PROFI ®
PROCESS FIELD BUS
BUS

SSI

LE-200

User Manual

Laser Measuring Device LE-200 with PROFIBUS-DP and SSI - interface

- Safety notes
- Assembly
- Installation / Commissioning
- Parameter setting
- Trouble elimination and diagnostic possibilities

- Software/Support CD: 490-01001
    - Soft-No.: 490-00406

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Revision index

i *Note*

The current revision number and date appears on the front cover of this document. Since the footer of each individual page contains its own revision number and date, the revision status may vary within the same document.

The pin assignment, included in the appendix, has its own revision index.

Document issued: 12.09.2002

Revision	Date
• General completions for the usability of the device • Function expansion of the module "Preset" (new: Function ext. input) and "Control bits with acknowledgement"	21.10.2002
• Correction: Bit 0 = Intensity error, Bit 1 = Device temperature	30.10.2002
Completion of the module "Error Display": • Bit 4 = Intensity warning	13.12.2002
• Additional notes in the technical data for linearized devices • Ordering informations	29.01.2003
• New GSD file TR040458.GSD - Free resolution in module Position - SSI-Output value in module SSI interface	13.02.2003
• New GSD file TR050458.GSD - Laser-Diode-Operating hours counter	27.03.2003
• New GSD file TR060458.GSD, 08.07.2003 - Function ext. Input: Failure quit • Module Error Display: Implementation of the Speed-check • General technical- and layout modifications	25.09.2003
• Revision of the warning label in chapter "Intended purpose"	18.12.2003
New functions in the module "Error Display": • Warning Bit "Fail Plausibility Measured Value"	01.12.2004

New GSD file: "TR070458.GSE"
 	
• New module: "Switching position"
 	
• Module "Function external input" renamed in "Function external IO pins"
  - Now the functions of the external output are also programmable over the PROFIBUS
   (before only via TRWinProg)
 	
• Module "SSI interface"
  - Number of SSI bits = 12 – 26
   (before: 24 – 26)
		26.02.2005

• Text correction in „Module Control Bits With Acknowledgement": Clear Preset • Completion of the ordering information's		23.01.2006
• Correction in „Module Speed": Default output format = 10mm / sec		08.01.2007
• Introduction of the Software/Support CD: 490-01001 • Additional reflector foils, chap. Ordering information		28.02.2007
• Max. measuring range 240 m		18.12.2007
New GSD file: "TR080458.GSE" • Correction of the byte sequence for Preset HI/LO word		25.03.2008

Table of Contents

1 Safety

1.1 General risk potential

The Laser Measuring Device LE-200 Profibus-DP cannot be operated independently, but is installed as part of an overall system usually consisting of several interacting components. For this reason, the laser measuring device is not equipped directly with a protective device.

Warning
The corresponding measures must be taken in order to avoid person and property damages!

However, different error reports can be read out via an error message, see 6.4 page 28. It is therefore essential to integrate the module "Error-Display" into your **own safety system** via the evaluation software (e.g. a PLC).

All persons responsible for the assembly, start-up and operation of the device must

- be suitably qualified
- adhere strictly to this operating manual.

Your safety and the safety of your equipment depends on this!

1.2 Safety information

This operating manual contains information which must be observed in the interests of your own personal safety and that of your equipment. The safety hints are emphasized by a warning triangle and classified according to the degree of danger as follows:

Warning
means that failure to take the relevant safety precautions can lead to serious damage to property or injuries.

i ### *Note*
refers to important information and features of the product, plus tips on its application.

1.2.1 Hints on installation

Since the Laser Measuring Device is normally used as part of a larger system, these hints are merely intended as a guide for integrating the device safely into its environment.

⚠️ *Warning*

- During the operation of the Laser Measuring Device it isn't allowed to interrupt the laser beam. If it comes nevertheless to an interruption, at the restart of the automatic operation mode first the validity (plausibility) of the measured value has to be checked.

- Precautionary measures must be taken to allow an interrupted program to be properly resumed following a voltage drop or failure. Dangerous operating conditions must not be permitted to arise even for short periods. If necessary, an *"EMERGENCY STOP"* must be forced.

- EMERGENCY STOP devices according to EN 60204/IEC 204 (VDE 0113) must remain operational in all operating modes of the programmable controller. The release of the EMERGENCY STOP devices must not trigger an uncontrolled or undefined reactivation of the equipment.

- The safety and accident prevention regulations applicable to the specific application must be observed.

- In the case of permanently installed plants or systems without an all-pole mains switch and/or fuses, one of these devices must be installed accordingly and the equipment connected to a PE conductor.

- In the case of 24 V supplies, make sure the extra-low voltage is reliably disconnected. Only use power supply units manufactured to the standards IEC 364 - 4 - 41 / HD 384.04.41 (VDE 0100 Part 410).

- Fluctuations or deviations of the supply voltage from the nominal value must not exceed the tolerance limits stated in the specifications, otherwise operational failures and dangerous states in the electrical assemblies cannot be ruled out.

- Connecting and signal wires must be installed in such a way as to prevent the automation functions from being hampered by inductive and capacitive interference.

- The units of the automation system and their operating elements must be installed in such a way as to ensure adequate protection against accidental actuation.

- In order to prevent a wire or strand breakage on the signal side from causing undefined states in the programmable controller, suitable hardware and software safety precautions must be taken with regard to the I/O interface.

1.2.1.1 General interference suppression measures

- Lay the (shielded) connecting cable to the device at a sufficient distance or in a separate room from any power cables which are subject to interference. Otherwise the data transmission of the measured value can be interfered.

- To ensure reliable data transmission, use fully shielded cables and make sure they are well earthed. For differential data transfer (SSI, Profibus), twisted-pair wires must be used in addition. For the Profibus absolutely the installation requirements (bus cable, line length, shielding etc.) specified in the EN 50170 standard are to be considered.

- Use a minimum cable cross-section of 0.22 mm^2 for data transfer purposes.

- Use a minimum earthing cable (machine base) cross-section of 10 mm^2 in order to avoid equipotential currents across the shield. Make sure the resistance of the earthing cable is much lower than that of the shield.

- Avoid crossing cables where possible. If unavoidable, only cross them at right-angles.

- Ensure continuous wiring of the shield and a large contact area on special shield clampings or cable screw glands, see Figure 1 point [A] and [B].
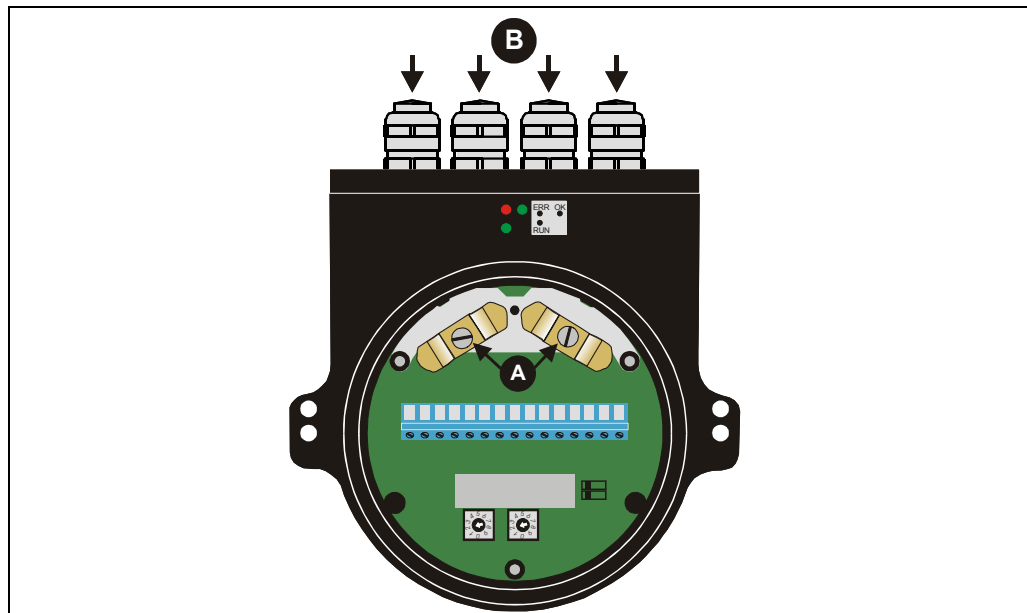
Figure 1: Connection cap with cable screw glands and shield clampings

Shield connection via cable screw glands:

1. Screw the cable screw gland into the housing. 2. Dismount the compression nut (1) and the terminal holder (2). 3. Push the compression nut (1) and the terminal holder (2) over the cable. 4. Strip the cable; push back the braiding around the terminal holder (2) such that the braiding goes over the inner O-ring (3) and does not lie over the cylindrical section or the torsional bars. 5. Insert the terminal holder (2) into the intermediate gland (4) such that the torsional bars fit into the intended lengthwise grooves in the intermediate gland (4). 6. Screw the compression nut (1) to the intermediate gland (4).	 **Element 1** Compression nut **Element 2** Terminal holder **Element 3** inner O-ring **Element 4** Intermediate gland
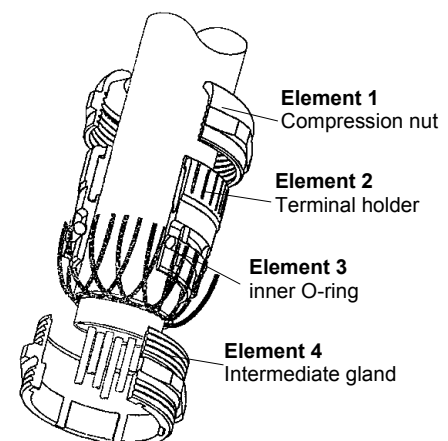
1.3 Intended purpose

The measuring system is used for recording linear movements and processing the measured data for a downstream control system with a PROFIBUS-DP- or SSI-interface.

Particularly the measuring system is designed for the use of distance measurements for the detection of the position and positioning of:

- High-bay storage devices and lifting gears
- Crane systems
- Side-tracking skates and truck storage vehicles
- Transfer machines

Warning
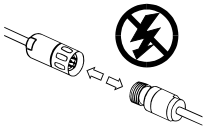
Switch off the voltage supply before carrying out wiring work or opening and closing electrical connections!
Short-circuits, voltage peaks, etc. can cause operating failures and uncontrolled operating states, as well as serious personal injuries and damage to property.

Check all electrical connections before switching on the system!
Incorrectly wired connections can cause operating failures, while wrong connections can lead to serious personal injuries and damage to property.
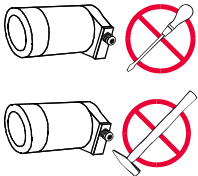
Mechanical or electrical modifications to the measuring systems *are prohibited for safety reasons!*

In particular the following uses are forbidden
- operation in areas where interruption of the laser beam, e.g. by covering the laser lens opening, can lead to equipment damage or injury to personnel
- in environments, in which strong rain, snow, fog, steams or direct insolations etc. can influence the laser beam intensity negatively
- operation in rooms with explosive atmospheres
- operation for medical purposes

With use-purposes larger 125m measuring length, a special reflector must to be used! (see chapter "Accessories", page 46)

⚠ *Warning*

Laser Light
Do not stare into the beam
Laser Class 2
P max = 1 mW, λ = 670 nm
DIN EN 60825-1: 2003-10
Complies with 21 CFR 1040.10 and
1040.11 except for deviations pursuant
to laser notice No. 50, July 2001

- In the case of Class 2 laser devices, the eye is not endangered if the exposure of the laser radiation is very short (up to 0.25 s) and accidental. For this reason, devices of this class can be used without additional protective measures, provided for the application it is not necessary to look into the laser beam deliberately for longer periods, i.e. 0.25 s, or to look repeatedly into the laser beam itself or the specular reflected beam.

  > *The existence of the blinking reflex for the protection of the eyes may not be assumed. Therefore the eyes should be closed consciously, or the head should be turned away immediately!*

- The device must be installed in such a way that the exposure of persons to the laser beam can only happen accidentally.

- The laser beam may only extend as far as is necessary for the range measurement. The beam must be limited at the end of the useful range by a diffusely reflecting target area in such a way as to minimize the danger from direct or diffuse reflection. For this purpose, you should use the TR-Electronic reflecting foil supplied with the device.

- The area outside the operating range where the unshielded laser beam falls should be limited as far as possible and should remain out of bounds, particularly in the area above and below eye level.

- Observe the legal and local regulations applicable to the operation of laser units.

i *Note*
The start-up, operating and programming instructions contained in this manual are mandatory.

1.4 Authorized operators

The start-up and operation of this device may only be performed by qualified personnel. For the purposes of this manual, the term "qualified personnel" refers to persons who are authorized to operate, earth and label equipment, systems and power circuits according to recognized safety standards.

1.5 Safety measures at the installation site

⚠ *Warning*

Do not perform any welding work once the device is connected and switched on!
Variations in potential can destroy the device or restrict its operation.

Do not touch plug contacts with your hands!
Static charges may destroy electronic components of the device.

Do not connect unused inputs (see pin assignment)!

Observe the voltage supply range:
Standard device: 18-27 V DC ($\pm$ 5 %)
Device with heating: 24 V DC ($\pm$ 5 %)

Clean lens opening of the laser and the reflecting foil regularly!
(see chapter "Maintenance", page 43)

i *Note*
Make sure that the environment of the installation site is protected against corrosive media (acids, etc.)

2 General Description

The laser measuring devices of the series LE are optical sensors, with which larger distances can be measured without contact and serviceable for controller. The measuring system consists of the real measuring device with laser light source, receiving optics, electronic evaluation and data interface as well as a reflector. The device sends out a modulated light beam which is reflected by the reflector. From the phase difference of the sent and received light beam the distance is measured 1000 times per second. Thus the LE is suitable also directly for the position feedback in controller loops.

According to the requirements the laser distance measuring devices of the series LE-200 Profibus-DP are configured either directly over the Profibus-DP or with the PC-programming software "TRWinProg".

Principle

Receiver signal
Transmitter signal
φ
Reflecting foil

φ = Phase displacement
d = Distance
d = f(φ)

Measuring start
Measuring range
Measuring end
0,2m
125m
Display range max. 240m (Special Device)
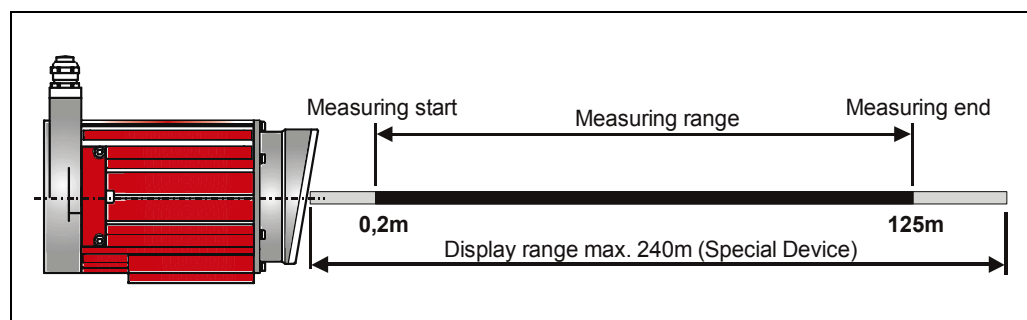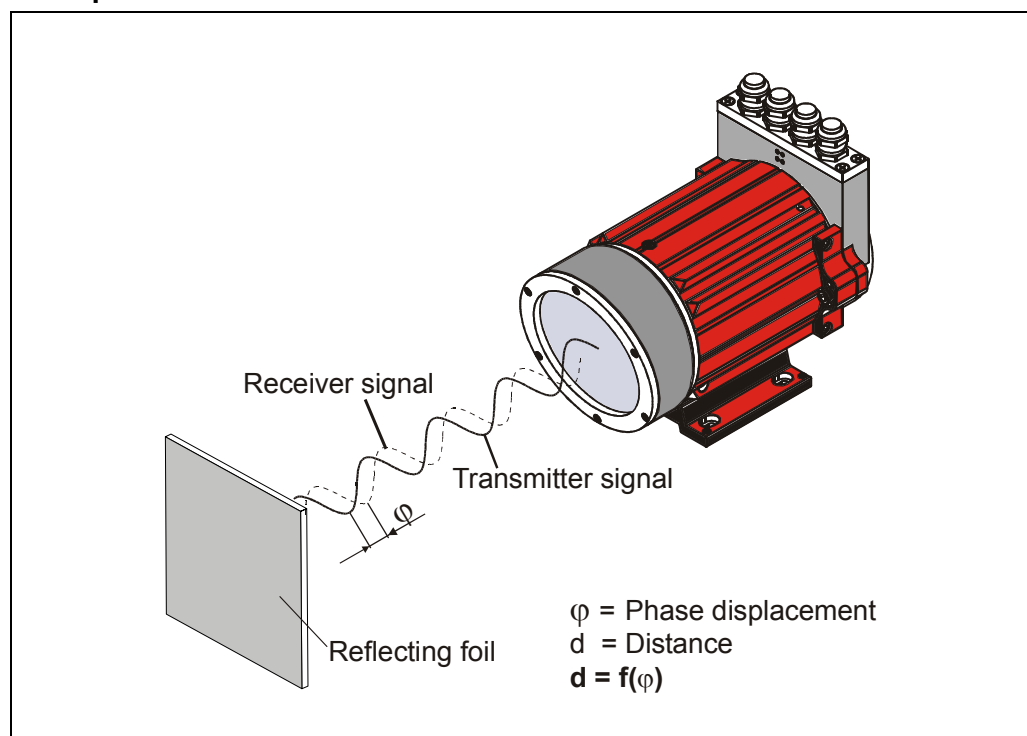
3 Transportation / Storage

Transport instructions

Do not drop the device or expose it to shocks or vibrations!
Device contains an optical system with glass elements.

Only use the original packaging!
The wrong packaging material can cause damage to the device during transportation.

Storage

Storage temperature : -20 to +75°C

Store in dry conditions.

4 Assembly instructions

The adjustment of the laser measuring device in the vertical plain is carried out via four studs **(A)** in the mounting plate. The adjustment in the horizontal plane can be made by four hexagon bolts **(B)**. It has to be taken into account that the screw diameter is approx. 1-2 mm smaller than the through bore of the mounting plate. Exact dimensional properties are on the dimensional drawing in the rear part of the document.
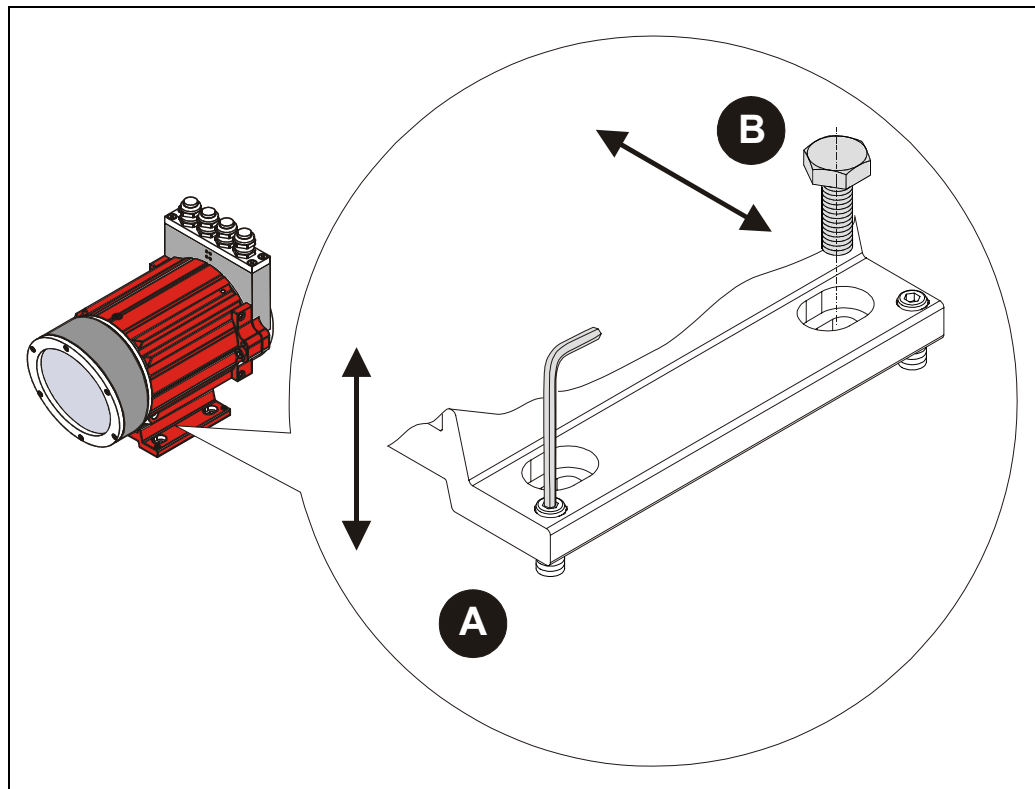
Figure 2: Mechanical adjustment possibilities

4.1 Aligning of the laser light spot to the reflector / foil inclination

The measuring device or reflector is attached to the moving object and the reflector/sensor to the fixed remote station in such a way that the reflector always remains within the visual field of the sensor. This can be done using the light spot of the laser diode, which is still clearly visible on the reflecting foil even at long distance. When aligning the laser measuring device, the user may need to take measures to ensure that it can be mechanically adjusted.
The size of the reflecting foil must be such that the light spot cannot be displaced from the reflector by vibrations. Since with an increasing distance the light spot gets larger and larger, the edge areas of the foil also have to be avoided.
The device comes with a reflecting foil measuring 20 x 20 [cm], but other sizes can be ordered on request.

i *Note*
Reflecting foils by other manufacturers should not be used under any circumstances, as all the information in the "Specifications" chapter refers to the foil already supplied with the device.

Procedure:

- **Figure 3: Detection of the surface reflectivity:**

  - At first attaching the reflector foil flatly and drive plant on minimal distance Laser – Foil.

  - Centering paper (C) in front of the laser optics so, that the laser beam can unhinderedly emerge by an approx. 2 cm hole. Now, the interfering signal (B) should get visible on the paper (C). To the better location of the interfering signal (B) the reflector foil can be moved also a little. Here it is valid: angle of incidence = angle of reflection

- **Figure 4: Transmitting away the surface reflectivity:**

  - Rotate the reflector foil in the Y- or in the Z-axis so, that the interference signal (B) always is outside the laser lens. Nevertheless keeping the inclination of the reflector foil as low as possible to minimize measuring errors caused by misalignments in the procedure movement. For example, if the light spot drifts on the reflector foil around, small differences arise as a result of the oblique position.

  - Fix reflector foil
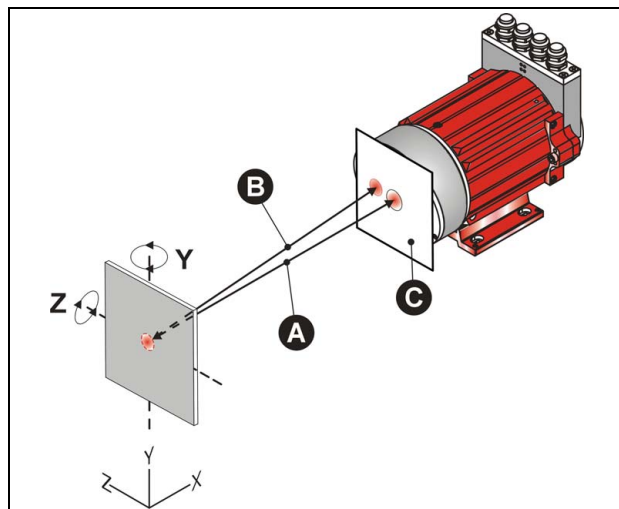
(A)
real wanted signal, is always thrown back 180° independently of the reflector inclination

Figure 3: Detection of the surface reflectivity

(B)
Surface reflectivity (interference signal)

(C)
Paper with an approx. 2 cm large hole in the center
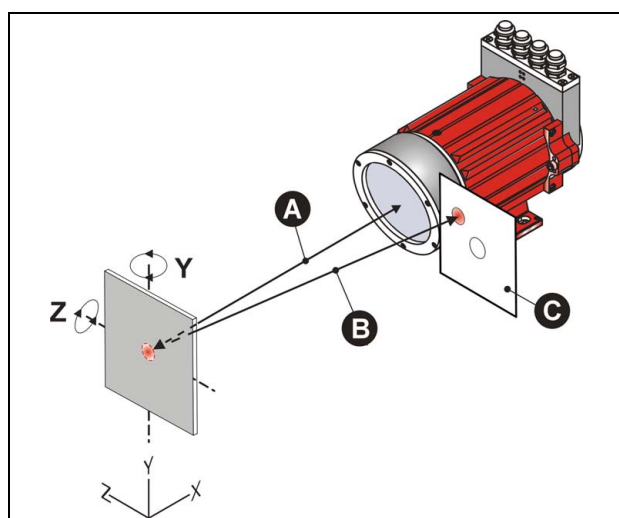
Figure 4: Transmitting away the surface reflectivity

4.2 Parallel operation of laser linear paths

It has to be taken care in the parallel operation of laser linear paths that a minimum distance of 1 m is kept. The reflector foil inclination must be made in such a way that the surface reflectivity (see arrows) points not into the other laser linear path.
The alignment is carried out as described in chapter 4 / 4.1.
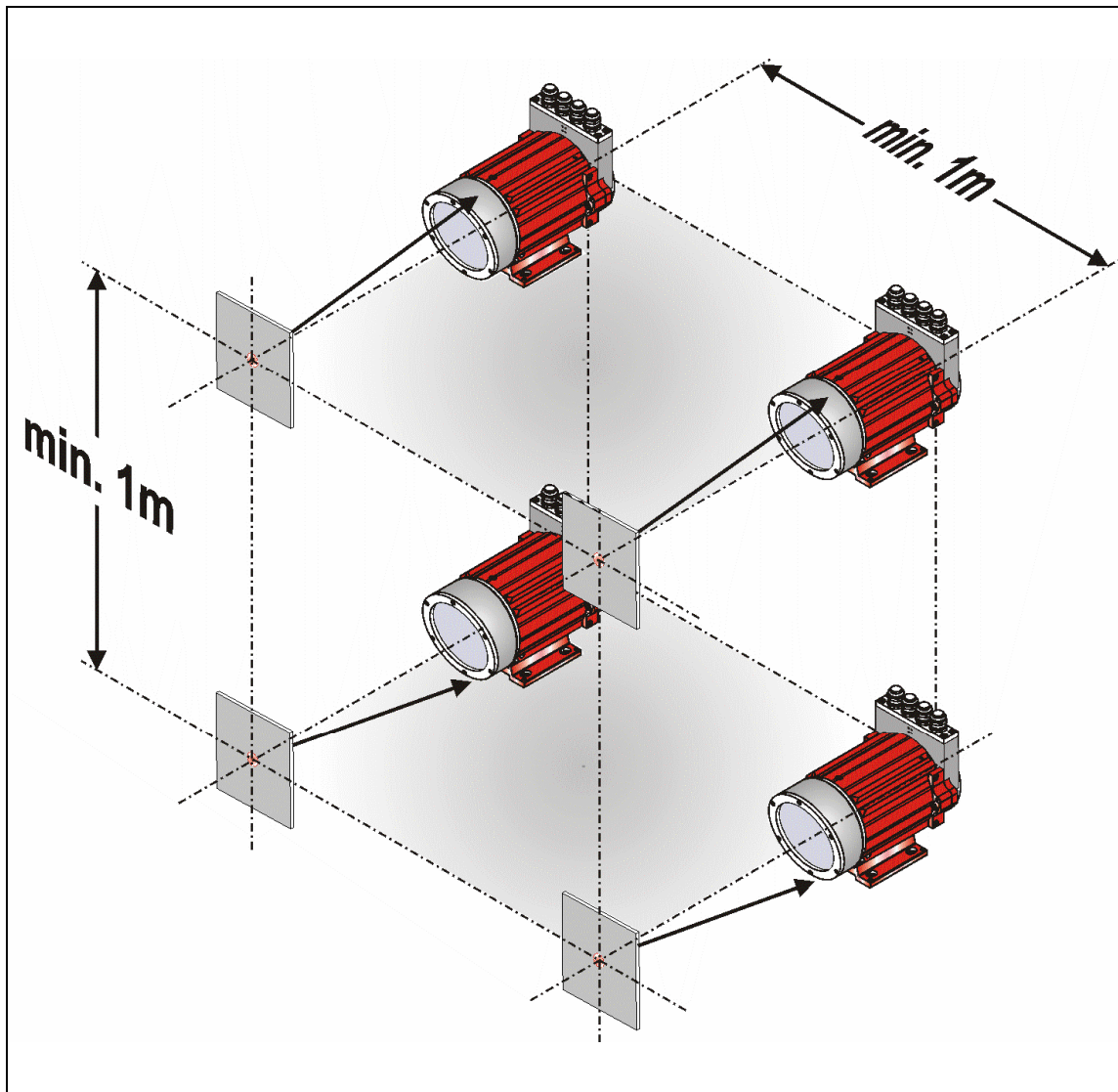
Figure 5: Minimum distance in parallel operation

5 Commissioning / Installation

5.1 Electrical connection

i *Note*

At the realization of the electrical connection the references in chapter 1.2.1, starting from page 8 must be considered.

In order to be able to carry out the connection, the connection cap must be removed from the laser first.
For this the screws **(A)** are loosened and the cap **(B)** is removed away from the laser.
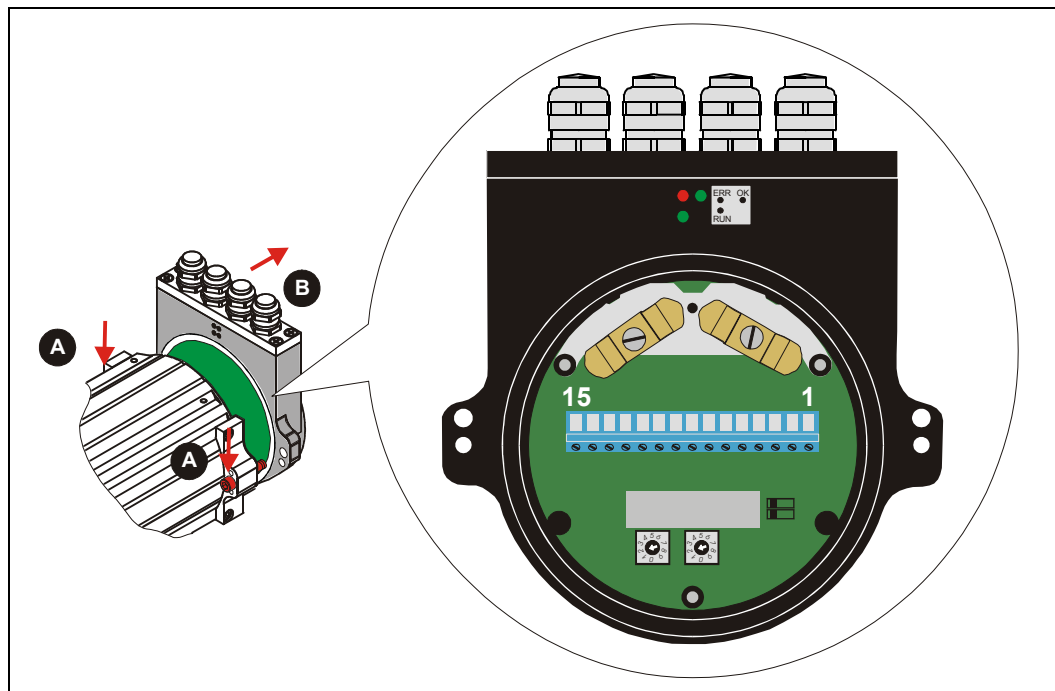
5.1.1 Supply voltage

Pin 10   Standard: 18 – 27 V DC
Device with heating: 24 V DC (±5%)

Pin 11   0V, GND

5.1.2 Profibus-DP

Simultaneous use of the Profibus DP- and SSI - interface possible.

Pin 1   Profibus Data PB_A_IN

Pin 2   Profibus Data PB_B_IN

Pin 3   Profibus Data PB_A_OUT

Pin 4   Profibus Data PB_B_OUT

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5.1.2.1 Bus termination

If the laser measuring device is the last slave in the Profibus segment, the bus line is to be terminated by the termination switches = ON.
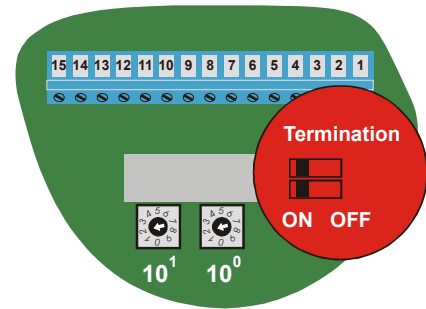
5.1.2.2 Bus addressing

Valid Profibus addresses: 3 – 99

10^0: Setting of the units position

10^1: Setting of the decimal position
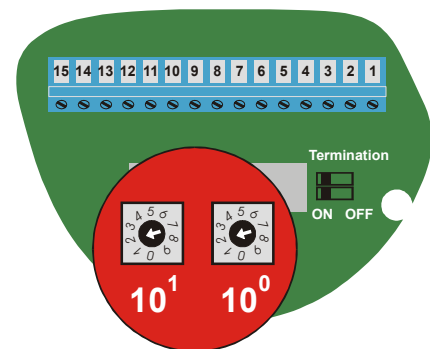
5.1.3 SSI interface

Simultaneous use of the SSI- and Profibus DP - interface possible.

Pin 12 SSI-Clock +
Pin 13 SSI-Clock –
Pin 14 SSI-Data +
Pin 15 SSI-Data –

5.1.4 Switching input / Switching output

The programming of the switching input /switching output is carried out either directly via the bus, or via the PC software "TRWinProg".

Functions of the switching input:
- Preset, - Switch off laser diode, - Failure quit

Functions of the switching output:
- Temperature- , - Intensity- , - Hardware-Fail-Output , - every fail
- Speed-check, Plausibility measured value, Switching output position

Pin 5 Switching input
Pin 6 Switching output
Pin 7 GND, reference potential pin 6

5.1.5 RS485 - programming interface

The RS485 programming interface was developed mainly only as service interface for the technician.
Primarily therefore the programming possibilities via the Profibus-DP should be used.
Via the PC software "TRWinProg" and a PC adapter the connection to the laser measuring device is established. More informations see below or in the TRWinProg software manual.

Pin 8   RS485+

Pin 9   RS485–

5.1.6 Wiring examples

* Shield connection, see chapter 1.2.1.1 page 9.

Profibus connection

LE-200

Pin	Description
1	Profibus Data PB_A_IN
2	Profibus Data PB_B_IN
3	Profibus Data PB_A_OUT
4	Profibus Data PB_B_OUT
5	Switching Input, programmable
6	Switching Output, programmable
7	GND, reference potential pin 6
8	
9	
10	Supply Voltage
11	0V, GND

incoming Profibus
outgoing Profibus

SSI-connection with parameter setting via "TRWinProg"

LE-200

Pin	Description
5	Switching Input, programmable
6	Switching Output, programmable
7	GND, reference potential pin 6
8	Programming interface RS485+
9	Programming interface RS485-
10	Supply Voltage
11	0V, GND
12	SSI-Clock+
13	SSI-Clock-
14	SSI-Data+
15	SSI-Data-

Switch Cabinet Module 490-00105

RS485+
RS485-

11-27 VDC
0 V
Case / Shield

PC adapter 490-00310

RS485
USB

PC
+
TRWinProg

Printed in the Federal Republic of Germany

5.2 SSI interface

The Laser Measuring Device is equipped with an SSI data interface, i.e. the data are transmitted via the synchronous/serial technique.

The SSI technique is a synchronous/serial transfer process for the encoder positions, and has become more or less standard for absolute encoders. Using the RS422 interface makes it possible to obtain sufficiently high transfer rates. The device operates at a clock rate of 80 kHz to 820 kHz max.

The transfer process works as follows: the user transmits bundles of clock pulses via the clock-pulse lines. With every incoming pulse, the device returns the information in its shift register bit by bit to the transmitter via the data lines, starting with the most significant bit. The last data bit is followed merely by zero bits. In the interval between the bundles, "1" bits are sent. The interval is detected by a re-triggerable monoflop. Only then can a new bundle begin. The mono-time is 20µs.

Because the data transfer is synchronized by the start of the bundle, it is not necessary to use one-step codes such as Gray code.

In the example below, the receiver reads the value 001 0111 0011 1101 0011 0010 (HEX 173D32) as the encoder position.

Clock+

Clock-

Data+

4V

Data-

Clock+

Data+

Monoflop time that can be seen when lowest encoder bit = 0

Lowest encoder bit from 0 to 1
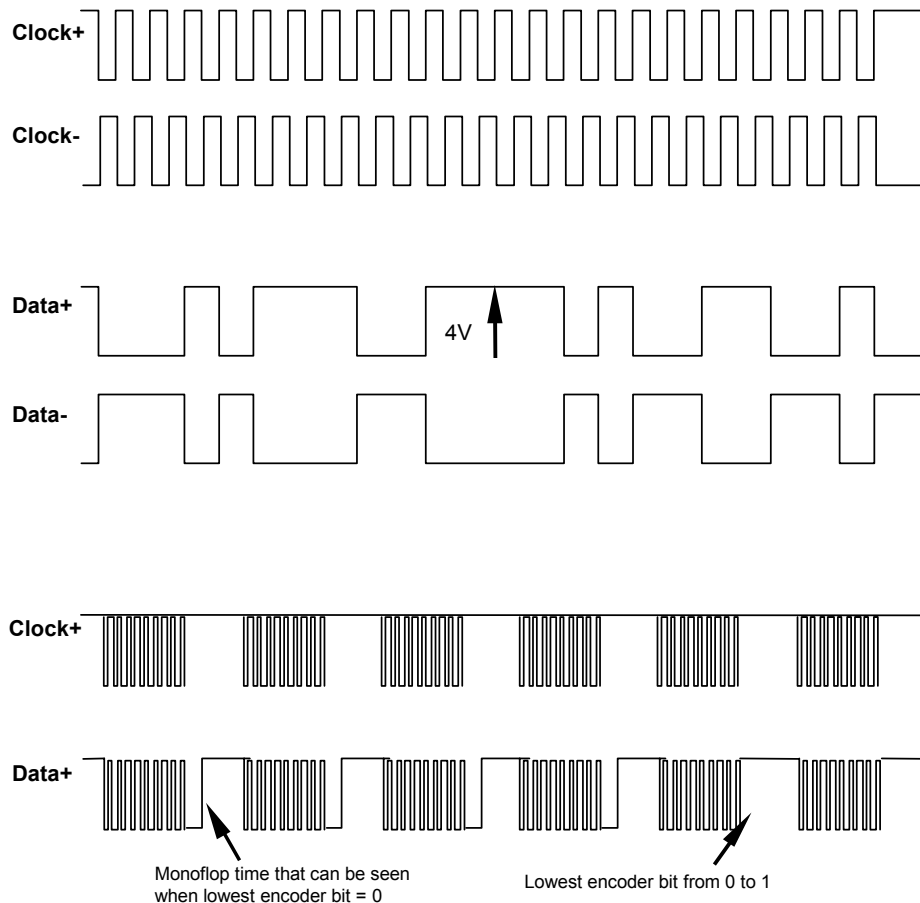
i *Note*

Since this transmission technique affords no protection against faulty transfer data, it is essential to use well shielded twisted-pair cables.

5.3 Profibus-DP interface / Profibus-DP master

5.3.1 Identification number

The Laser Measuring Device has the PNO ID number 0458 (hex). This number is reserved and filed with the PNO.

5.3.2 Operating requirements / GSD-file

Theoretically, the Laser Measuring Device can be connected to any Profibus-DP network, provided the PROFIBUS-DP master is capable of transmitting a parameter message. Similarly, the configuration software should be able to display the parameter structure specified in the device master file in order to allow the parameters to be entered. If this is not the case, the Laser Measuring Device can not be put into operation.

TR-Electronic supplies a CD containing the device master file (.GSD). If the CD is not enclosed with this documentation, it can be ordered quoting reference number 490-01001. The Soft-No. for the fieldbus files is 490-00406.
The current device master file of the Laser has the filename **TR070458.GSD**, dated from 23.02.2005.

The Laser Measuring Device also has two bitmap files named TR_0458N.BMP and TR_0458S.BMP which represent the Laser Measuring Device in the normal and faulty states respectively.
For details of how to integrate the files (*.GSD, *.BMP) into the system configuration, please refer to the relevant documentation of the configuration program for the Profibus master.

Overview of the previous device master file versions:

GSD file:	TR010458.GSD, 12/01/99
Device type:	LE-100
Entry hardware catalogue:	TR LE100 DP
Version no.:	1
Comment:	Base version device type LE-100.

GSD file:	TR020458.GSD, 14/02/2001
Device type:	LE-100
Entry hardware catalogue:	TR LE100 DP
Version no.:	2
Comment:	**Functional expansion:** ▪ Module "Adjustment", ▪ Module "Control Bits With Acknowledgement"

GSD file:	TR030458.GSD, 14/10/2002
Device type:	LE-200
Entry hardware catalogue:	TR LE200 DP
Version no.:	2
Comment:	Base version device type LE-200

Continuation see next page

GSD file:	TR040458.GSD, 12/02/2003
Device type:	LE-200
Entry hardware catalogue:	TR LE200 DP
Version no.:	3

Comment:	**Functional expansion:**
	▪ Parameter "Free resolution" in module Position
	▪ Parameter "SSI output value" in module SSI interface
	
	Compatibility to LE-100 device master file TR020458.GSD:
	Generally, a compatible operation with LE-100 DP-projects is problem-free possible. However the following restrictions must be made:
	▪ The module "Control Bits" may not be used, instead of its, the module "Control Bits With Acknowledgement" is to be used.
	▪ The module "Signal Bits" may not be used
	▪ The following parameters are not evaluated and have therefore no influence:
	  - Parameter "Initial value" in module "Position"
	  - Parameter "Input" in module "Error Display"
	  - Parameter "26-bit-repetition" and "Negative values" in module "SSI interface"

GSD file:	TR050458.GSD, 27/03/2003
Device type:	LE-200
Entry hardware catalogue:	TR LE200 DP
Version no.:	5
Comment:	**Functional expansion:** ▪ Module "Laser-Diode-Operating hours counter" **Compatibility to LE-100 device master file TR020458.GSD:** see comment device master file "TR040458.GSD"

GSD file:	TR060458.GSD, 08/07/2003
Device type:	LE-200
Entry hardware catalogue:	TR LE200 DP
Version no.:	6
Comment:	**Functional expansion:** ▪ Module "Function ext. Input": - Failure quit **Compatibility to LE-100 device master file TR020458.GSD:** see comment device master file "TR040458.GSD"

GSD file:	TR070458.GSD, 23/02/2005
Device type:	LE-200
Entry hardware catalogue:	TR LE200 DP
Version no.:	7
Comment:	**Functional expansion / Adaptation:** • New: Module "Switching position" • The module "Function ext. input" was renamed in "Function ext. IO pins". Now this module contains all features to program the external switching output also over the PROFIBUS. • Module "SSI interface": So far the number of SSI-data bits were programmable from 24 - 26. New: 12 – 24 **Compatibility to LE-100 device master file TR020458.GSD:** see comment device master file "TR040458.GSD"

GSD file:	TR080458.GSD, 14/03/2008
Device type:	LE-200
Entry hardware catalogue:	TR LE200 DP
Version no.:	8
Comment:	**Correction of the byte sequence:** • Module "Function External IO Pins": - Preset HI/LO word, byte sequence 4, 6 --> 3, 5 **Compatibility to LE-100 device master file TR020458.GSD:** see comment device master file "TR040458.GSD"

5.3.3 Setting the station address

The station address of the Laser Measuring Device is set exclusively via the rotary switches which becoming visible after removing the cover:

10^0: Setting of the units position
10^1: Setting of the decimal position

The addressing of the Laser Measuring Device is limited within the Profibus address area.
Valid station addresses are 3 - 99.
If an invalid station address is set, the device will not start up!
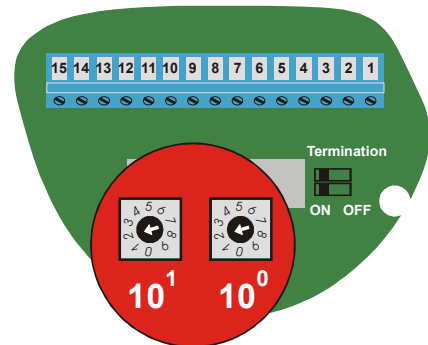
5.3.4 Bus termination

All PROFIBUS networks must be terminated by a resistor at the ends of the bus segments. The termination resistor and resistors for connecting to the data reference potential are located in the bus cap with the terminals, and can be connected via DIL-switches if necessary, provided the Laser Measuring Device is the last station of a bus segment.

In this case the outgoing bus line (PB_A_OUT, PB_B_OUT) is interrupted!
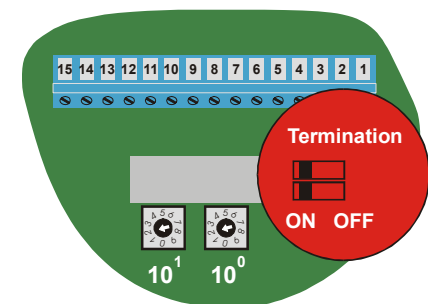
5.3.5 Baud rate

The Baud rate at which the PROFIBUS is operated may lie within the range of 9.6 kBaud to 12 Mbaud, and is detected automatically by the Laser Measuring Device.

5.3.6 Bus status

At the connection cap the laser has 3 LEDs, which display the bus status of the laser:
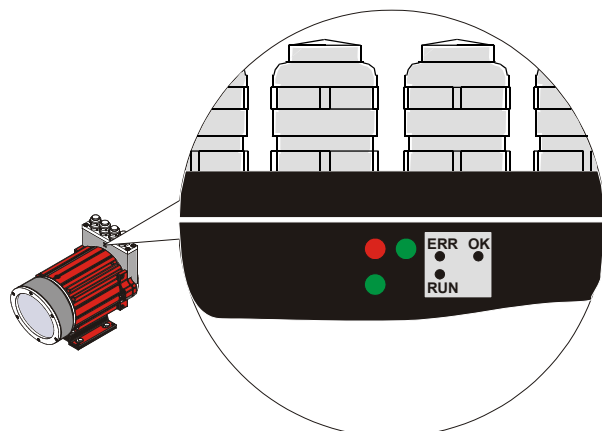
RUN (green): Profibus-DP active
ERR (red): flashing = Profibus-DP not active, static = hardware failure
OK (green): Hardware ok

6 Configuration / Parameter setting via the Profibus-DP master

The configuration of the laser occurs alternatively via the configuration software of the Profibus-DP - master or via the TRWinProg-software. With a download of the control parameters the parameters, which were configured via the TRWinProg-software, will be overwritten by the control.
In this instruction only the configuration via the Profibus-DP - master is described. The PC program TRWinProg is described in an instruction of its own.

6.1 Modular configuration

Since all functions of the Laser Measuring Device are used not at any time, individual functions can be disabled on the bus.
For this, in the mask of configuration software of the Profibus master, the Laser Measuring Device is represented as a modular compact device .
That means after insertion of the laser into the configuration list of the master, the corresponding configuration list at first is empty.
Every module requires inputs and outputs and has a parameter data set. The parameter data set must be set dependent of the application.
That the laser starts at the Profibus, in the configuration list at least one module must be entered.

i   **Important note:**

It exist configuration programs which include an "universal module". This module is not defined in the device master file of the laser and must not be used.

6.2 Module Position

The module uses two input words which are consistently transferred via the bus. The position of the Laser Measuring Device is transferred via these two input words.

Position of the I/O data in the input double word ID x

	Data byte 3	Data byte 2	Data byte 1	Data byte 0	
MSB					LSB
	Input byte x+0	Input byte x+1	Input byte x+2	Input byte x+3	
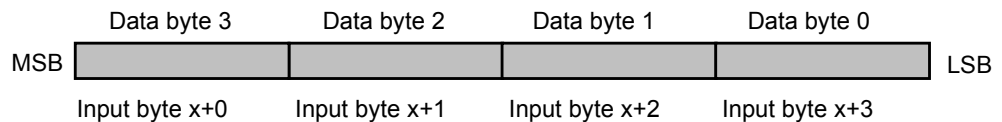
corresponding parameter data:

Resolution
Sets the resolution of the measurement system.
The available options are :

Centimeter
Millimeter (default)
1/10 millimeter
1/100 millimeter
Inch
1/10 inch
* Free resolution (in 1/100 mm), valid values are 1 - 65535, default = 100

* As of GSD file TR040458.GSD (12.02.2003)
Freely selectable resolution, by input of the corresponding data value.

If e.g. a resolution shall be adjusted of 1 mm, you must type in the data value 100.

Count direction

Sets the count direction of the measurement system.

The available options are :

positive (default)	position values increasing
negative	position values decreasing

6.3 Module Speed

The module uses one input word which is consistently transferred via the bus.
Here the momentary actual speed is output. About the PC program TRWinProg the output format can be determined:

- 10 mm/s = 0.01 m/s, Default
- 1 mm/s = 0.001 m/s

Input word IW x

	Data byte 1	Data byte 0	
MSB			LSB
	Input byte x+0	Input byte x+1	
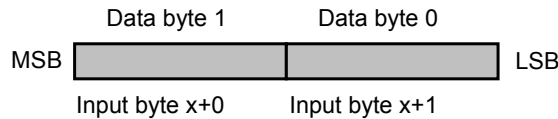
6.4 Module Error Display

The module uses 1 input byte, which is coded bit by bit. Over the input byte the error message of the laser will transfer and is reset, if the error were recovered, or is no more present.

No error Input byte = 0x00	Corresponds to the normal condition
Intensity Bit 0 in the input byte	The bit is set, if an intensity value of smaller 8% is present, or the laser beam is interrupted and leads to the error value output.
Temperature Bit 1 in the input byte	The bit is set, if the device temperature is outside of the range from 0 - 50 °C. A low range deviation has still no influence on the measurement and is therefore to be regarded as a warning.
Hardware Bit 2 in the input byte	The bit is set, if an internal hardware error or a station address < 3 were detected and leads to the error value output.
Laser diode switched off Bit 3 in the input byte	The bit is set, if the laser diode was switched off over the bus, or the switching input. Serves only for information purposes.
Intensity warning Bit 4 in the input byte	The bit is set, if an intensity value of smaller 12% were determined and means that the measuring system optics, or the reflecting foil is to be cleaned. However, the device operates error-freely furthermore.
Overspeed warning Bit 5 in the input byte	The bit is set if the speed, adjusted in the PC program TRWinProg, is exceeded. About the default setting the speed-check is switched off. A configurability over the bus is not possible.
Warning bit Plausibility Bit 6 in the input byte	The bit is set if the plausibility of the measured value cannot be guaranteed. E.g. this is the case at a position jump if a second reflection foil is held into the laser beam.

corresponding parameter data:

Error value

It determines which data value should be transmitted in the module position in the case of an error. The data value is output, if the laser can output no more measurement. This is given e.g., if a beam interruption is present.

The available options are :

Null (default)	The position is set to "0"
0xFF	All 24 bits are set to '1' (0xFFFFFF or -1)
last valid value	Output of the last valid position

6.5 Module Switching Position

Starting from GSD file TR070458.GSD / 23.02.2005

The module uses two output words which are consistently transferred via the bus. The module specifies the position value, on which the switching output is switched actively, when the function "Switching output position" (see "Function ext. output" page 31) is preselected. Below this switching position the switching output is inactive.

Position of the I/O data in the output double word OD x

	Data byte 3	Data byte 2	Data byte 1	Data byte 0	
MSB					LSB
	Output byte x+0	Output byte x+1	Output byte x+2	Output byte x+3	

6.6 Module Function External IO Pins

The module uses no inputs and no outputs and is only used for the parameterization of the function for the external input/output at the Laser Measuring Device.

Overview of operating parameters

Parameter	Data type	Relative byte-address	Range of values (dec.)
Function ext. input	unsigned8	0	0 – 3
Function ext. output	unsigned8	1	0 – 7
Preset HI-Word	unsigned16	2 – 3	0 – 65 535
Preset LO-Word	unsigned16	4 – 5	0 – 65 535
Active slope ext. input	unsigned8	6	0 – 1
Wait-time to enable ext. input	unsigned8	7	0 – 3
Active output level	unsigned8	8	0 – 1

6.6.1 Operating parameters

6.6.1.1 Function ext. input

Definition of the function for the external switching input.

DDLM_Set_Prm

unsigned8

Rel. byte address	0
Bit	7 – 0
Data	$2^7 – 2^0$
Default (dec.)	0

Value	Assignment	Description
0	Disabled	Function switched off, following parameters without meaning.
1	Preset-function	With connection of the switching input or by executing the control bit "Execute Preset" in the module "Control bits with quit", the laser is adjusted to the predefined position value (Preset HI- and LO-Word).
2	LD-switch-input	With connection of the switching input the laser diode is switched off for the extension of the life time. If in the PC-program "TRWinProg" in the basic parameters the switching-off of the laser diode is carried out automatically, the switching input does not have a function.
3	Fail-quit-input	Starting from GSD file TR060458.GSD / 08.07.2003 Switching input is used as error acknowledgement. Software acknowledgement see "Module Control Bits With Acknowledgement", page 38.

6.6.1.2 Function ext. output

Starting from GSD file TR070458.GSD / 23.02.2005

Definition of the function for the external switching output.

DDLM_Set_Prm

unsigned8

Rel. byte address	1
Bit	7 – 0
Data	$2^7 - 2^0$
Default (dec.)	0

Value	Assignment	Description
0	Disabled	Function switched off, following parameters without meaning.
1	Temperature	The switching output is set, if the device temperature is outside of the range from 0 - 50 °C. A low range deviation has still no influence on the measurement and is therefore to be regarded as a warning.
2	Intensity	The switching output is set, if an intensity value of smaller 8% is present, or the laser beam is interrupted and leads to the error value output.
3	Hardware fail	The switching output is set, if an internal hardware error or a station address < 3 were detected and leads to the error value output.
4	every fail	The switching output is set, if one of the errors, listed here, is active.
5	Speed-check	The switching output is set, if the speed, adjusted in the PC program TRWinProg, is exceeded. About the default setting the speed-check is switched off. A configurability over the bus is not possible.
6	Plausibility measured value	The switching output is set, if the plausibility of the measured value cannot be guaranteed. E.g. this is the case at a position jump if a second reflection foil is held into the laser beam.
7	Switching output position	The switching output is set, if the stored value (see "Module Switching Position" page 29) is reached.

6.6.1.3 Preset HI-Word / Preset LO-Word

Defines the position value to which the laser is adjusted, when the preset function is executed. The preset value must be programmed in the range from 0 ... measuring length.

DDLM_Set_Prm

unsigned16, Preset HI-Word

Rel. byte address	2	3
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$
Default (dec.)	0	0

Range of values	Description
0 – 65 535	Preset value high-word

DDLM_Set_Prm

unsigned16, Preset LO-Word

Rel. byte address	4	5
Bit	15 – 8	7 – 0
Data	$2^{15} - 2^8$	$2^7 - 2^0$
Default (dec.)	0	0

Range of values	Description
0 – 65 535	Preset value low-word

6.6.1.4 Active slope ext. input

Defines whether the function of the switching input is activated with an rising or falling slope at the switching input.
This parameter has no influence on the triggering of a function over a control bit via the PROFIBUS. There is always the rising slope valid.

DDLM_Set_Prm

unsigned8

Rel. byte address	6
Bit	7 – 0
Data	$2^7 – 2^0$
Default (dec.)	0

Value	Assignment	Description
0	L->H	Execution with rising slope
1	H->L	Execution with falling slope

6.6.1.5 Wait-time to enable ext. input

Defines the response time of the switching slope of the switching input up to the actual execution. This parameter is used for the interference suppression of the signal at the switching input.

DDLM_Set_Prm

unsigned8

Rel. byte address	7
Bit	7 – 0
Data	$2^7 – 2^0$
Default (dec.)	0

Value	Assignment	Description
0	100 ms	Response time = 100 ms
1	250 ms	Response time = 250 ms
2	500 ms	Response time = 500 ms
3	1000 ms	Response time = 1000 ms

6.6.1.6 Active output level

Starting from GSD file TR070458.GSD / 23.02.2005

Defines the output level of the switching output.

DDLM_Set_Prm

unsigned8

Rel. byte address	8
Bit	7 – 0
Data	$2^7 - 2^0$
Default (dec.)	0

Value	Assignment	Description
0	active low	When the event is active, switching output = "0"
1	active high	When the event is active, switching output = "1"

6.7 Module Counter Measuring-Cycle

The module uses two input words which are consistently transferred via the bus.
Over the input words the counter reading of the measuring-cycle counter is transferred. Every correct measuring cycle in the device increases the counter reading by 1. An overflow of the 32-bit counter causes a new beginning with "0".

Input double word ID x

	Data byte 3	Data byte 2	Data byte 1	Data byte 0	
MSB					LSB
	Input byte x+0	Input byte x+1	Input byte x+2	Input byte x+3	

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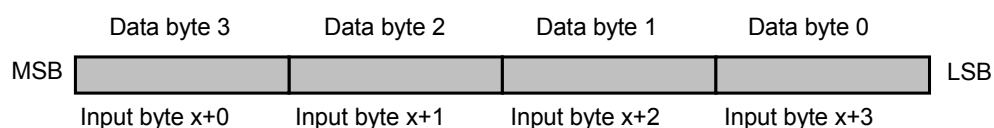
6.8 Module SSI interface

The module SSI interface uses no inputs and no outputs and is used only for the parameterization of the SSI interface of the laser.

Overview of operating parameters

Parameter	Data type	Relative byte-address	Range of values (dec.)
SSI-Data bits	unsigned8	0	0 – 14
Code	unsigned8	1	0 – 1
SSI-Failure bit	unsigned8	2	0 – 5
SSI-Output-Value	unsigned8	3	0 – 2

6.8.1 Operating parameters

6.8.1.1 SSI-Data bits

DDLM_Set_Prm

unsigned8

Rel. byte address	0
Bit	7 – 0
Data	$2^7 - 2^0$
Default (dec.)	0

Value	Assignment	Description	
0	24 Bit	Number of SSI data bits = 24	
1	25 Bit	Number of SSI data bits = 25	
2	26 Bit	Number of SSI data bits = 26	
3	12 Bit	Number of SSI data bits = 12	Starting from GSD file TR070458.GSD / 23.02.2005
4	13 Bit	Number of SSI data bits = 13	
5	14 Bit	Number of SSI data bits = 14	
6	15 Bit	Number of SSI data bits = 15	
7	16 Bit	Number of SSI data bits = 16	
8	17 Bit	Number of SSI data bits = 17	
9	18 Bit	Number of SSI data bits = 18	
10	19 Bit	Number of SSI data bits = 19	
11	20 Bit	Number of SSI data bits = 20	
12	21 Bit	Number of SSI data bits = 21	
13	22 Bit	Number of SSI data bits = 22	
14	23 Bit	Number of SSI data bits = 23	

6.8.1.2 Code

DDLM_Set_Prm
unsigned8

Rel. byte address	1
Bit	7 – 0
Data	$2^7 - 2^0$
Default (dec.)	0

Value	Assignment	Description
0	Gray	SSI output code = Gray
1	Binary	SSI output code = Binary

6.8.1.3 SSI-Failure bit

The SSI-Failure bit is an additional bit in the SSI protocol and is attached after the "LSB bit".

DDLM_Set_Prm
unsigned8

Rel. byte address	2
Bit	7 – 0
Data	$2^7 - 2^0$
Default (dec.)	0

Value	Assignment	Description
0	Disabled	No SSI error bit
1	Temperature	The bit is set, if the device temperature is outside of the range from 0 - 50 °C. A low range deviation has still no influence on the measurement and is therefore to be regarded as a warning.
2	Intensity	The bit is set, if an intensity value of < 8% is present, or the laser beam is interrupted and leads to the error value output (see also "Module Error Display", page 28).
3	Hardware	The bit is set, if an internal hardware error or a station address < 3 is detected and leads to the error value output (see also "Module Error Display", page 28).
[1] 4	every fail	The bit is set, if one of the errors, which can be detected by the device, is active (see also "Module Error Display", page 28).
[1] 5	Plausibility measured value	The bit is set, if the plausibility of the measured value cannot be guaranteed. E.g. this is the case at a position jump if a second reflection foil is held into the laser beam.

[1] Starting from GSD file TR070458.GSD / 23.02.2005

6.8.1.4 SSI-Output-Value

Starting from GSD file TR040458.GSD / 12.02.2003

DDLM_Set_Prm

unsigned8

Rel. byte address	3
Bit	7 – 0
Data	$2^7 – 2^0$
Default (dec.)	0

Value	Assignment	Description
0	Position	Output of the laser position
1	Intensity	Output of the laser intensity value
2	Speed	Output of the laser actual speed

6.9 Module Adjustment

The module adjustment uses 4 output bytes and determines the position value to which the laser is adjusted, when the adjustment function *via the I/O-Level* is executed. The adjustment value must be programmed in the range from 0 ... measuring length.

The execution of the adjustment is carried out via the module *"control bits with acknowledgement"* by setting bit 4 *"Execute adjustment"*.

6.10 Module Control Bits With Acknowledgement

The module uses 1 input byte and 1 output byte. The bytes are coded in bits. Via the output byte control commands can be transmitted to the laser. Via the input byte the control commands transmitted to the laser are acknowledged by the laser.

Bit 2 and 3	not used
Switch off laser diode Bit 0 in the output byte	By setting this bit the laser diode is switched off for the extension of the life time. If under the operating parameter "Function ext. input" = "LD-switch-input" (page 30) is preselected, or in the PC-program "TRWinProg" in the basic parameters the switching-off of the laser diode is carried out automatically, this function is ineffective.
Switch on laser diode Bit 1 in the output byte	By setting this bit the laser diode is switched on. This function is ineffective if: see "Switch off laser diode" above.
Execute adjustment Bit 4 in the output byte	By setting this bit the laser is adjusted to the value deposited in the module "Adjustment".
Execute Preset Bit 5 in the output byte	By setting this bit the laser is adjusted to the value deposited in the operating parameter "Preset HI-Word / Preset LO-Word", page 32.
Clear Preset Bit 6 in the output byte	By setting this bit a Preset function or an Adjustment executed before is cancelled.
Clear Error Bit 7 in the output byte	If in the module "Control Bits With Acknowledgement" in the parameter "Error Acknowledgement" the setting is preselected "not automatically", by setting this bit an occurring error report is deleted. If the error could not be eliminated, the corresponding bit in the module "Error Display" is set in the next cycle again.

corresponding parameter data:

Error Acknowledgement

It determines whether occurring error reports should be cleared automatically after eliminating the trouble.

not automatically (default)	An occurring error report can be cleared only via bit 7 in the output byte.
automatically	An occurring error report is cleared automatically after remedying of the error.

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6.11 Module Laser-Diode-Operating Hours

As of GSD file TR050458.GSD (27.03.2003)

The module uses one input word which is consistently transferred via the bus.
Here, the operation hours of the **activated laser diode** are output.

Input word IW x

```
          Data byte 1        Data byte 0
MSB  ┌───────────────┬───────────────┐  LSB
     │               │               │
     └───────────────┴───────────────┘
          Input byte x+0    Input byte x+1
```

7 Trouble elimination and diagnostic possibilities

7.1 How to use the PROFIBUS diagnostics

In a Profibus system, the Profibus masters supply the process data to a so-called host system, e.g. a PLC-CPU. If a slave is not accessible, or no longer accessible, on the bus, or if the slave itself reports a fault, the master must communicate this fault to the host system in some form or other. There are several possible ways of doing this, the evaluation of which depends entirely on the application in the host system.

As a general rule, a host system cannot be stopped following the failure of only one component on the bus, but must respond appropriately to the failure as prescribed by the safety regulations. The master normally provides the host system initially with a summary diagnosis, which the host system reads cyclically from the master, and which serves to report the states of the individual bus stations to the application. If a station is reported to be faulty in the summary diagnosis, the host can request further data from the master (slave diagnostics), which then allow a more detailed evaluation of the causes. The indications thus obtained may either have been generated by the master, if the relevant slave does not respond (or no longer responds) to the master's requests, or they may come directly from the slave, if the slave itself reports a fault. The generation or reading of the diagnostic message between the master and slave takes place automatically, and does not have to be programmed by the user.

7.1.1 Standard diagnosis

The standard DP diagnosis is structured as follows (always from the point of view of the master in relation to the slave).

Byte no.	Meaning	
Byte 1	Station status 1	General part
Byte 2	Station status 2	
Byte 3	Station status 3	
Byte 4	Master address	
Byte 5	Manufacturer's identifier HI byte	
Byte 6	Manufacturer's identifier LO byte	

7.1.1.1 Station status 1

Bit 7	Master_Lock	Slave has been parameterized by another master (bit is set by master)
Bit 6	Parameter_Fault	The last parameterization message to have been sent was rejected by the slave
Bit 5	Invalid_Slave_Response	Set by the master if the slave does not respond
Bit 4	Not_Supported	Slave does not support the requested functions
Bit 3	Ext_Diag	Bit = 1 means that there is an extended diagnostic message from the slave
Bit 2	Slave_Cfg_Chk_Fault	The configuration identifier(s) sent by the master was/were rejected by the slave
Bit 1	Station_Not_Ready	Slave is not ready to exchange cyclical data
Bit 0	Station_Non_Existent	The slave has been configured but is not present on the bus

7.1.1.2 Station status 2

Bit 7	Deactivated	Slave has been deleted from the poll list by the master
Bit 6	Reserved	
Bit 5	Sync_Mode	Set by slave on receipt of SYNC command
Bit 4	Freeze_Mode	Set by slave on receipt of FREEZE command
Bit 3	WD_On	Slave watchdog is activated
Bit 2	Slave_Status	Always set for slaves
Bit 1	Stat_Diag	Static diagnosis
Bit 0	Prm_Req	The slave sets this bit if it has to be re-parameterized and re-configured.

7.1.1.3 Station status 3

Bit 7	Ext_Diag_Overflow	Overflow in extended diagnosis
Bit 6 - 0	Reserved	

7.1.1.4 Master address

In this byte, the slave enters the station address of the first master to have sent a valid parameterization message. If several masters access the bus simultaneously, their configuration and parameterization information must coincide exactly in order to ensure correct operation of the Profibus.

7.1.1.5 Manufacturer's identifier

In bytes 5+6, the slave enters the manufacturer-specific identification number, an unambiguous number for each device type which is reserved and filed with the PNO. The identifier number of the laser is 0458 (h).

7.2 Other troubles

7.2.1 Causes of Faults and Remedies

The error causes are determined in the module "Error Display" (see page 28). Depending on setting the error must be possibly acknowledged for resetting the malfunction code in the input byte (see "Module Control Bits With Acknowledgement", page 38 and "Module Function External IO Pins", page 30).

Malfunction Code	Cause	Remedy
Bit 0 Intensity error	The device checks the intensity of the received laser signal continuously, it was detected a below-minimum intensity.	1. Clean measuring system optics 2. Clean reflecting foil 3. Rule out an interruption of the laser beam If the possibility of soiling or interruption of the laser signal can be ruled out, the device must be replaced.
Bit 1 Device temperature	The temperature has exceeded or fallen short of the range of 0 - 50°C at the housing of the device	Appropriate measures must be taken to prevent the device from overheating or undercooling.
Bit 2 Hardware error	The device has detected an internal hardware error or an adjusted station address < 3.	- If the error occurs repeated, the device must be replaced. - Check station address, see page 25.
Bit 3 Laser diode switched off	The bit is set, if the laser diode was switched off over the bus, or the switching input.	Serves only for information purposes.
Bit 4 Intensity warning	The device deter-mined an intensity of < 12%.	This message is only a warning and means that the measuring system optics, or the reflecting foil is to be cleaned. However, the device operates error-freely furthermore.
Bit 5 Speed-check warning	The speed level adjusted over the PC program TRWinProg was exceeded.	This message is a warning and means that possibly corresponding measures must be taken, so that no system components will be damaged.
Bit 6 Plausibility warning	The plausibility of the measured value couldn't be guaran-teed any more.	This message is a warning and means that possibly corresponding measures must be taken, so that no system components will be damaged.

TR - ELE - BA - GB - 0006 - 15 25.03.2008

8 Maintenance

8.1 General Maintenance Information

The Laser Measuring Device does not, in general, require maintenance by the operator.

i *Note*
If the lens opening of the laser or the reflecting foil become dirty, clean with a soft cloth.

Do not use an aggressive cleaning material such as thinner or acetone !

8.2 Repair, Maintenance

Repairs to the devices must only be carried out by the manufacturer.

Contact your TR-Electronic GmbH distributor or service organization should repairs be required. The addresses are listed on the last page of this description.

9 Appendix

9.1 Specifications

i *Note*
The electric characteristics have validity, only after an operating time of approximate 30 minutes.

9.1.1 Electrical ratings

Measuring principle:...	Phase delay time measurement
Range (measurement on reflecting foil):........	0,2 – 125 m standard, 50m, 170m, 195m, 240m (special devices)
Resolution:	selectable, physical resolution 0,7 mm
Linearization	
up to 12m (standard):..........................	absolute linearity error ±3 mm
complete measuring length:................	absolute linearity error ±5 mm
Operating voltage	
Standard device:	18-27 V DC (± 5%)
Device with heating:............................	24 V DC (± 5%)
Power consumption (no-load):........................	< 6 watts
Power consumption with heating:	< 60 watts
Opto-transmitter:...	Laser diode (red light)
Wavelength λ:	670 nm
Max. laser power:...............................	P ≤ 1 mW
Laser protection class:	2 according to DIN EN 60 825-1: 2003-10
Lifetime:..	50 000 h
Measured value output / refresh cycle:	1000 values / s
Integration time:	1 ms
Reproducibility:...	± 2 mm
Programming via RS485:.................................	PC IBM compatible (TRWinProg) / Profibus-DP
SSI Interface	
* Output code:	Binary, Gray
Clock input:	Optocoupler
Clock frequency:	80 kHz - 820 kHz
Cable length:	Depending on cable cross-section, shielding
Data output:..	RS422 (2-wire)
* Number of data bits:	24 - 26, with error bit transmission
Profibus-DP Interface	PROFIBUS-DP acc. to DIN 19245 Part 1-3
Output code:..	Binary
Baud rate:..	9,6 kBaud to max. 12 MBaud
Special features:	Programming is performed via the parameterization message at the start-up of the laser or the PROFIBUS-DP master
Station addresses	3 - 99
* Switching input/output	
Levels switching input:.........................	1-level > +8V, 0-level < +2V, up to ±35V, 5 kOhm
Levels switching output:.......................	1-level > US-2V, 0-level < 1 V, up to 100mA

* programmable parameter

9.1.2 Environmental conditions

EMC: .... EN 61000-4-2 (IEC-801-2) /
EN 61000-4-4 (IEC-801-4)

Operating temperature range: .... 0-50°C
Device with heating: .... -30 to +50°C

Thermal drift: .... 1 ppm / °C, related to the max. measuring
length of 50 m, 125 m, 170 m, 195 m or 240 m

Storage temperature range: .... -20 to +75°C

Relative air humidity: .... 98 % (no moisture condensation)

* Degree of protection: .... IP 65 (DIN 40 050)

Vibration (50-2000 Hz Sinusoidal) DIN IEC 68-2-6: ..... ≤ 50 m/s^2 (5g)

Shock (11ms) DIN IEC 68-2-27: .... ≤ 300 m/s^2 (30g)

* The protection class is valid for the device with screwed-together cable glands.

9.2 Ordering information

9.2.1 Laser devices

Article-No.:	Description
2200-04102	Laser device Profibus+SSI 50 m, linearized
2200-04112	Laser device Profibus+SSI+Heating 50 m, linearized
2200-00102	Laser device Profibus+SSI 125 m, linearized
2200-00112	Laser device Profibus+SSI+Heating 125 m, linearized
2200-01100	Laser device Profibus+SSI 170 m
2200-01102	Laser device Profibus+SSI 170 m, linearized
2200-01112	Laser device Profibus+SSI+Heating 170 m, linearized
2200-02102	Laser device Profibus+SSI 195 m, linearized
2200-02112	Laser device Profibus+SSI+Heating 195 m, linearized

9.2.2 Accessories

Article-No.:	Description
490-00105	TR-PT-15/2: switch cabinet module for PC adapter connection
490-00310	Device: PC adapter (RS485 <--> USB)
490-01001	Soft-No.: 490-00416 "TRWinProg" PC-software with user manual German and English
	Soft-No.: 490-00406 Device Master File
Reflecting foils for measurements up to 125m	
49-500-020	200 x 200 mm, package contents
49-500-038	200 x 300 mm
49-500-031	749 x 914 mm
Other sizes upon request. In addition, the foils can be sticked-on side-by-side up to the desired size.	
Fresnel Reflecting foils for measurements > 125m	
49-500-032	554 x 480 mm, package contents
49-500-034	554 x 480 mm, predrilled
49-500-036	720 x 693 mm
49-500-037	1108 x 960 mm
49-500-039	200 x 200 mm, for measurements approx. up to 130m