



Laser Scanner

HG 43600ZA

English, Revision 05	Dev. by: L.M.
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1 General Annotations

This is the description of the Götting Laser Scanner HG 43600ZA. The Laser Scanner allows a very variable way of guiding vehicles. Using reflecting marks, vehicles can be guided more or less autonomously depending only on the programming.

With additional sensors for obstacle detection (like ultrasonic or optical systems) it is possible to guide the vehicle around an obstacle on alternative routes. The accuracy of the position is sufficient enough for even meeting the high requirements for taking over loads automatically.

1.1 Intended use

ATTENTION! The Laser Scanner HG 43600ZA may only be applied in industrial areas.



The Laser Scanner HG 43600ZA has exclusively been designed for detecting reflecting marks (source: refer to section 2.4 starting on page 12) in its environment and output the position of the reflection marks for further processing through an interface.

In order to be able to guide and position a vehicle, it is necessary to construct a positioning system, which is able to control a vehicle based on the available positioning data. The Laser Scanner will then be part of this system.

1.2 Safety Information (Laser)

Figure 1 Laser Class 1

The optical output power of the laser is **not dangerous** for the eyes (in general: for human tissue). The optical output power of the laser is limited and eye-safe according to

- EN 60825-1
- VDE 0837 and
- IEC 825-1

The sensor therefore meets the requirements of the 'laser class 1'.

Using **invisible laser radiation** the sensor searches (scans) its environment for reflecting marks. In stand-by (motionless), the laser is turned off and will not be turned on before the sensor has reached a certain minimum speed of rotation.

1.3 Maintenance Instructions

In order to guarantee the undisturbed operation of the Laser Scanner, ensure that the Laser Scanner screen is clean. Only use very soft fabric, e. g. slightly dampened micro-fibre cloth or pre-moistened lens cleaning wipes, to clean the transparent cover. Do not use paper tissues!

LASER CLASS 1

1.4 Special Advice regarding Positioning Accuracy

The accuracy of the position calculation depends on the accurate placement of the reflecting marks (reflectors). As long as a minimum of four marks with a distance of at least 15° between each other and a distance to the sensor of not more than 15 m are recorded, the repeating accuracy of the absolute positioning measurement will be **better than ± 5 mm**. The difference between the absolute and the repeat accuracy results from possible mistakes during the reflector placement.

NOTE!

The measurement of the coordinates and the positioning of the reflectors has to be carried out by experienced and specialised staff. Inaccuracy during this measurement will inevitably lead to inexact determination of the position and in the overall view to an incorrect navigation.



2 Mounting Instructions

2.1 Mounting

Three drill holes M5 are required for mounting the Laser Scanner (e.g. on the outer body of the vehicle).

NOTE! Underneath the whole area of the Laser Scanner, the body of the vehicle needs to be plane and tough in order to level the Laser Scanner after the mounting (also refer to section 2.1.2)!

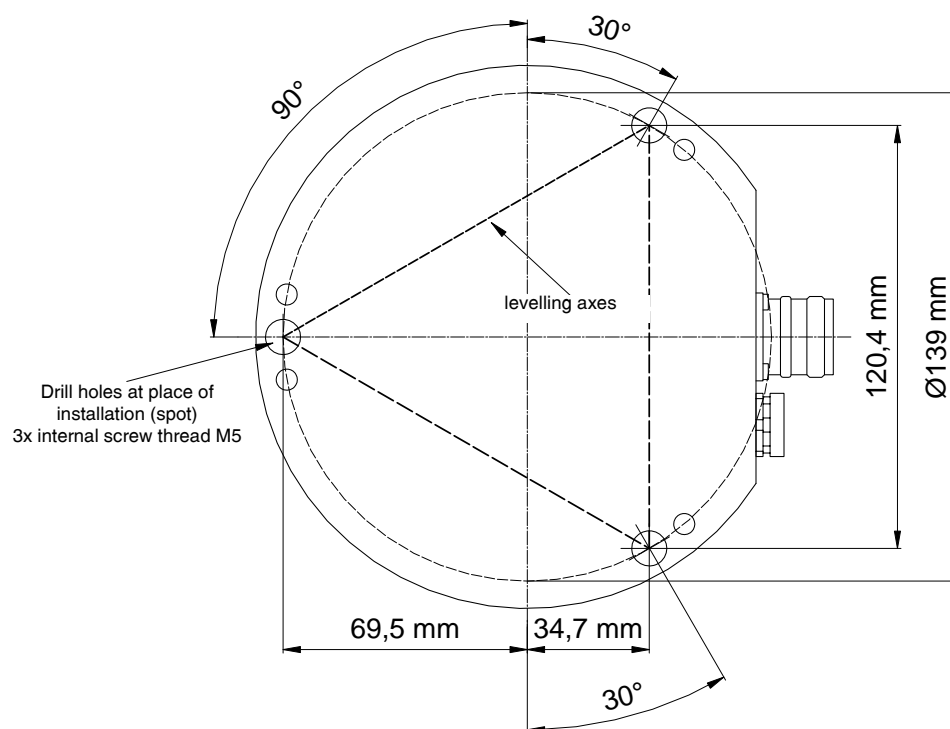


Figure 2 Position of the M5 drill holes for mounting

Mount the Laser Scanner in the drill holes using M5 screws. Refrain from tightening the screws, since there must remain a gap between the Laser Scanner and the place where it is mounted for the Laser Scanner to be levelled later on (also refer to Figure 5 on page 8).

2.1.1 Output Height of the Laser Beam

In order to be able to determine the correct height of the reflecting marks, it is essential to know the exact height at which the laser beam rotates. This height is exactly 113 mm above the bottom line of the Laser Scanner (refer to Figure 3).

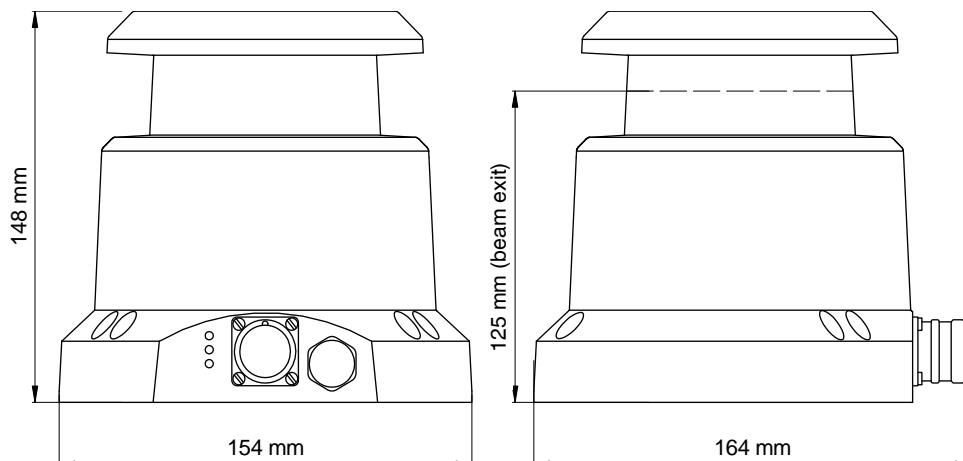


Figure 3 Casing dimensions / Output height of the laser beam

2.1.2 Levelling the Laser Scanner

Following the mounting of the Laser Scanner it needs to be levelled in order to assure that the laser beam rotates on the correct level. For this purpose it is essential that the Laser Scanner is supplied with power and that the interface is read out.

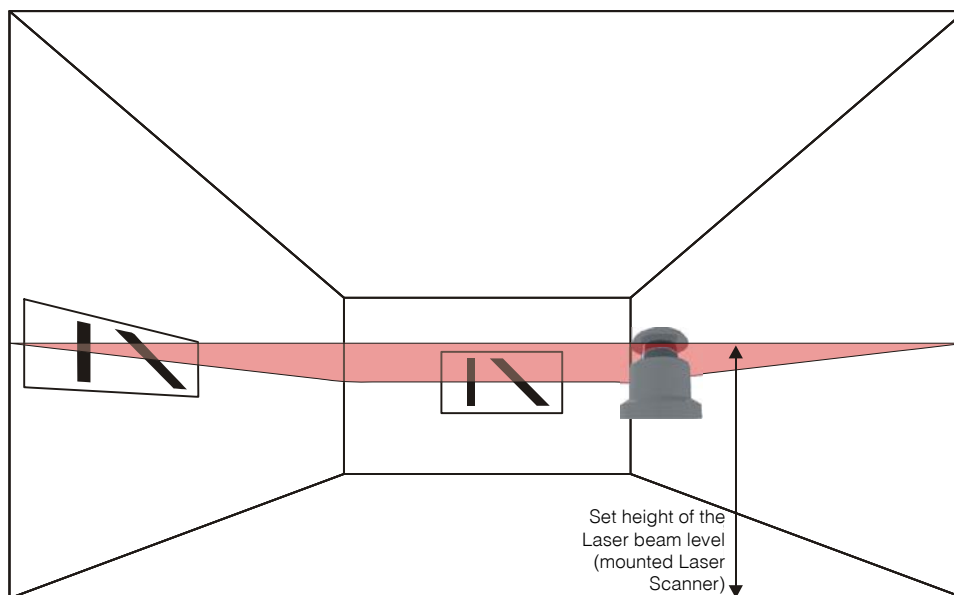


Figure 4 Levelling the laser beam by using two levelling marks

Mounting Instructions

HG 43600ZA

For tightening and levelling the laser scanner casing has four M5 threads and three drill holes for M5 screws.

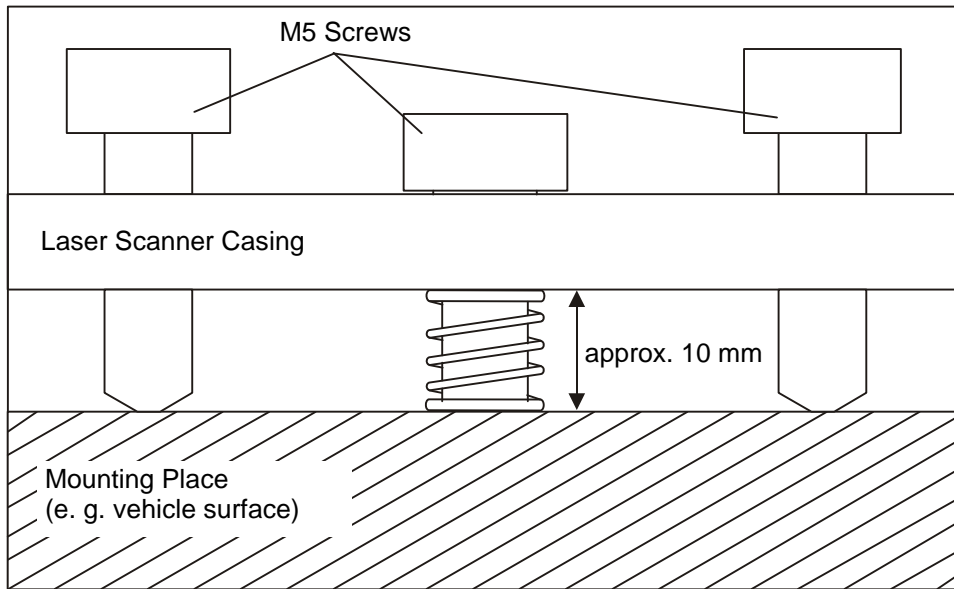


Figure 5 Mounting of the Laser Scanner

Levelling the sensor is done by the three-point adjuster of the casing. The edges of an imaginary triangle of which the M5 screws are the corners form the levelling axes.

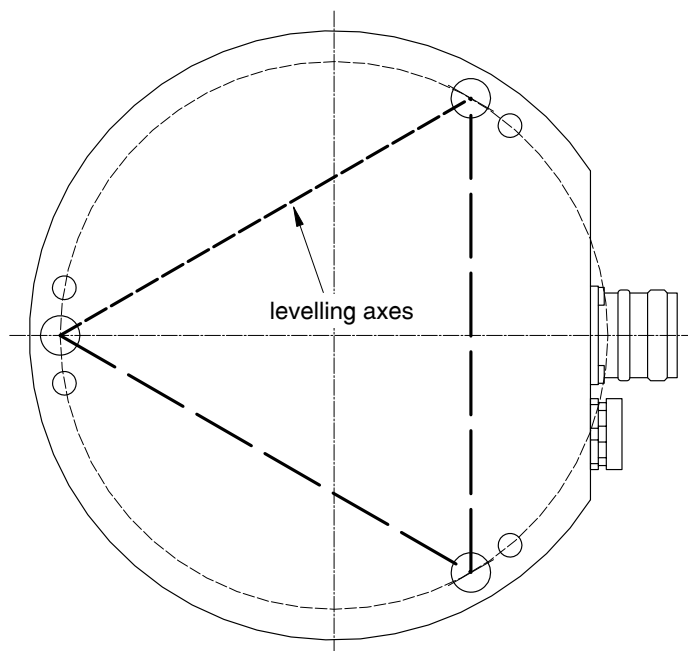


Figure 6 Levelling the Laser Scanner using the M5 screws

If an M5 screw is tightened, the sensor's axis leans towards the direction of this screw (over the levelling axis being located on the opposite side of the screw).

Figure 7 Levelling mark including indication of the set height (for set-up)

To level the Laser Scanner to its set height it is necessary to have two levelling marks. Mounting them is a lot easier if they are provided with according markings of the desired height.

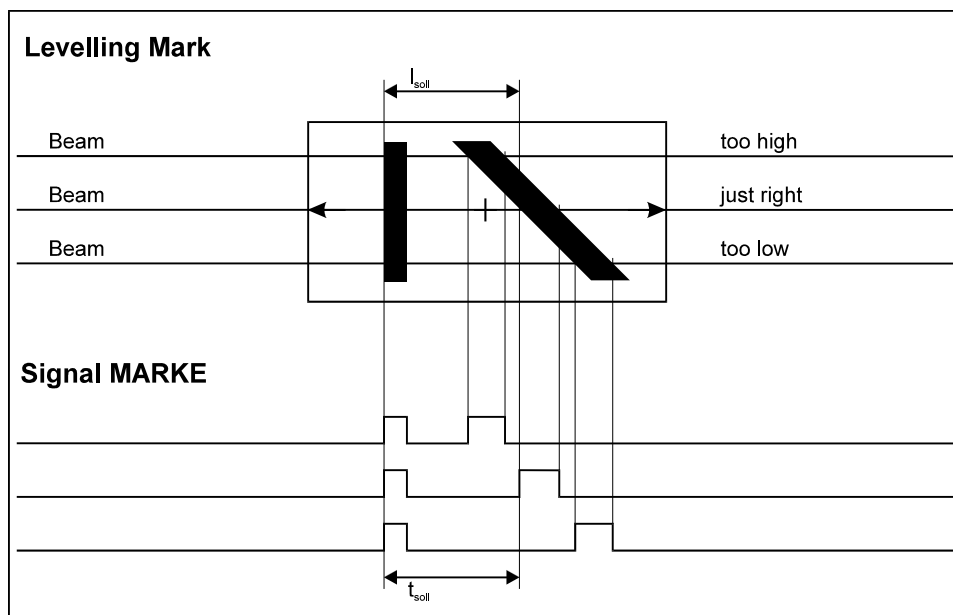
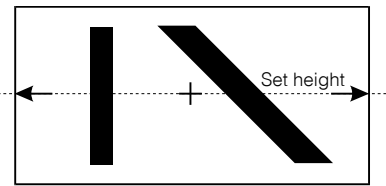


Figure 8 Comparison of three possible levels of the laser beam during levelling (shown is one of the two marks)

While levelling the Laser Scanner to set height, it is possible to determine whether the laser beam is too high (above), too low (underneath) or just right (centre) by the signal of output MARKE.

The value of t_{soll} can be determined in each case using the following formula (this calculation will only lead to the correct result if the laser beam actually hits the levelling mark vertically):

$$t_{soll} = \frac{l_{soll}}{L} \times T$$

- with
- l_{soll} = Set distance on the levelling mark
 - L = Deviation of rotation axis Laser Sensor to levelling mark
 - T = Laser Sensor's period of revolution

2.2 Electrical Interfacing

2.2.1 Pin Assignment of M23-Socket on the Equipment

Subsequent to the following explanations you will find a table with the connector pin assignment.

Explanations

- INDEX Pulse of a duration of 5 μ s, which is emitted once per revolution (also refer to Figure 9 on page 11).

- Track A (steps) Output rotary encoders channel A.

- Track B (steps) Output rotary encoders channel B.
Track B has a phase shift of -90° compared to track A.

- MARKE Output is only set to high level for the period of time in which the laser beam hits a reflecting mark.

- IRQ Each time an INDEX pulse or a slope is set in MARKE a pulse with a duration of 5 μ s is generated in this output.

- Enable Motor This input must have a level of +24 V to enable the laser scanner motor. Otherwise the motor is switched off.

- PC_RxD, PC_TxD Serial RS 232-interface to PC (for service purpose)

Pin	Color	Name	I/O	Description
1				
2				
3				
4				
5				
6	red	+Ub	I	Supply Sensor +24V
7	brown	INDEX	O	Reference Signal for 0°
8				
9	green	MARKE	O	Reflecting Mark Signal
10				
11	white	Track A	O	Track A of rotary encoder
12	grey-pink	PC_RxD		Receiving line Service interface (RS 232)
13	grey	Track B	O	Track B of rotary encoder

Table 1 Pin assignment (part 1 of 2)

Pin	Color	Name	I/O	Description
14	pink	PC_TxD		Transmitting line Service interface (RS 232)
15	violet	IRQ	O	Event message
16				
17	blue	Enable Motor	I	Must be +24 V to enable motor
18				
19	black	GND	I	Supply Sensor Ground

Table 1 Pin assignment (part 2 of 2)

2.2.2 Output Signals Time Diagrams

The most important signals are explained in the following diagram.

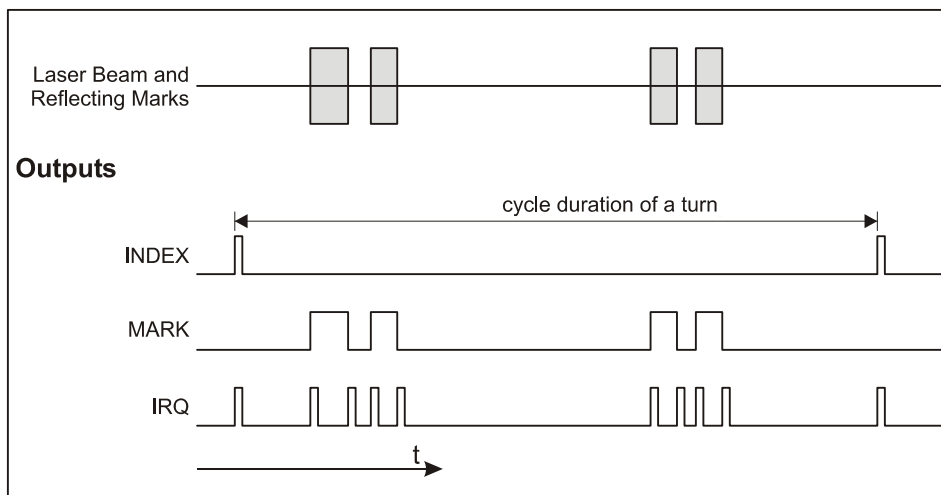


Figure 9 Time diagram 1: Logical levels of the output signals INDEX, MARKE, NULL and IRQ for two groups of reflecting marks during one full turn (over the time)

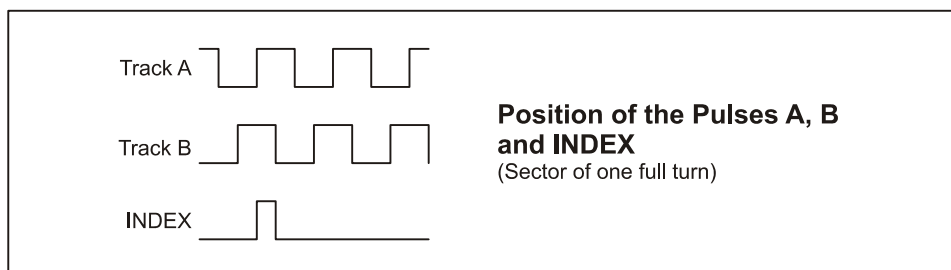
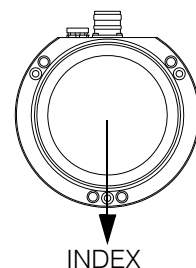


Figure 10 Time diagram 2: Position of the track pulses / position of the INDEX pulse (Sector of one full turn)



2.3 Signification of LEDs on the Equipment

LED-Display	
● Red	Supply voltage applied, device switched- on
● Yellow	- Continuous light: heating switched- on - Flashing: temperature < 10°, motor shut off
● Green	Flashes at each index-pulse rsp. every 200 ms at the latest

Table 2 Signification of LEDs

2.4 Reflecting Marks

In order to use the Laser Scanner according to its intended purpose, reflecting marks are essential. They may be self produced, according to the signals needed. Important is a good contrast between mark and background and highly reflecting beacons.

NOTE! While determining the size of the reflecting marks, please note, that the height of the laser beam may vary depending on the load of the vehicle and on the bumpiness of the ground!



The Laser Scanner has been tested with reflective marks made from the material **FD 1403** by the company Reflexite. This self-adhesive material is available on rolls in different widths:

- ♦ 25 mm x 45,7 m
- ♦ 50 mm x 45,7 m

For further information please refer to the Reflexite homepage at <http://www.reflexite.eu/>.

2.5 Reflecting Tag Codes

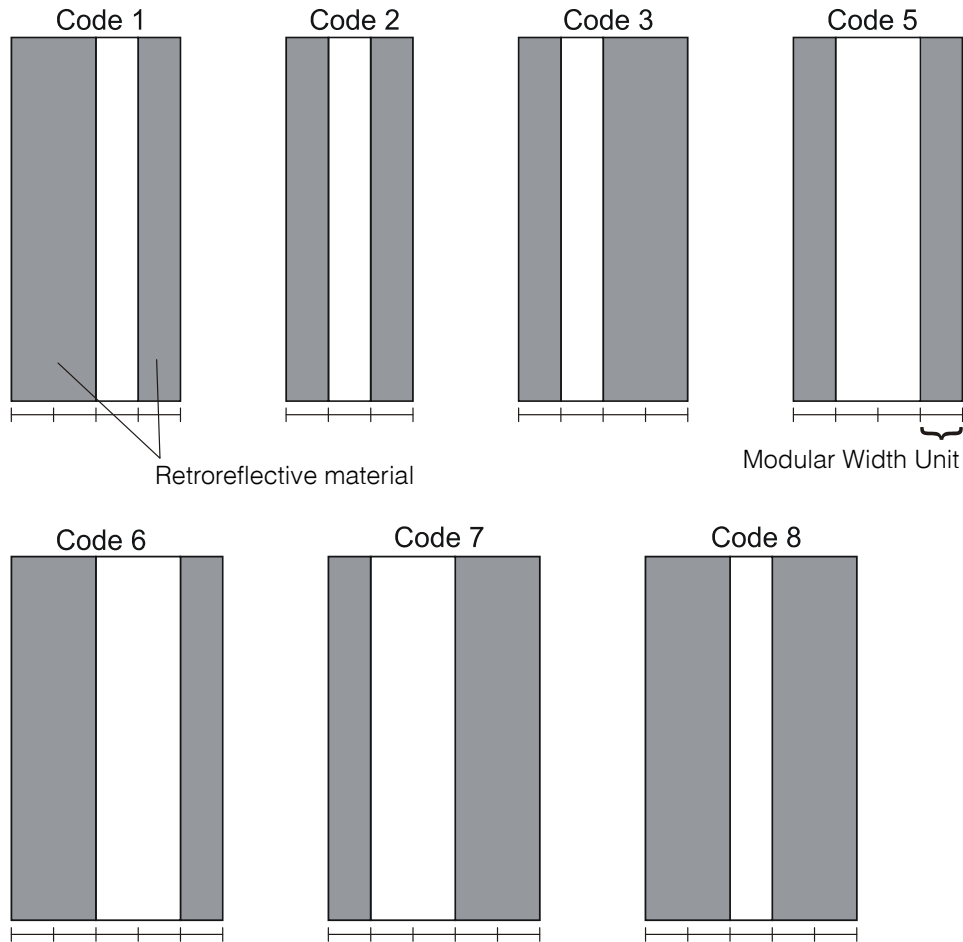


Figure 11 Predefined reflecting tag codes

The total width of the retroreflective surface as well as the width of the gap between retroreflective surfaces may be selected arbitrarily. Only the width - proportion between retroreflective stripes and gaps (the modular width units) on each tag has to be observed.

3 Software

3.1 LST Service programme

This software is for diagnosis and parameterization of the Laser Scanner

System requirements

- ♦ IBM- compatible hardware
- ♦ Microsoft Windows version 95 and higher
- ♦ A free serial RS 232 interface

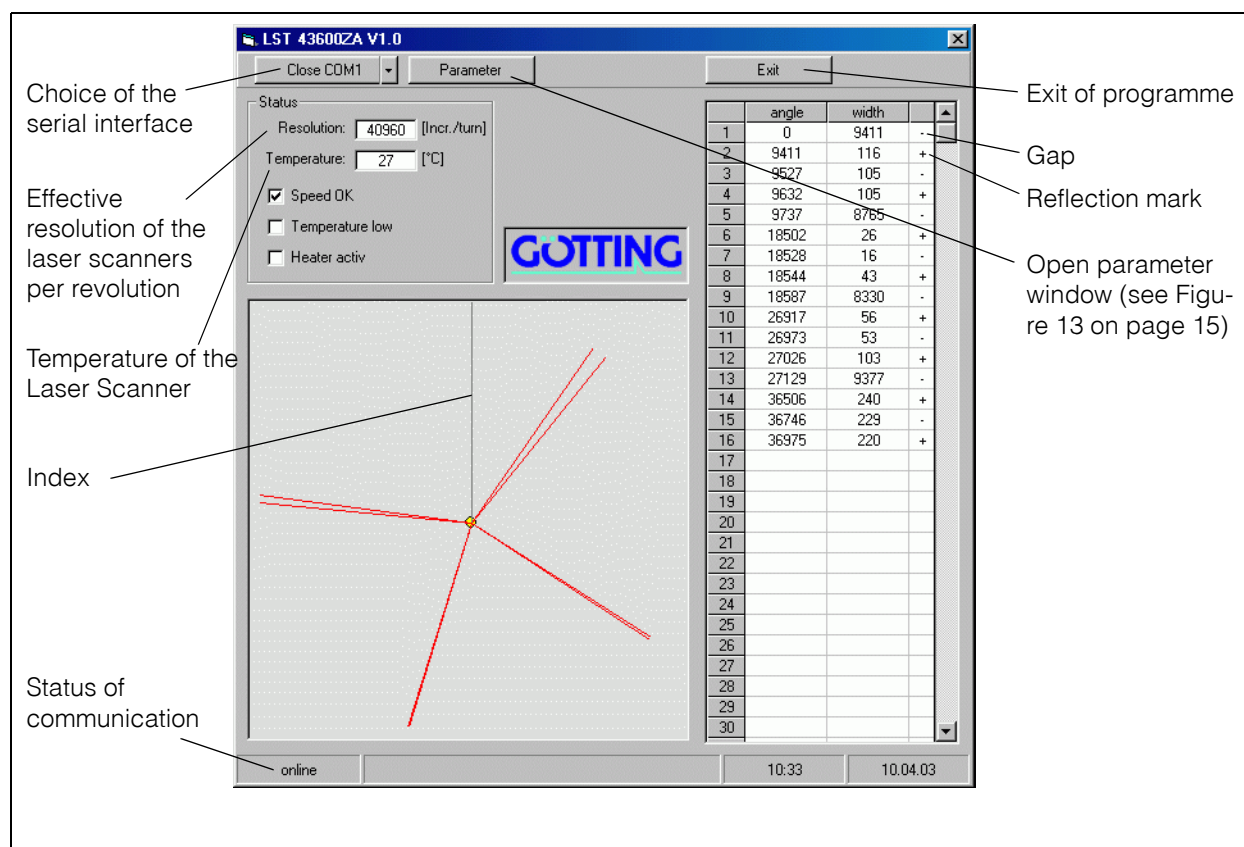


Figure 12 LST Service programme

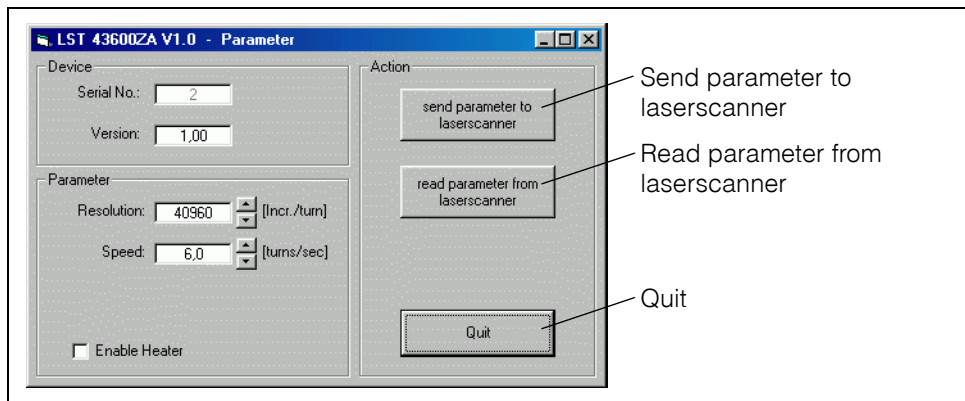


Figure 13 Parameterization of the Laser Scanner

Serial No. Factory- provided by the manufacturer

Version Version of firmware of the Laser Scanner.

Resolution Resolution of the Laser Scanner.
Possible adjustments are: 8192, 16384, 24576, 32768, 40960, 65536 increments /revolution

Speed Rotational speed of the Laser Scanner
Potential values are: 6,0 to 18,0 revolutions / sec.

Enable Heater Release resp. blocking of heating

3.2 Software Update

It is possible to update the software of the Laser Scanner via the serial interface using a portable PC. After activation the integrated download unit will check for approx. 10 seconds whether a download is to be carried out.

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!



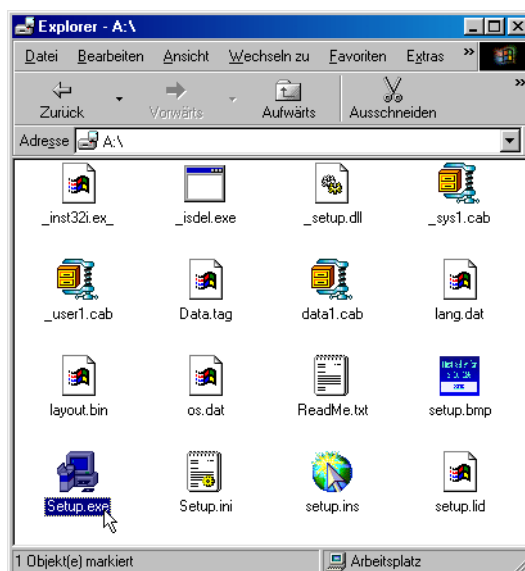
3.2.1 Installation of the Programme for Software Update

The programme for the antenna software update is a 32-bit application for Microsoft® Windows®. Upon request, this programme is available either on disc (described in the following paragraphs) or can be send by email. Please address your requests to the email, phone, fax or mailing address given on the cover of this manual.

Activate the `setup.exe` file on the disc for the installation of the programme, either via the `Ausführen...` procedure of the start menu or via a double click on the file in the Explorer (refer to screen shot on the right).

Figure 14 The `setup.exe` file of the update program on disc

The opening window appears. The buttons `Weiter>` (forward) and `<Zurück` (back) help navigating through the four steps of the installation.

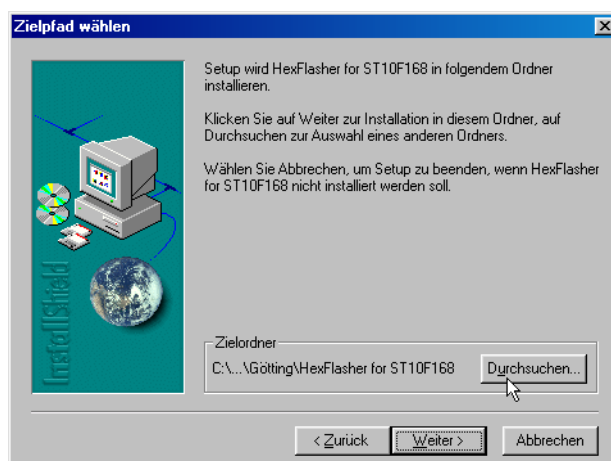


The second step of the installation enables selecting the directory on the harddisc under which the software is to be installed.

Figure 15 Update program: Selecting the directory for the installation

If a directory different from the one given is to be used, click on the button `Durchsuchen...` (search...) and select the corresponding directory from the appearing dialog window.

The next step enables selecting the group of programmes to which this programme icon is to be added (standard: Götting).



Following another click on `Weiter>` (forward>)

the programme will be installed automatically. Once this process is completed a corresponding message will appear on the screen. Now the programme can be carried out.

In case the programme is to be deleted from your computer at a later point of time, switch to the system control level, open the software section and select the HexFlasher software from the appearing window. Then click on `Add/Delete...` and the automatic deinstallation will start. Now all files and programme links will be deleted from the computer. If you want to use the programme again afterwards, it is necessary to re-install it as described above.

3.2.2 Software Update

Connect the Laser Scanner to your PC (concerning connector pin assignment of the laser scanner refer to Table 1 on page 10). Start the update program on your PC (provided that the program has been installed as described in section 3.2.1 on page 16).



Figure 16 Start of the update programme via the main menu

The programme icon with the start link for the HexFlasher is located in the main menu (Start -> Programme) in the subdirectory defined during the installation (standard: götting). Following the startup, the following programme window appears.

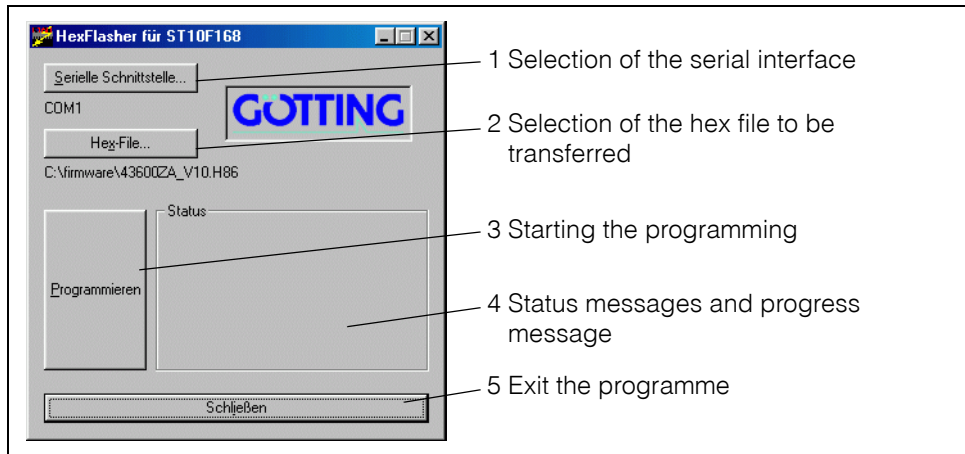


Figure 17 Update programme: Control elements

Following the first startup of the programme, it is necessary to select the serial interface which is used for the connection between the interpreter and the PC (example: COM1).

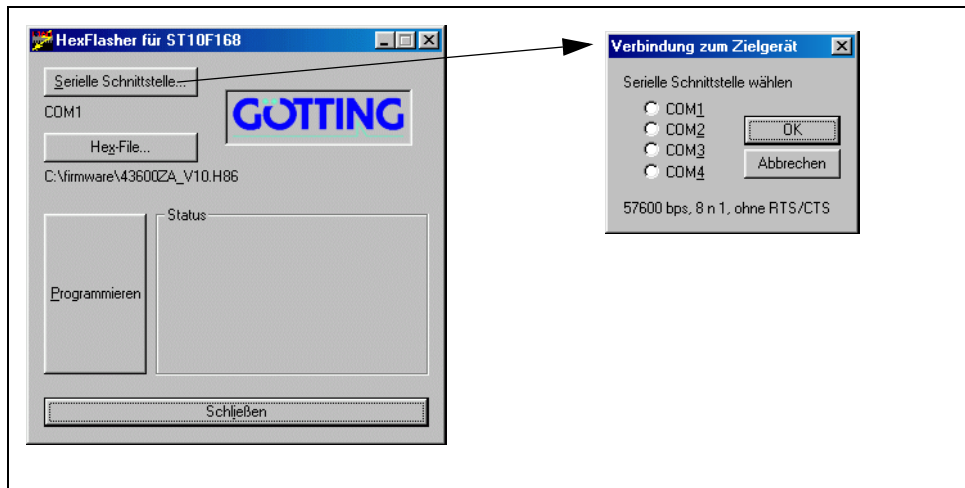


Figure 18 Update programme: Selecting the serial interface

Then select the file that is to be transferred to the interpreter.

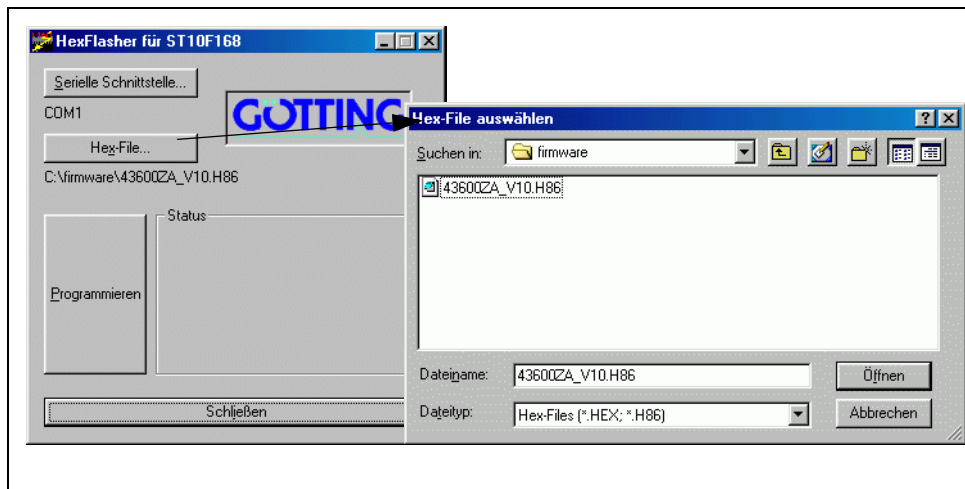


Figure 19 Update programme: Selecting the hex file to be transferred

Then start the programming process: switch on the interpreter and click on *Programmieren* (programming) within the next 10 seconds. This generates a device reset and after a short while the file is being transferred.

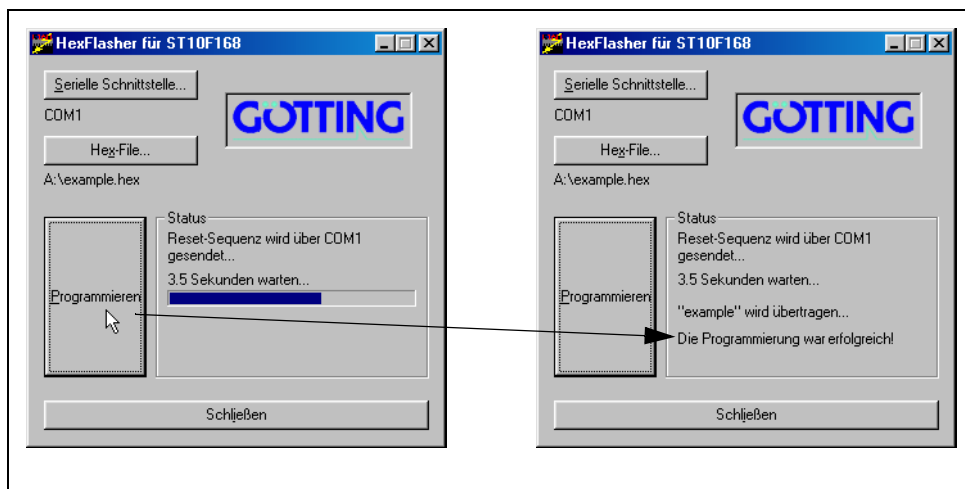


Figure 20 Update programme: Programming

Following the successful programming process, the programme may be exited (*schließen*). From now on the interpreter will use the new programme.

4 Technical Data

Technical Data	
Current Supply Sensor	+18 to +30 VDC Current consumption: - typ. 240 mA at 24 Volt and 6 revolutions / sec. - typ. 550 mA at 24 Volt and 18 revolutions /sec.
Current Supply Heating	+18 to +30 VDC Current consumption: typ. 1,2 A at 24 Volt
Outputs: INDEX, MARKE, track A, track B, IRQ	Output voltage: + 24 Volt Output current: max. 50 mA per output
Service interface	RS 232
Environmental conditions	Temperature: - +10 to +50° C without heating - -25 to +50° C with heating max. 80 % air humidity, not condensing
Type of protection	IP 67
Laser power	1 mW, not dangerous for the eyes, Laser class 1 (at a distance of less than 300 mm to the laser scanner laser class 1M will be ap- plied), automatical switch-off at standstill
Read area	1 to 30 meters
Reading rate	6 to 18 measurements per second (programmable)
Intercept range	360°
Angular resolution	8192, 16384, 24576, 32768, 40960 or 65536 in- crements per revolution (programmable)
Ambient light	< 10000 Lux
Dimensions	- Ø 153 mm - height 150 mm
Weight	2.3 kg

Table 3 Technical Data of the Laser Scanner

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8 Handbook Specifications

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

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

NOTE!



ATTENTION!



WARNING!



- ♦ Further information or advices are indicated as follows:

TIP!



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



9 Copyright and Exclusion of Liability

9.1 Copyright

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

9.2 Exclusion of Liability

Any information given is to be understood as a 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.