the so-called `Inhibit time` within the CAN menu of the serial monitor. It is, however, possible to transmit a PDO cyclically. In this case, it is necessary to select the Event Time accordingly and also set the Inhibit Time = 0.

It is possible to permanently deactivate a TxPDO by selecting the asynchronous mode (255) with Inhibt Time = 0, Event time = 0 and storing the parameters. In addition, it is possible to temporarily deactivate/activate the TxPDO by setting/deleting the highest ranking bit within the corresponding PDO COB Identifier.

PDO_1 is transmitted with identifier 0x180 + node address. It contains 8 bytes, which include, amongst others, the status indicated in serial monitor. The transmission sequence is status, transponder code and deviation of the transponder position.

Value	Variable	Value range	Comment
Status	unsigned 16	0..0xffff	Status bits according to Table 5 on page 19
Code	unsigned 32	0...ffff.ffff	20 bit transponder code (R/W Transponder)
Deviation	signed 16	0xff83...0x007d	Y-deviation, ±125 mm In case of an invalid value (e.g. no transponder detected) = 32767

Table 12 Variables of PDO_1

PDO_2 is transmitted with identifier 0x280 + node address. It contains 8 bytes according to the following table.

Value	Variable	Value range	Comment
Sum Voltage	unsigned 16	0...1023	Voltage of the reference antenna coil
Dif Voltage	signed 16	0...±1023	Voltage of the positioning coil
Codes read	unsigned 8	0...255	Number of code readings
Voltage	unsigned 8	0...255	Operating voltage of the antenna [100 mV]
Power	unsigned 8	0...255	Power consumption of the antenna [10 mA]
Temperature	signed 8	-23...61	Board temperature [^{o} C]

Table 13 Variables of PDO_2

The synchronous identifier is 0x80. It is possible to read out this parameter under index [1005,00], but it is not possible to change it.

4.2.3.4.2 Heartbeat

The heartbeat mode is supported. Whenever a heartbeat time > 0 is set in the CAN menu, the device status is transmitted under identifier (0x700 + node address) each time the heartbeat timer has expired. The guard time is set to 0 afterwards.

Node status	Code
stopped	0x04
preoperational	0x7f
operational	0x05

Table 14 Coding of the Node status

4.2.3.4.3 Node Guarding

Whenever the Heartbeat time is set to 0, the device replies to a Remote Transmission Request of the Identifier (0x700 + Node address) with the device status (refer to Table 14 above), while the highest bit changes. The device does not monitor the timely reception of RTR Frames.

4.2.3.4.4 Description of the Service Data Objects (SDOs)

The service data opject is used to access to the object index. An SDO is always transmitted with a confirmation, i. e. each reception of the message is acknowledged. The identifiers for read and write access are:

Read access	0x600 + Node address
Write access	0x580 + Node address

Table 15 Identifiers for read and write access

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

Name	Number	Description
SDO_ABORT_UNSUPPORTED	0x06010000	non-supported access to an object
SDO_ABORT_READONLY	0x06010001	write access to a read-only object
SDO_ABORT_NOT_EXISTS	0x06020000	object not implemented
SDO_ABORT_PARA_VALUE	0x06090030	Parameter value range exceeded
SDO_ABORT_PARA_TO_HIGH	0x06090031	Parameter value too high
SDO_ABORT_SIGNATURE	0x08000020	The signature 'load' or 'save' was not used for loading or saving parameters.

Table 16 Error codes

4.2.3.4.5 Object Directory

All objects relevant for the device are included in the CANopen Object Directory. Each entry is indicated by a 16 bit index. Sub-components are indicated by a 8 bits subindex. RO indicates only readable entries. The complete object directory is listed in appendix C on page 53.

4.2.3.5 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 value of „deviation“ in the serial telegrams at the time of the positioning pulse for an adjustable number of telegrams (refer to section 5.2.2.2 „(S)erial Output“ on page 35 and 5.2.2.5 „C(A)N-Parameters“ on page 40).

4.2.4 Software Download

If necessary, the Antennas may be updated via the serial interface. Please refer to section 5.3 „Software Update (Antenna Software)“ on page 45.

4.2.5 Connection Cables

Connection cables are not part of the scope of supply. The needed kind of cables are commercially obtainable at many manufacturers (e. g. Binder 79-3444-32-05 M12 line 2 m PUR 5 x 025), the standard length is 2 m..

NOTE! If a high interference level is expected shielded cables ought to be used.

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. Once all the connections have been set up, start a terminal program on the PC.

For the connection to be established the serial interface of the PC has to be connected to the serial interface of the antenna. The serial interface of the antenna is integrated into its power interface. The user needs to tailor cables for connecting the antenna pins listed below to the PC and a power supply.

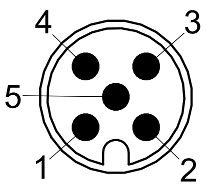
Antenna			**9-pol. Sub D Interface PC, pins not listed are not to be connected**	**Power supply**
Power	**Pin**	**Signal**		
 M12 5-pin male	1	+Ub (24 V)		24V, 2A
	2	Posi		
	3	TxD	Pin 2	
	4	RxD	Pin 3	
	5	GND	Pin 5	Ground

Table 17 Power Interface

5.1 Terminal Program

In the following we refer to the program **HyperTerminal®** (http://www.hilgraeve.com/hyperterminal/). At http://www.goetting-agv.com/components/transponderconf you can download matching configuration files for HyperTerminal®.

Nevertheless, any other terminal program can be utilized, provided that it supports VT52 emulation. If you should use a different program, please read its documentation carefully and adjust it to the values given in Table 18 below.

The following parameter settings are necessary.

Terminal settings monitor program (refer to section 5.2)	
baud rate	19200 or 38400 Bd depending on the system configuration, default 38400 Bd
terminal emulation	VT52
parity	even
data bits	8
stop bits	1

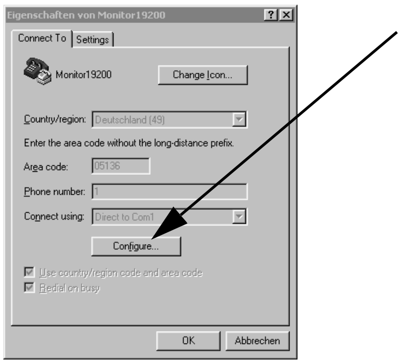
Table 18 Terminal settings for the monitor program

Terminal settings monitor program (refer to section 5.2)	
character delay	1 ms
line delay	0 ms
PC interface (port)	COM1 can vary depending on the PC (see below)

Table 18 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 OK. Save the altered values if you are asked for it while exiting HyperTerminal.

5.2 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.

The possible communication procedures are:

Modus	Description
Monitor only	Default mode, see section 5.2.2 on page 32
3964R	For direct PLC communication, see annex A on page 51
Transparent	For direct PLC communication, see annex B on page 52

Table 19 Monitor modes

For changes to the modes and data rates see section 5.2.2.2 on page 35.

5.2.1 How to start the monitor program

Depending on the currently active procedure, the monitor program is started differently.

5.2.1.1 Procedure Monitor only

If the antenna is set to the procedure „Monitor only“, the monitor mode is started 10 s after switch on. In this case no files have to be transmitted and section 5.2.1.2 may be ignored.

5.2.1.2 Procedures 3964R/transparent

The command to switch to monitor mode should be entered directly via a PC. To do so, start your terminal program. For the startup, as 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.

Start your terminal program. If you are using HyperTerminal (see section 5.1 on page 29) 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.

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

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`

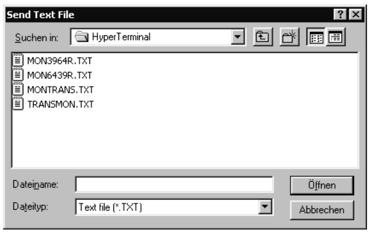
2. `Mon6439r.txt`
   Transfer if the system is adjusted to procedure **3964R** with “**LowByte first**“. The file contains the characters: `0x02 0x4F 0x4D 0x49 0x4E 0x10 0x03 0x16in hexa-decimal notation`

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 (if the correct 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 12 on page 33 will appear.

5.2.2 How to work with the monitor program

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 5.2.1) 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 (resp. 26 s) after activating the Antenna.

5.2.2.1 Main menu

```
S:0007  D:-007       D_Y:+32767   Code: 00000000  Read:   0: N:   0
Frx[/Hz]:66800  Ftx[/Hz]:127990
U[/mV]:24200  I[/mA]: 300  T[Grd.C]:+24     E: 0800  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,Y,Tr,Co,S-,Pos,N,E,Cnt<crlf>]  (abort with <a>)
    display (Y)Histogram
    (W)rite Transponder

    (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


    Software Version  98820A41.07 / Oct 31 2016    Serial Number: 110191
```

Figure 12 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 20), as they also appear in the output telegram (described in section 4.2.3.1.1 on page 17). The bottom line of 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. ±125, 32767 when position invalid)
Code	The data bits of the Transponder in hexa decimal coding. The code is recorded as soon as voltage `S` exceeds the `Threshold for Decoding` (refer to Figure 15 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
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)

Table 20 Description of system variables (monitor program) (part 1 of 2)

Description of the system variables	
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
E	Hexa decimal system status. The description of the individual bits is included in Table 5 on page 19
Noise	Output of a counter: - Whenever the sum voltage S exceeds the `Threshold for Decoding` the counter is increase every 8 ms until it reaches the value of `Level to Noise Error`. - Whenever S falls under this threshold, the counter counts backwards towards 0. 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 exceeds an adjustable value (refer to section 5.2.2.3 „(T)ime & Code“ on page 37), the system status bit RX_NOISE is set.

Table 20 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, they have to saved as described in section 5.2.2.11 on page 44. This prevents unwanted alterations of values. With L the values are saved after alteration and input of the password.

Input of Q will exit each menu.

The following sections describe the submenus

- (S)erial Output (section 5.2.2.2 on page 35)
- (T)ime & code (section 5.2.2.3 on page 37)
- (F)requency & Antenna tuning (section 5.2.2.4 on page 39)
- C(A)N Parameters (section 5.2.2.5 on page 40)
- CA(N)open Parameters (section 5.2.2.6 on page 41)
- Display Systemstatus (5.2.2.7 on page 42)
- Cs(V) (section 5.2.2.8 on page 42)
- display (Y)Histogram (section 5.2.2.9 on page 43)
- (W)rite transponder (section 5.2.2.10 on page 44)
- (L)oad values to EEProm (section 5.2.2.11 on page 44)
- (U)pdate Firmware (section 5.2.2.12 on page 44)
- (1) Import / (2) Export User Parameter (section 5.2.2.13 on page 44) and
- P(R)int Parameters (section 5.2.2.14 on page 45).

5.2.2.2 (S)erial Output

Any changes within 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 5.2.1 on page 31).

```
S:0007  D:+007      D_Y:+32767   Code: 00000000  Read:   0: N:   0
Frx[/Hz]:66800  Ftx[/Hz]:127990
U[/mV]:24200  I[/mA]:2550  T[Grd.C]:+28     E: 0002  Noise    0



    (B)audrate:                               38400
    (P)rocedure                               3964R
    (O)rder of Data Transfer (0= HiByte first):    0
    (T)elegram Content Mask      [0..FFF]:   00000fff
    (D)isplay Telegram Content
    (C)har-Delaytime            [1..220ms]:       220

    (A)ck-Delaytime (3964R)     [1.1680ms]:      1680
    Co(n)tinous Telegrams                            0
    (S)erial Data Period        [4.500mS]:           8
    (F)reeze Values for n Telegrams:[0..10]:         0


    (Q)uit Menue
```

Figure 13 Menu: (S)erial Output

Pressing B switches between 19200 and 38400 Bd.

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

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 changed automatically.

According to the values given in Table 4 „Data words in a telegram with 21 byte length“ on page 18, 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 `Lateral Displacement Y`, the `Code` and the `System Status` are to be output.
Add, according to the table the values 0x0000.0001, 0x0000.0002, 0x0000.0008 and 0x0000.0800. The result is 0x080b. Therefore the input for the “(T)elegram Content Mask“ is 0x080b.

Using “(D)isplay Telegram Content“ it is possible to review the generated telegram (see Figure 14 below). The shown case has a mask value of 0x0000.0fff and the telegram length is 21. Pressing any key generates the return to menu `Serial Output`.

```
S:0007  D:-007       D_Y:+32767   Code: 00000000  Read:   0: N:   0
Frx[/Hz]:66800  Ftx[/Hz]:127990
U[/mV]:24200  I[/mA]:2550  T[Grd.C]:+28     E: 0002  Noise    0


    STX         1 Bytes from Position: 1
    Delta_Y     2 Bytes from Position: 2
    Udif        2 Bytes from Position: 4
    CODE        4 Bytes from Position: 6
    Usum        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






    (Q)uit Menue
```

Figure 14 Menu: „(D)isplay Telegram Content“

Parameter „(C)har Delaytime“ is the so-called Character Delay Time for procedure 3964R (refer to appendix A „Procedure 3964R“ on page 51) and the timeout time for incoming characters transparent mode (refer to appendix, section B „Procedure „transparent““ on page 52).

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 value at the time of the positioning pulse output is preserved.

5.2.2.3 (T)ime & Code

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

```
S:0006  D:-006  D_Y:+32767   Code: 00000001  Read: 123: N:   0
Frx[/Hz]:66800  Ftx[/Hz]:127990
U[/mV]:23800  I[/mA]: 600  T[Grd.C]:+28     E: 0800  Noise    0



    (B)Level to Noise Error             [0..1000]:   1000
    (S)elect Code Channel                               S
    (H)igh-Nibble of RW-Code            [0..F,>F]:     10
    (N)umber of equal Codes               [0..15]:      1
    (T)hreshold for Decoding            [20.1023]:    256

    PosiPulse (a)fter Decoding                          1
    (L)evel for Positioning/Calculation [20.1023]:    256
    (P)osi-Pulse Time                     [n*1ms]:    100
    (O)ne Positioning Pulse per Crossing                0
    (X) Timed Positioning Pulse                         1
    (C)CODE_OK -> POSI_OUT                              1

    Th(r)eshold MAX-Detection           [10.1023]:    400


    (Q)uit Menue
```

Figure 15 Menu: (T)ime & Code

B enables setting the threshold for generating the bit RX_NOISE of the system status word as described in Table 20 on page 33 under 'Noise'.

With S it is possible to select which of the two existing receiver channels is used for the code transfer. Usually this will be the S-channel (sum channel). It is, however, possible to select the difference channel for reasons of interference minimization.

NOTE! If you are using the difference channel, the code will fall away in the middle (at the zero point) within a very limited area.

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

1. When using RW transponders 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 with N. With `0` the received code is immediately output, with `1` the code is compared 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.

[L] enables setting the voltage value S which is the threshold for releasing the positioning pulse output in order to eliminate false calculations due to antenna side lobes (see Figure 6 on page 11).

[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. This filter function reduces the maximum crossing speed, since the preset number of codes has to be read in time before the antenna center is reached.

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

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. In order to release this again the voltage S would then have to fall under the `Threshold for Calculation-Positioning` (refer to section 5.2.2.2 on page 35).

With [X] it can be chosen whether the Posipulse and the corresponding bit in the system status are turned off after the preset time [P] or after the sinking of voltage S below the threshold determined with [L].

[C] is used to define the behavior of the Posipulse output. With [1] the positioning pulse is switched to the output, with [0] the bit CODE_OK is switched to the output.

[R] enables setting a threshold for the scan coils which has to be reached in order to activate the calculation of the lateral deviation in Y direction.

NOTE! For the determination of he thresholds see chapter 3 on page 10.

5.2.2.4 (F)requency & Antenna Tuning

```
S:0008  D:-006  D_Y:+32767   Code: 00000000  Read:   0: N:   1
Frx[/Hz]:66800  Ftx[/Hz]:128000 Csel:1
U[/mV]:23100  I[/mA]: 530  T[Grd.C]:+24     E: 0002  Noise    0



    (R)x_Frequency [/Hz]:       1553000   ( 66750 Hz)

    A(u)to-Tune                      0
    (A)ntenna-Tuning [0..15,+,-]:    4
    switch (T)ransmitter:            1





    (Q)uit Menue
```

Figure 16 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 17 Formula: Calculation of the receiver frequency

As this is a SSB-reception, according to the above mentioned formula the lower sideband should be set to 1553000 Hz and the higher sideband to 1575000 Hz (see chapter 3 on page 10).

NOTE! It is possible to enter values between 0 and 1600000. This is necessary for testing purposes. In practice 1553000 Hz resp. 1575000 Hz have proven to be optimal.

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 checked (as long as there is no transponder within the field) and re-tuned if necessary. For correct operation the antenna has to be re-started after activating this function.

5.2.2.5 C(A)N-Parameters

This menu enables setting the various CAN Bus parameters. In order to be able to use the CAN bus interface it is necessary to activate it by pressing [C].

```
S:0007  D:-007       D_Y:+32767   Code: 0000affe  Read:   7: N:   0
Frx[/Hz]:66760  Ftx[/Hz]:127980
U[/mV]:24000  I[/mA]: 270  T[Grd.C]:+33     E: 0802  Noise    0

SR = 08:        NO ERROR    / TXOK /      /      /

    (!)Antenna-ID: front (01)
    (C)AN active                            YES
    E(X)tended CAN                      STANDARD
    (I)dentifier:    TX  [0..2047]:            0
    (A)-Identifier:  TX  [0..2047]:            0
    (D)-Identifier:  TX  [0..2047]:            0
    (S)-Identifier:  TX  [0..2047]:           10
    CAN-(B)aud [20,50,125,250,500,1000 kB]:  500.0
        B(R)P Baudrate Prescaler [0..63]:      0
        S(J)W Sync Jump Width     [0..3]:      0
        Tseg(1)                  [2..15]:     15
        Tseg(2)                   [1..7]:      2  sp:  80 %
    (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
    (O)rder of Data Transfer (0= HiByte first):  1
    (Q)uit Menue
```

Figure 18 Menu: C(A)N-Parameters

NOTE! The functions [!] and [S] refer to a special function that is not part of the scope of the current documentation.

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 (Table 7 on page 24). The identifier selectable under [A] refers to the Message Object 2 (Table 8 on page 24), [D] refers to the Message Object 3 (Table 9 on page 25). Input of 0 deactivates the corresponding Message Object.

CAN [B]audrate: You can either select a predefined data rate or configure the bit timing with [R]/[S]/[1]/[2]. The resulting baudrate and sample point are displayed immediately.

NOTE! Usually the predefined baud rates should work for most applications. Only change the bit timings if you really know what you do!

[N] switches between a permanent output according to the `Clock for Sampling` [P] with (`1`) and only generating the output whenever a Transponder is decoded within the field (`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 allows to 'freeze' the output for 0 to 20 telegrams, i. e. the values at the time of the positioning pulse output are preserved.

O allows to switch the byte order of multibyte values.

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

5.2.2.6 CANopen®

```
S:0007  D:-007       D_Y:+32767   Code: 00000000   Read:   0: N:    0
Frx[/Hz]:66760  Ftx[/Hz]:127990
U[/mV]:24200  I[/mA]:2550  T[Grd.C]:+28     E: 0000  Noise    0

CAN offline   :                  / int.Status: ffff

    (C)ANopen active                              0
    (N)ode ID:                         [1..127]:     1
    CAN-(B)aud   [20,50,125,250,500,1000 kB]:   125.0

    (1) TPDO 1 mode               [1..240,255]:   255
    (2) TPDO 1 Event time      [0,8..32000 ms]:     8
    (3) TPDO 1 Inhibit time    [0,8..32000 ms]:     0
    (4) TPDO 2 mode               [1..240,255]:   255
    (5) TPDO 2 Event time      [0,8..32000 ms]:     8
    (6) TPDO 2 Inhibit time    [0,8..32000 ms]:     0

    (H)eartbeat time          [0,10..32000 ms]:  1000
    (A)utostart                                   1
    (F)reeze Values for n Telegrams    [0..20]:     0
    (O)rder of Data Transfer (0= HiByte first):     0
    (Q)uit Menue
```

Figure 19 Screenshot: CANopen menu

In addition to the status line described in the previous section, the state of the CAN bus is displayed: `Bus online` changes to `Bus offline` if e.g. the CAN bus is unplugged or because of a lacking terminator. Besides that the `CAN open Node` states `stopped`, `preoperational` or `operational` are displayed.

NOTE! Before being able to use the CANopen interface it must be activated by pressing C. The basic CAN will automatically be disabled.

The following keys have a specific function:

- with N the node address in a range from 1 to 127 can be chosen.
- by pressing B the listed baudrates can be chosen, the function autobaud is not implemented. Deviating baudrates and sample points can be configured via the basic CAN menu (see 5.2.2.5 on page 40).

- by using key [1] the `PDO_1` operational mode can be selected. Choosing a value between 1 and 240 the synchronous, cyclical mode can be picked. By selecting 255 the asynchronous mode is set. The two following modes are only available in the asynchronous mode:
  - [2] is the cycle time of the `PDO_1` transmission. If both values are 0, `PDO_1` will no be transmitted.
  - [3] is the inhibit time of `PDO_1`. In `PDO_1` the system status and the calculated distances are transmitted. The inhibt time is the shortest time period between two periods that can be achieved.
- by pressing [4] the operational mode of PDO_2 is selected. Choosing a value between 1 and 240 the synchronous, cyclical mode can be chosen. By selecting 255 the asynchronous mode is set. The two following modes are only available in the asynchronous mode:
  - [5] is the time of the cycle of the `PDO_2` transmission. If both values are 0, `PDO_2` will no be transmitted.
  - [6] is the inhibit time of `PDO_2`. In `PDO_2` the four analog antenna voltages are transmitted. The inhibt time is the shortest time period between two periods that can be achieved.
- [H] changes the so called `Heartbeat time`. A control message is sent. If the time equals 0 no message is sent and the node guarding is active (see 4.2.3.4.3 on page 27).
- with [A] the autostart is (de)activated.
  - if autostart is deactivated only the `Heartbeat` message (if activated) is sent after turning on the device. The device is in `preoperational` state.
  - if autostart is activated the `Heartbeat` message (if activated) and the `PDOs` are sent immediately after turning on the device. The device is in `operational` state.
- [F] offers the option to ‘freeze‘ the output of the Y deviation for 0 to 20 telegrams, so that e.g. the value at the time of the positioning pulse output is preserved.
- by pressing [O] the order of the bytes within the `PDOs` is changed: by choosing `Lowbyte first = 1` the low order byte of a 16bit word is transmitted first.

5.2.2.7 (D)isplay Systemstatus

Here the status bit is output (see. Table 5 on page 19). All status values that are set are shown. As soon as a value is reset it is immediately removed from the output.

5.2.2.8 Cs(v)

For diagnosis, it is possible to start the output of the values `Code`, U_{Sum}, U_{Dif}, the states `Transponder in field`, `Code OK`, `SEGMENT-`, `Positioning pulse` (also refer to Table 5 on page 19), 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 the [A] key, after which the Antenna is reset to its original condition (not monitor mode) with the saved parameters.

The CSV output could e. g. be saved using the program HyperTerminal® (also refer to section 5.1 on page 29). 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 spreadsheet program (e. g. Microsoft® Excel®, OpenOffice® Calc®, ...).

When opening the file, the spreadsheet 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 spreadsheet file.

5.2.2.9 Display (Y)Histogram

This menu displays the voltages induced by a Transponder into the individual scan coils.

```
Y_Histogram, press any key to return



    > 1400................................
    > 1300................................
    > 1200................................
    > 1100................................
    > 1000................................
    > 900:................................
    > 800:..............o.................
    > 700:............o.OOoooO............
    > 600:..........O.OOOOOOOOo...........
    > 500:........oOOOOOOOOOOOO...........
    > 400:........OOOOOOOOOOOOOO.O........
    > 300:......OoOOOOOOOOOOOOOOOo......
    > 200:Oo...oOOOOOOOOOOOOOOOOOOOO.o....
    > 100:OOo.OOOOOOOOOOOOOOOOOOOOOOOO.Ooo
                 <<<<<<<M>>>>>>>>
   -10      -4       8
    18
```

Figure 20 Menu: display (Y)Histogram

Each column represents one coil. A voltage value is represented by a row of Os. These values were already converted using the correction values.

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.

5.2.2.10 (W)rite Transponder

Transponders can not only be programmed using the corresponding system command (see Table 6 on page 20 / Table 11 on page 25) but also by entering W. Therefore, enter a max. 5 digit code as hex number. Then put a RW transponder in reading distance in the antenna field and run the programming with Enter.

5.2.2.11 (L)oad User parameters to EEProm

This submenu enables saving the parameters within a non-volatile memory once the corresponding password `815` has been entered. This is necessary in order to store changes as permanent settings.

5.2.2.12 (U)pdate Firmware

This item offers the option of a software update without having to disconnect and reconnect the power supply. However, first it is necessary to install the update program as described in section 5.3 on page 45. Then prepare the flash program as follows:

1. Close the COM port connection in HyperTerminal.
2. Open the flash program.
3. Select the COM-Port in the flash program, via which the antenna is currently connected to your PC.
4. Select the hex file to be programmed.
5. Now return to Hyperterm and open the COM port again.

Then press U within the main menu. The password to be entered is the same as listed in section 5.2.2.11. Explanatory text is shown.

- Within the next 20 sec. close the COM-Port in Hyperterm e.g. by using the icon , switch over to the flash program and start the programming.
- Once the programming is completed, return to Hyperterm, wait 10 sec., re-connect the COM-Port (e. g. via the icon ) and then re-start the monitor mode (as explained in section 5.2.1 on page 31).

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

It is possible to store or load all user parameters on or from a host PC 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 into the parameter RAM. To preserve the loaded values you should transfer them into the EEPROM (see 5.2.2.11 on page 44).
- 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.

5.2.2.14 P(r)int Parameters

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

5.3 Software Update (Antenna Software)

It is possible to update the software of the integrated interpreters via the serial interface 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 unit 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!

5.3.1 Installation of the 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 execute the file `ST-Flasher2_setup.exe`.

In order to use the flash program afterwards, start `ST10-Flasher.exe`.

5.3.2 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). Connect the antenna with your PC. Start the update program on your PC as described in section 5.3.1 on page 45.

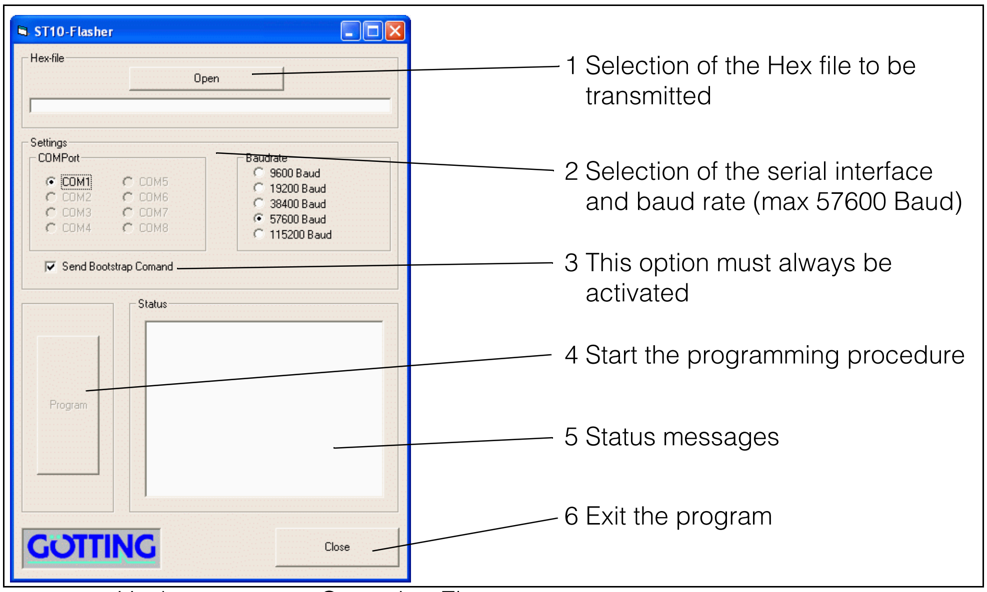
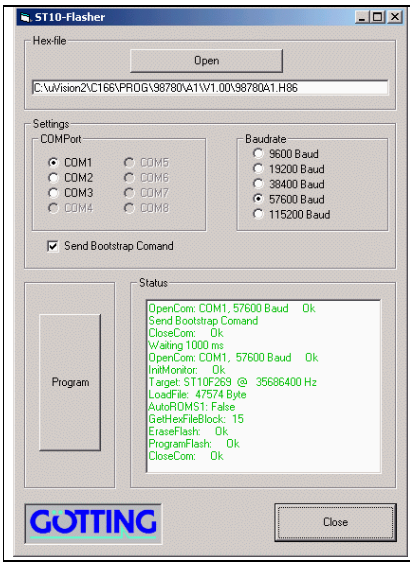


Figure 21 Update program: Operating Elements

Start the programming process by switching the antenna on and then click `Program` within a period of 10 seconds. 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 `Close-Com: Ok`

Figure 22 Update program: programming procedure

Once the programming process is completed, the program can be closed (`close`). The antenna 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 5.2.2.12 on page 44 or 5.3 on page 45). 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 ideally close to the M12 plugs.
No contact is possible, only unintelligible characters are sent.	1. Wrong setting of transfer parameters 2. 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.
Output values are not reproducible, lack of accuracy	Radio interference	Check value for S in the monitor mode. If these are over approx. 50, there could be interferences in the range of 64 kHz.
Transponders are detected unreliably / no reliable positioning pulses	1. Interfering frequencies 2. The corresponding thresholds (refer to Figure 15 on page 37) are not correctly set 3. Tuning not carried out.	1. See one point up 2. Carry out the commissioning as described in section 3 on page 10 3. See one point up
Set values not used after antenna reset	Changed values have not been stored permanently	Save all values as described in sectoin 5.2.2.11 on page 44

Table 21 Trouble shooting

8 Technical Data

Antenna HG G-98820ZA	
Operational safety	According to the German norm BGV B11 Area 1
Casing	see annex G on page 68
Weight	approx. 3.2 kg
Effective antenna area	250 x 110 mm (function range positioning)
Power supply antenna	- 18 to 36 V, approx. 300 mA @ 24 V - 1 A peak while programming transponders
Operating temperature	0 to +50 °C
Mechanical stability	5 g 11 ms / 2 g 10 to 55 Hz
Protection class	IP 65
Metal and interference free area	- no closed loop within 300 mm around the antenna, especially around the cover - no metal surfaces nearer than 50 mm - Current-carrying wires have to be far enough away from the antenna (minimum 150 mm) so that their power and frequencies does not influence the antenna too much, its sum voltage in idle mode has to be below 50 and during driving below 100 (guideline: For very high or very small reading distances those values may be higher/lower. The sum voltage without a transponder in the reading area should always be smaller than half the sum voltage that is generated by a transponder within the reading area). The only exception to this rule is the connection cable of the antenna itself.
Max. pass-over speed	2 m/s
Reading distance (distance transponder - underside reading antenna)	- 20 to 50 mm (with HW DEV00095/HW DEV00098) - 20 to 80 mm (with HG G-71325XA)
Nominal reading distance	30 to 40 mm
Width of the active Antenna reading area	±125 mm
Static positioning accuracy	±5 mm @ a height of 40 mm (with HG G-71325XA, HW DEV00095; also refer to section F on page 66)
Connection	3 M12 connectors
Signal processing time	8 ms
output RS 232	The connection speed is 19200 or 38400 Bd. The telegram content may be configured. 3964R or “transparent“ protocol selectable
Output positioning pulse	20 mA current source, isolated

Table 22 Technical Data Antenna HG G-98820ZA (part 1 of 2)

Antenna HG G-98820ZA	
CAN interface	Not electrical isolated, Terminating resistor (Terminator) not integrated Full CAN
Basic CAN	According to ISO/DIS 11898 Identifier, Data rate, Basic/Extended CAN; configurable via serial interface
CANopen®	CANopen, Device Profil DS 401 Node ID and transmission rate via serial interface or SDOs can be configured

Table 22 Technical Data Antenna HG G-98820ZA (part 2 of 2)

9 Annex

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, baud rate 38400 Bd (default) or 19200 Bd.

A.1 Data direction Antenna -> PLC

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 baud rate and the chosen telegram content.

In the diagram

T_ZVZ stands for the programmable character delay time and

T_QVZ for the programmable acknowledgement delay time.

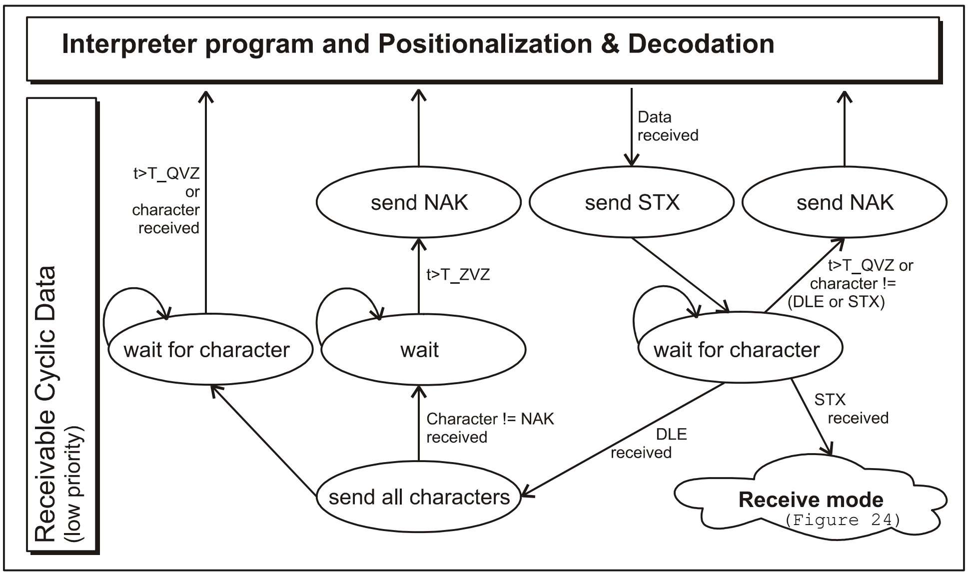


Figure 23 Diagram procedure 3964R; antenna –> PLC

A.2 Data direction PLC -> 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 page 20). In order to be visible between the frequent cyclical data output of the antenna, the 3964R of the antenna has a lower priority (see Figure 23).

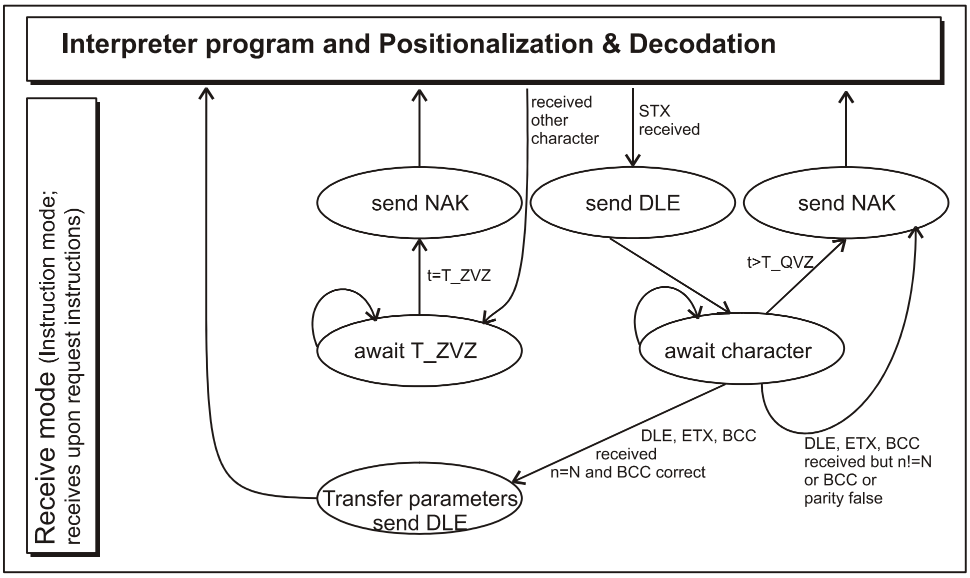


Figure 24 Diagram procedure 3964R; PLC –> antenna

B Procedure „transparent“

For the interconnection antenna <–> PLC 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 38400 Bd (default) or 19200 Bd.

B.1 Data direction antenna -> PLC

In this direction, cyclical antenna data is transmitted. The duration is parameterizeable, it should ideally last an integer part of the transponder code transmission or a plural thereof. The minimum cycle duration depends upon the telegram duration and thus is defined by the baud rate 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 finished with an 8 bit check sum over all characters including the start character. For the check sum XOR is performed over all characters. The characters are sent without delay.

B.2 Data direction PLC -> 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 4.2.3.1.2 on page 20. The telegram is to be finished with a 8 bit check sum over all characters. The characters have be received within the parameterizeable character delaytime. Otherwise the telegram will be rejected.

C Overview of the CANopen® directory

All objects of the antenna are included in the CANopen Object Index. Each entry is indicated by a 16 bit index. Sub-components are indicated by a 8 bits subindex. RO indicates read only entries.

- Communication parameters are indicated by a C in the corresponding tables.
- Manufacture parameters are indicated by a M in the corresponding tables.

The object index is subdivided into the following areas:

C.1 Communication specific Entries within the Range of 0x1000 to 0x1FFF

Index	Subindex	Access	Content	EEProm
0x1000	0	RO	Device Type	
0x1001	0	RO	Error Register	
0x1005	0	RO	COB ID Sync Message	
0x1008	0	RO	Device Name	
0x1009	0	RO	Hardware Version	
0x100A	0	RO	Software Version	
0x1010	0	RO	Number of entries of Store Parameter	
	1	RW	Save all	
0x1011	0	RO	Number of entries of Restore Default Parameter	
	1	RW	Restore Default all	
	2	RW	Restore Default Communication Parameter	
	3	RW	Restore Default Manufacture Parameter	
0x1017	0	RW	Producer Heartbeat Time	C

Table 23 Overview object index I (part 1 of 2)

Index	Subindex	Access	Content	EEProm
0x1018	0	RO	Number of entries of Identity Object	
	1	RO	Vendor ID	
	2	RO	Product Code	
	3	RO	Revision	
	4	RO	Serial Number	
0x1800	0	RO	Number of entries of Transmit PDO_1	
	1	RW*	COB-ID	
	2	RW	Transmission Type	C
	3	RW	Inhibit Time	C
	5	RW	Event Time	C
0x1801	0	RO	Number of entries of Transmit PDO_2	
	1	RW*	COB-ID	
	2	RW	Transmission Type	C
	3	RW	Inhibit Time	C
	5	RW	Event Time	C
0x1A00	0	RO	Number of Objects mapped to Transmit PDO_1	
	1	RO	Specification of Appl. Object 1	
	2	RO	Specification of Appl. Object 2	
	3	RO	Specification of Appl. Object 3	
0x1A01	0	RO	Number of Objects mapped to Transmit PDO_2	
	1	RO	Specification of Appl. Object 1	
	2	RO	Specification of Appl. Object 2	
	3	RO	Specification of Appl. Object 3	
	4	RO	Specification of Appl. Object 4	
	5	RO	Specification of Appl. Object 5	
	6	RO	Specification of Appl. Object 6	
*) Only the highest bit may be altered, in order to (de)activate the PDO temporarily.				

Table 23 Overview object index I (part 2 of 2)

C.2 Manufacturer specific Entries starting at 0x2000

Index	Subindex	Access	Content	EEProm	Refer to
0x2000	0	RO	Number of parameters		
	1	RW	Prog Transponder	M	
	2	RW	Threshold for decoding	M	5.2.2.3 page 37
	3	RW	Threshold for positioning	M	5.2.2.3 page 37
	4	RW	Posipulse time	M	5.2.2.3 page 37
	5	RW	High nibble of RW code	M	5.2.2.3 page 37
	6	RW	Number of equal codes	M	5.2.2.3 page 37
	7	RW	Level to noise error	M	5.2.2.3 page 37
	8	RW	Rx frequency	M	5.2.2.4 page 39
	9	RW	Antenna tuning	M	5.2.2.4 page 39
	a	RW	Freeze values for n telegrams	M	5.2.2.6 page 41
	b	RW	Threshold max detection Y	M	5.2.2.3 page 37
	c	RW	Config	M	Table 41 page 63
0x2001	0	RO	Number of Parameter		
	1	RW	Node Baudrate	C	
	2	RW	Node ID	C	

Table 24 Overview object index II

C.3 Standardized Device Profile higher than 0x6000

0x6000	0	RO	Number of 8 Bit Digital Inputs	Refer to
	1	RO	Number of codes read	Table 20 page 33
0x6100	0	RO	Number of 16 Bit Digital Inputs	
	1	RO	System Status	Table 20 page 33
0x6120	0	RO	Number of 32 Bit Digital Inputs	
	1	RO	Code	Table 20 page 33

Table 25 Overview object index III (part 1 of 2)

0x6400	0	RO	Number of 8 Bit analog Inputs	
	1	RO	Supply voltage	Table 20 page 33
	2	RO	Supply current	Table 20 page 33
	3	RO	Board Temperature	Table 20 page 33
0x6401	0	RO	Number of 16 Bit analog Inputs	
	1	RO	Y deviation	Table 20 page 33
	2	RO	Sum voltage	Table 20 page 33
	3	RO	Dif voltage	Table 20 page 33

Table 25 Overview object index III (part 2 of 2)

D Details of the CANopen® directory

D.1 Device Type

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1000	00	Device Type	Unsigned 32	RO	No	0x00050191	Digital/analog Inputs - DS 401

Table 26 CANopen® Directory: Device Type

D.2 Error Register

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1001	00	Error Register	Unsigned 8	RO	No	0x00	Error Register

Table 27 CANopen® Directory: Error Register

NOTE! The error register is not used, thus the value 0 is transmitted.

D.3 COB-ID SYNC message

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1005	00	COB-ID SYNC	Unsigned 32	RO	No	0x80000080	Sync Consumer, Sync ID = 0x80

Table 28 CANopen® Directory: COB-ID SYNC message

D.4 Device Name

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1008	00	Device Name	Visible string	RO	No	„9882“	Device name: „G98820ZA“

Table 29 CANopen® Directory: Device Name

D.5 Hardware Version

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1009	00	Hardware Version	Visible_String	R0	No	„0ZA2“	Version number

Table 30 CANopen® Directory: Hardware Version

D.6 Software Version

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x100A	00	Software Version	Visible_String	R0	No	„1.00“	Version number

Table 31 CANopen® Directory: Software Version

D.7 Save Parameters

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1010	00	Save Parameter	Unsigned 8	RO	No	0x01	number of sub indexes
	01	Save All	Unsigned 32	RW	No	0x00000001	Save All is possible

Table 32 CANopen® Directory: Save Parameters

By writing the signature ’save’ in ASCII Code (hex-Code: 0x65766173) onto subindex 1, the currently set parameters are permanently saved. A successful recording procedure is acknowledged by a TxSDO (1. Byte = 0x60). The saving process is performed after that acknowledgement.

D.8 Restore Default Parameter

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1011	00	Restore Parameter	Unsigned 8	RO	No	0x03	Number of sub-indexes
	01	Restore All Parameter	Unsigned 32	RW	No	0x00000001	Restore All is possible
	02	Restore Com. Parameter	Unsigned 32	RW	No	0x00000001	Restore Communication is possible
	03	Restore Manufacture Parameter	Unsigned 32	RW	No	0x00000001	Restore Manufacture is possible

Table 33 CANopen® Directory: Restore Default Parameter

By writing the signature 'load' in ASCII Code (hex-Code: 0x64616F6C) onto subindex 1, 2 or 3, the corresponding default parameters are loaded. A reset should be carried out afterwards.

With 'Restore All', the Node ID is also set to 1 and the baud rate to 125 Kbaud.

D.9 Producer Heartbeat Time

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1017	00	Producer Heartbeat Time	Unsigned 16	RW	No	1000	Heartbeat time in ms (approx.)

Table 34 CANopen® Directory: Producer Heartbeat Time

With 0 this function is deactivated.

D.10 Identity Object

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1018	00	Identity Object	Unsigned 8	RO	No	0x04	Number of sub-indexes
	01	Vendor ID	Unsigned 32	RO	No	0x00000202	Manufacturer number given by CiA
	02	Product Code	Unsigned 32	RO	No	0x00098820	HG Number 98820
	03	Revision	Unsigned 32	RO	No	0x00000100	Version 1.00
	04	Serial Number	Unsigned 32	RO	No	9999999	Serial number

Table 35 CANopen® Directory: Identity Object

D.11 Transmit PDO_1 Parameter

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1800	00	TxPDO_1 Parameter	Unsigned 8	RO	No	0x05	Number of sub-indexes
	01	COB ID	Unsigned 32	RW	No	0x40000180 + Node-ID	PDO_1 valid, ID = 0x180 + Node ID
	02	Transmis-sion Type	Unsigned 8	RW	No	255	Asynchronous event-driven
	03	Inhibit Time	Unsigned 16	RW	No	100	shortest time between trans-missions [µs]
	05	Event Time	Unsigned 16	RW	No	10	Cycle time [ms]

Table 36 CANopen® Directory: Transmit PDO_1 Parameter

D.12 Transmit PDO_2 Parameter

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x1801	00	TxPDO_2 Parameter	Unsigned 8	RO	No	0x05	Number of sub-indexes
	01	COB ID	Unsigned 32	RW	No	0x40000181 + Node-ID	PDO_2 valid, ID = 0x181 + Node ID
	02	Transmis-sion Type	Unsigned 8	RW	No	255	Asynchronous event-driven
	03	Inhibit Time	Unsigned 16	RW	No	100	shortest time between trans-missions [µs]
	05	Event Time	Unsigned 16	RW	No	10	Cycle time [ms]

Table 37 CANopen® Directory: Transmit PDO_2 Parameter

D.13 Mapping TPDO_1

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
1A00	00	Number of mapped objects	Unsigned 8	RO	No	0x03	Number of subin-dexes
	01	1st mapped object	Unsigned 32	RO	No	0x61000110	mapped on index 0x6100,01 with 16 bit length (sta-tus)
	02	2nd mapped object	Unsigned 32	RO	No	0x61200120	mapped on index 0x6102,01 with 32 bit length (Code)
	03	3rd mapped object	Unsigned 32	RO	No	0x64010110	mapped on index 0x6401,01 with 16 bit length (Y deviation)

Table 38 CANopen® Directory: Mapping TPDO_1

D.14 Mapping TPDO_2

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
1A01	00	Number of mapped objects	Unsigned 8	RO	No	0x06	Number of subin-dexes
	01	1st mapped object	Unsigned 32	RO	No	0x64010210	mapped on index 0x6401,02 with 16 bit length (SUM voltage)
	02	2nd mapped object	Unsigned 32	RO	No	0x64010310	mapped on index 0x6401,03 with 16 bit length (DIF voltage)
	03	3rd mapped object	Unsigned 32	RO	No	0x60000108	mapped on index 0x6000,01 with 8 bit length (Codes read)
	04	4th mapped object	Unsigned 32	RO	No	0x64000108	mapped on index 0x6400,01 with 8 bit length (Sup-ply voltage)
	05	5th mapped object	Unsigned 32	RO	No	0x64000208	mapped on index 0x6400,02 with 8 bit length (Sup-ply current)
	06	6th mapped object	Unsigned 32	RO	No	0x64000308	mapped on index 0x6400,03 with 8 bit length (Board temperature)

Table 39 CANopen® Directory: Mapping TPDO_2

D.15 Device Parameter

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
2000	00	Number of parameters	Unsigned 8	RO	No	12	Number of subindexes
	01	Prog transponder code	Unsigned 32	RW	No		Write transponder *)
	02	Threshold for decoding	Unsigned 16	RW	No	256	5.2.2.3 page 37
	03	Level for positioning	Unsigned 16	RW	No	256	5.2.2.3 page 37
	04	Poispulse time	Unsigned 16	RW	No	100	5.2.2.3 page 37
	05	High nibble of RW code	Unsigned 8	RW	No	16	5.2.2.3 page 37
	06	Number of equal codes	Unsigned 8	RW	No	1	5.2.2.3 page 37
	07	Level to noise error	Unsigned 16	RW	No	1000	5.2.2.3 page 37
	08	Rx frequency	Unsigned 32	RW	No	1553000	5.2.2.4 page 39
	09	Antenna tuning	Unsigned 8	RW	No		5.2.2.4 page 39
	10	Freeze values	Unsigned 8	RW	No	0	5.2.2.6 page 41
	11	Threshold max detection Y	Unsigned 16	RW	No	400	5.2.2.3 page 37
	12	Config	Unsigned 32	RW	No		Table 41 page 63
*) To program a transponder, position it in the normal reading range and write the 20 bit code to index 0x2000,01.							

Table 40 CANopen® Directory: Device Parameter

D.16 Codes for System Configuration

Value	Name	Description
0x0001	HILOW	Change order of bytes within multi-byte values
0x0002	CODE_SELECT	Select code channel, see 5.2.2.3 on page 37
0x0004		
0x0008		
0x0010	POSI_TIMED	Timed or level driven positioning pulse, see 5.2.2.3 on page 37
0x0020		
0x0040		
0x0080		
0x0100		
0x0200	POSI_MASK	One positioning pulse per crossing, see 5.2.2.3 on page 37
0x0400	AUTO_TUNE	see 5.2.2.4 on page 39
0x0800		
0x1000		
0x2000	POSI_TRNSP	Posi pulse after decoding, see 5.2.2.3 on page 37
0x4000		
0x8000		
0x10000	AUTOSTART	If set the node is starting in operational state see 5.2.2.6 on page 41

Table 41 CANopen® Directory: Codes for System Configuration

D.17 Manufacture Parameter - Node Parameter

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x2001	00	number of parameter	Unsigned 8	RO	No	0x02	number of subindexes
	01	Node Bau-drate	Unsigned 8	RW	No	0x04	125 kbaud according to Table 43 below *)
	02	Node ID	Unsigned 8	RW	No	0x01	Node address 1 *)
*) After changing these values, they have to be saved with <save all> and a node reset has to be proceeded							

Table 42 CANopen® Directory: Manufacture Parameter - Node Parameter

Input / Output Value	Baud rate / kBaud
7	20
6	50
4 (Default)	125
3	250
2	500
0	1000

Table 43 CANopen® Directory: Manufacture Parameter - Node Parameter / Coding of baud rates

D.18 8 Bit Digital Input (transmission in TPDO_2)

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x6000	00	number of 8 bit inputs	Unsigned 8	RO	No	0x01	number of 8 Bit inputs
	01	Codes read	Unsigned 8	RO	Yes	./.	Amount of read codes, see Table 20 on page 33

Table 44 CANopen® Directory: 8 Bit Digital Input (transmission in TPDO_2)

D.19 16 Bit Status (transmission in TPDO_1)

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x6100	00	number of 16 bit inputs	Unsigned 8	RO	No	0x01	number of 16 bit inputs
	01	16 bit digital input	Unsigned 16	RO	Yes	./.	System status / TxP-DO_1 accord. to Table 5 on page 19

Table 45 CANopen® Directory: 16 Bit Status (transmission in TPDO_1)

D.20 32 Bit Transponder Code

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x6120	00	number of 8 bit inputs	Unsigned 8	RO	No	0x01	number of 32 Bit inputs
	01	Transponder code	Unsigned 32	RO	Yes	./.	32 bit transponder code

Table 46 CANopen® Directory: 32 Bit Transponder Code

D.21 8 Bit Analog Inputs

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x6400	00	number of 16 bit analog inputs	Unsigned 8	RO	No	0x03	number of the analog 8 bit inputs
	01	Supply voltage	Unsigned 8	RO	Yes	./.	Voltage [100 mV]
	02	Supply current	Unsigned 8	RO	Yes	./.	Current [10 mA]
	03	Board temperature	Integer 8	RO	Yes	./.	Temperature [^{o} C]

Table 47 CANopen® Directory: 8 Bit Analog Inputs

D.22 16 Bit Analog Inputs

Index	Sub Index	Name	Type	Attr.	Map	Default	Description
0x6401	00	number of 16 bit analog inputs	Unsigned 8	RO	No	0x03	number of the analog 16 bit inputs
	01	Y deviation	Integer 16	RO	Yes	./.	Y deviation [mm]
	02	Sum voltage	Unsigned 16	RO	Yes	./.	Sum voltage [units]
	03	Dif voltage	Integer 16	RO	Yes	./.	Dif voltage [units]

Table 48 CANopen® Directory: 16 Bit Analog Inputs

E EDS Configuration File

Electronic Data Sheet: The so-called EDS-File is available via the internet via the site http://www.goetting-agv.com/components/98820. The file name is `98820ZA.EDS`

F Accuracy of the deviation calculation

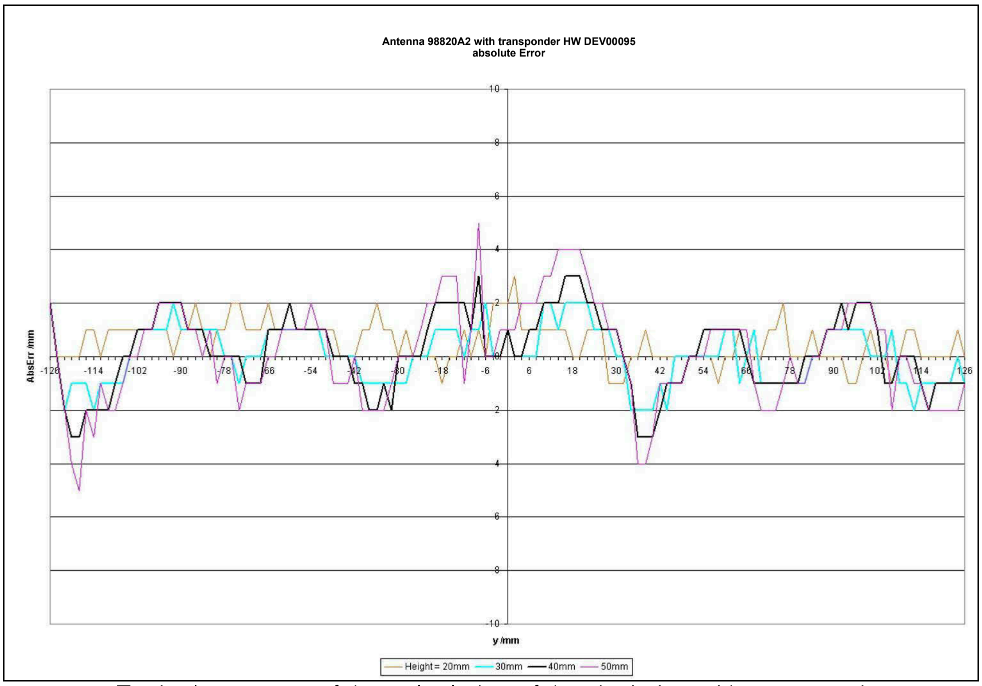


Figure 25 Typical accuracy of the calculation of the deviation with transponder HW DEV00095

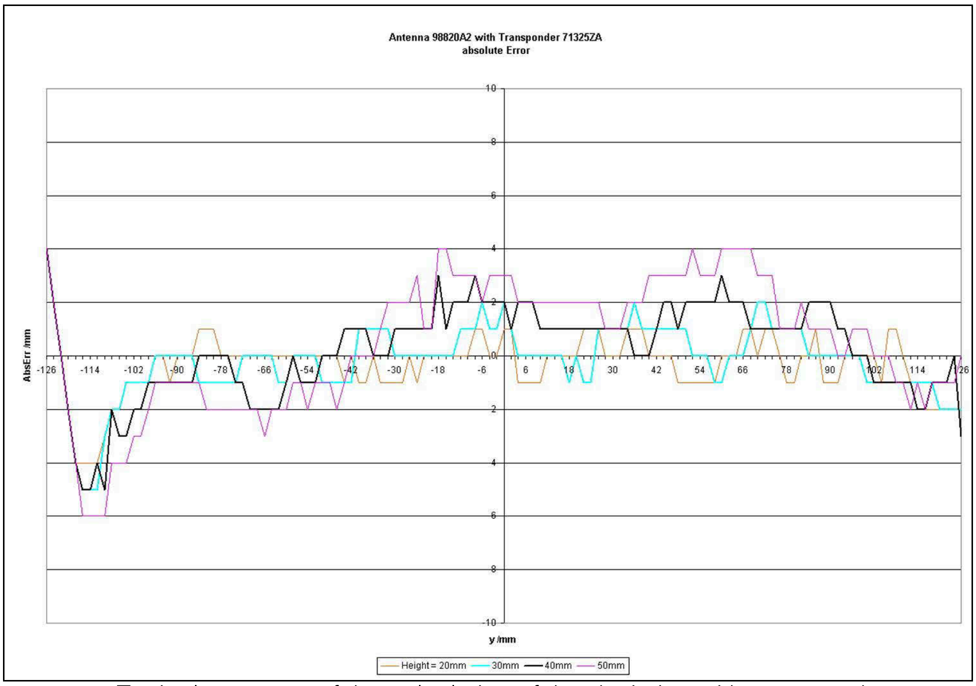


Figure 26 Typical accuracy of the calculation of the deviation with transponder HG G-71325XA

G Mechanical Drawing with Antenna Dimensions

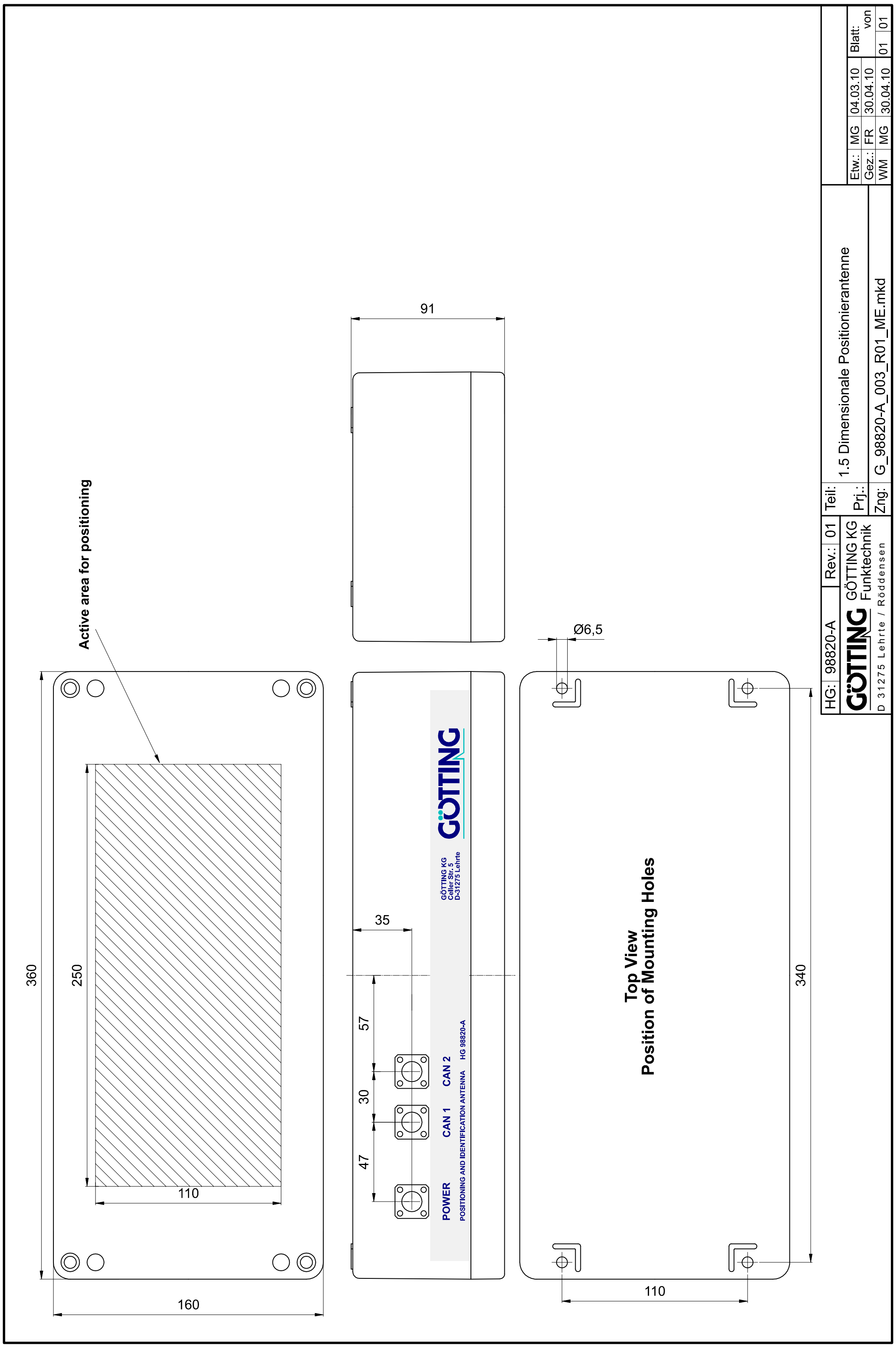


Figure 27 Mechanical Drawing with Antenna Dimensions

10 List of Figures

11 List of Tables

12 Index

13 Handbook Conventions

In documentations of Götting KG the following symbols were used at the time of printing this manual:

- **Safety notes** have the following symbols, depending on the emphasis and the degree of exposure:

WARNING!

CAUTION!

ATTENTION!

NOTE!

- 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 programs, 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 and translator, 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 a certain system revision.
- The online version (PDF) and the printed manual are generated from the same source. Due to the consistent use of Adobe FrameMaker for our documentations, 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.

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