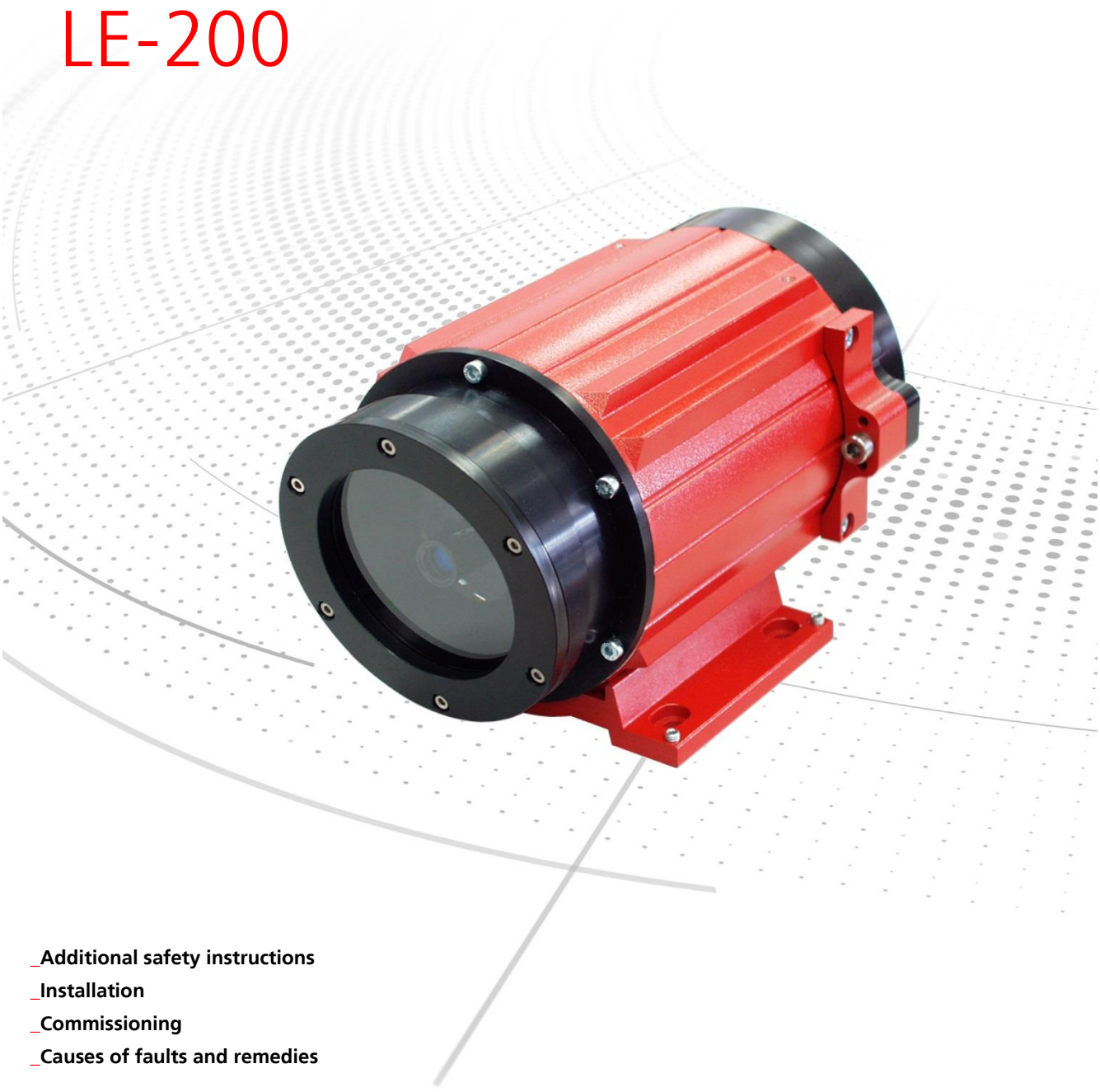
SSI

# Laser Measuring Device LE-200



_Additional safety instructions
_Installation
_Commissioning
_Causes of faults and remedies

User Manual

TR - ELE - BA - GB - 0011 - 07 12/11/2017

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## Document information

| | |
|---|---|
| Release date / Rev. date: | 12/11/2017 |
| Document / Rev. no.: | TR - ELE - BA - GB - 0011 - 07 |
| File name: | TR-ELE-BA-GB-0011-07.docx |
| Author: | MÜJ |

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# Contents




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# Revision index

| Revision | Date | Index |
|---|---|---|
| First release | 10/24/03 | 00 |
| • Revision of the laser warning label" | 12/18/03 | 01 |
| • Modification of the Laser Standard DIN EN 60825-1<br>• Warning bit “Plausibility measured value”<br>• Additional reflector foils<br>• Max. measuring range 240 m<br>• Modification of the parameters | 12/21/07 | 02 |
| • Implementation of new reflectors<br>• Physical resolution = 0,1mm | 02/05/09 | 03 |
| • General changes<br>• Modification of the warnings<br>• Mounting removed | 03/25/13 | 04 |
| • New design<br>• Laser lifetime | 02/20/15 | 05 |
| • Chapter “Basic rules” added | 02/22/16 | 06 |
| • Technical data removed | 12/11/17 | 07 |


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# 1 General information

This interface-specific User Manual includes the following topics:

- Safety instructions in additional to the basic safety instructions defined in the Assembly Instructions
- Installation
- Commissioning
- Causes of faults and remedies

As the documentation is arranged in a modular structure, this User Manual is supplementary to other documentation, such as product datasheets, dimensional drawings, leaflets and the assembly instructions etc.

The User Manual may be included in the customer's specific delivery package or it may be requested separately.

## 1.1 Applicability

This User Manual applies exclusively to the following measuring system models with ***SSI*** interface:

- LE-200

The products are labelled with affixed nameplates and are components of a system.

The following documentation therefore also applies:

- see chapter “Other applicable documents” in the Assembly Instructions www.tr-electronic.de/f/TR-ELE-BA-DGB-0018.

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## 1.2 Abbreviations used / Terminology

| | |
|---|---|
| LE-200 | ***L***aser Measuring Device, LE-200 series |
| CRC | ***C***ylic ***R***edundancy ***C***heck |
| SSI | ***S***ynchronous-***S***erial-***I***nterface |
| LSB | ***L***east ***S***ignificant ***B***it |
| MSB | ***M***ost ***S***ignificant ***B***it |
| T | Period |
| $t_M$ | SSI mono time |
| $t_p$ | Pause time |
| $t_D$ | Delay time |
| S | Sign |
| 0x | Hexadecimal notation |


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# 2 Additional safety instructions

## 2.1 Definition of symbols and instructions

| | |
|---|---|
| **⚠ WARNING** | means that death or serious injury can occur if the required precautions are not met. |
| **⚠ CAUTION** | means that minor injuries can occur if the required precautions are not met. |
| ***NOTICE*** | means that damage to property can occur if the required precautions are not met. |
|  | indicates important information or features and application tips for the product used. |

## 2.2 Additional instructions for proper use

The measuring system is used for recording linear movements and processing the measured data for a downstream control system with a synchronous-serial interface (SSI).

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

***Proper use also includes:***

- observing all instructions in this User Manual,
- observing the assembly instructions. The ***"Basic safety instructions"*** in particular must be read and understood prior to commencing work.

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## 2.3 Organizational measures

- This User Manual must always kept accessible at the site of operation of the measurement system.
- Prior to commencing work, personnel working with the measurement system must have read and understood
  - the assembly instructions, in particular the chapter ***"Basic safety instructions"***,
  - and this User Manual, in particular the chapter **"Additional safety instructions"**.

This particularly applies for personnel who are only deployed occasionally, e.g. at the parameterization of the measurement system.


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# 3 SSI information

The SSI procedure is a synchronous serial transmission procedure for the measuring system position. By using the RS422 interface for transmission, sufficiently high transmission rates can be achieved.

The measuring system receives a clock sequence from the control and answers with the current position value, which is transmitted serially and is synchronous to sent clock.

Since the data transfer is synchronized by the start of the sequence, it is not necessary to use single-step codes such as Gray code.

The data signals Data+ and Data– are transmitted by means of cable transmitters (RS422). The clock signals Clock+ and Clock– are received by means of optocouplers to protect them from damage resulting from interference, potential differences, or polarity reversal.

Parity bits or checksums can be added to detect faulty transmissions. The simplest measure is to read in the values twice with the data bits being repeated after 26 clock pulses of a sequence. However, this has the disadvantage of considerably increasing transmission times.

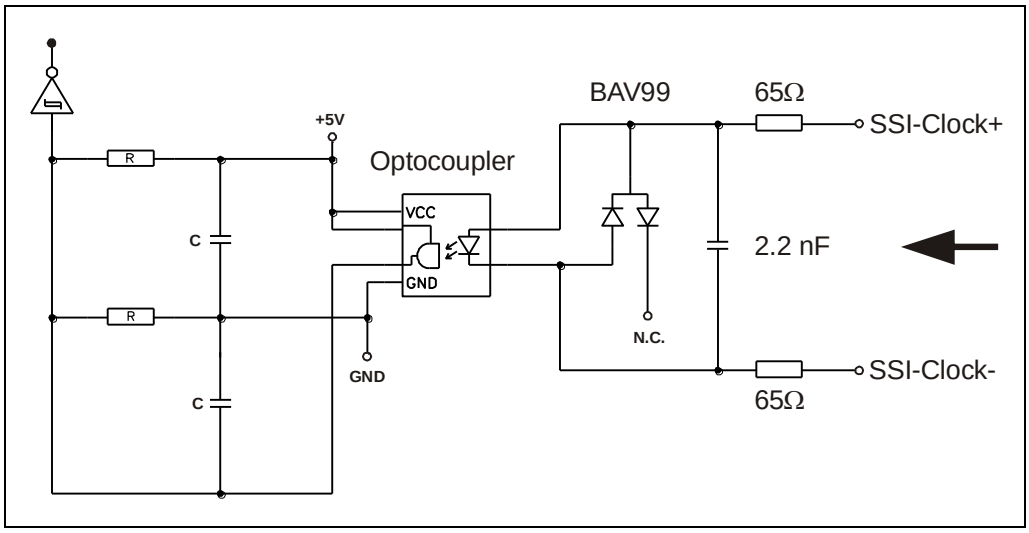


**Figure 1: SSI Principle input circuit**

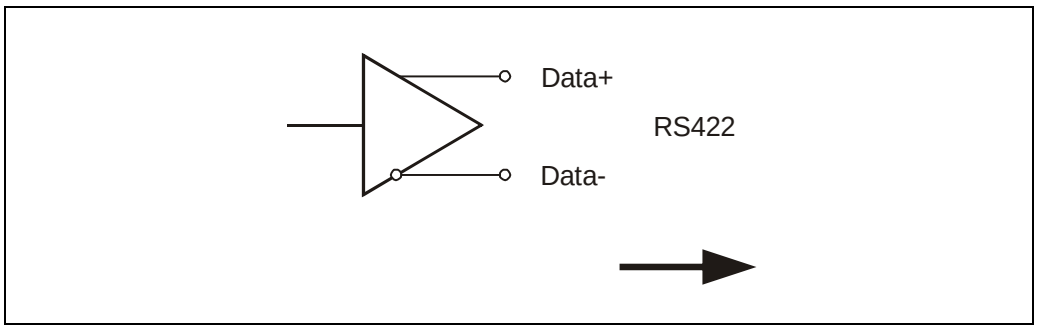


**Figure 2: SSI Output circuit**

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# 4 Installation / Preparation for commissioning

## 4.1 Basic rules

- The shielding effect of cables must also be ensured after installation (bending radii/tensile strength!) and after connector changes. In cases of doubt, use more flexible cables with a higher current carrying capacity.

- Only use connectors for connecting the measuring system, which ensure good contact between the cable shield and the connector housing. Connect the cable shield to the connector housing over a large area.

- A 5-wire cable with a PE-conductor isolated from the N-conductor (so-called TN network) should be used for the drive/motor cabling. This will largely prevent equipotential bonding currents and the development of interference.

- Equipotential bonding measures must be provided for the complete processing chain of the system. In particular compensating currents caused by differences in potential across the shield to the measuring system must be prevented.

- A shielded and stranded data cable must be used to ensure high electromagnetic interference stability of the system. The shielding should be connected with low resistance to protective ground using large shield clips at **both ends**. The shielding should be grounded **in the switch cabinet only** if the machine ground is heavily contaminated with interference towards the switch cabinet ground.

- Power and signal cables must be laid separately. During installation, observe the applicable national safety and installation regulations for data and power cables.

- No stub lines.

- Separation respectively differentiation of the measuring system from possible interfering transmitters.

- Observe the manufacturer's instructions for the installation of converters and for shielding power cables between frequency converter and motor.

- Ensure adequate dimensioning of the energy supply.

- The applicable standards and guidelines are to be observed to insure safe and stable operation. In particular, the applicable EMC directive and the shielding and grounding guidelines must be observed.

- Upon completion of installation, a visual inspection with report should be carried out.


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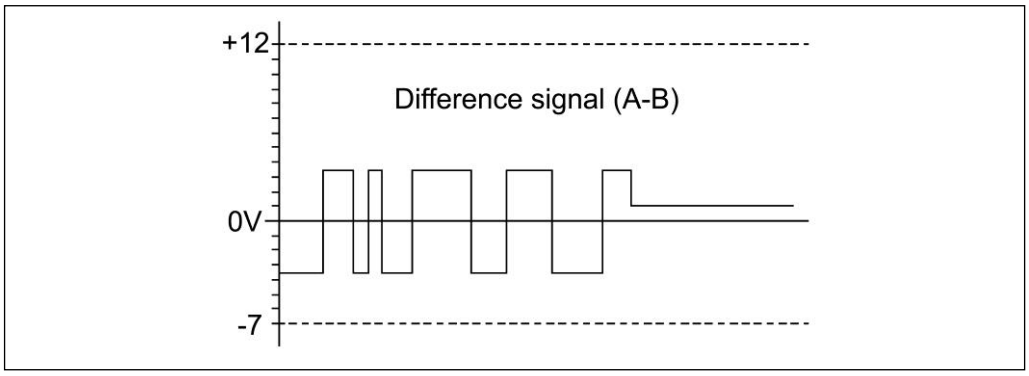
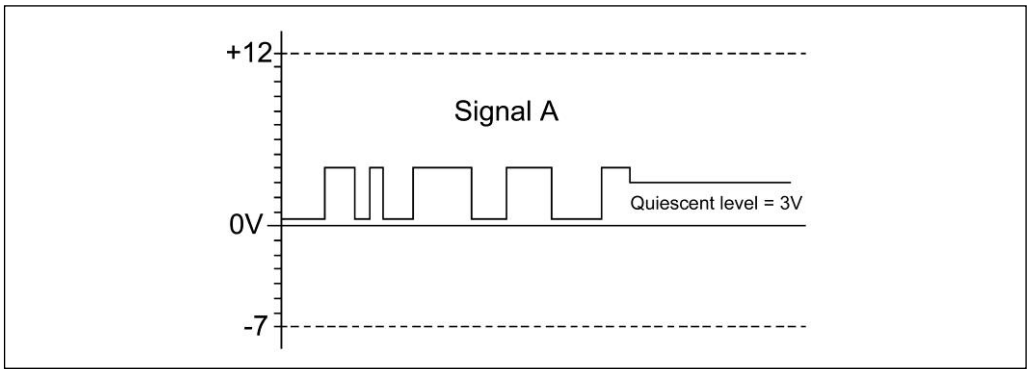
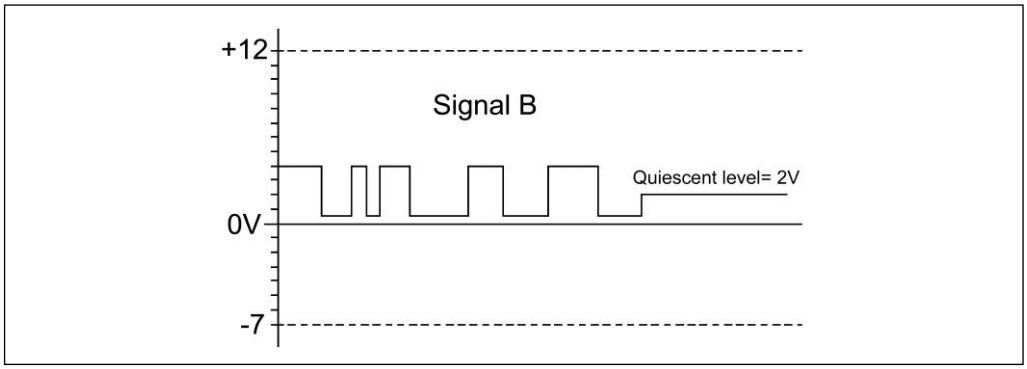
## 4.2 RS422 Data transmission technology

With the RS422 transmission one line-pair is used for the signals Data+ and Data– and one line-pair for the signals Clock+ and Clock–.

The serial data are transmitted without mass reference as a voltage difference between two corresponding lines.
The receiver evaluates only the difference between the two lines. Therefore common-mode interferences on the transmission line do not lead to a corruption of the useful signal.
By the use of shielded and twisted pair cable, data transmissions over distances from up to 500 meters with a frequency of 100 kHz can be realized.
Under load RS422 transmitters provide output levels of ±2V between the two outputs. RS422 receivers still recognize levels of ±200mV as valid signal.

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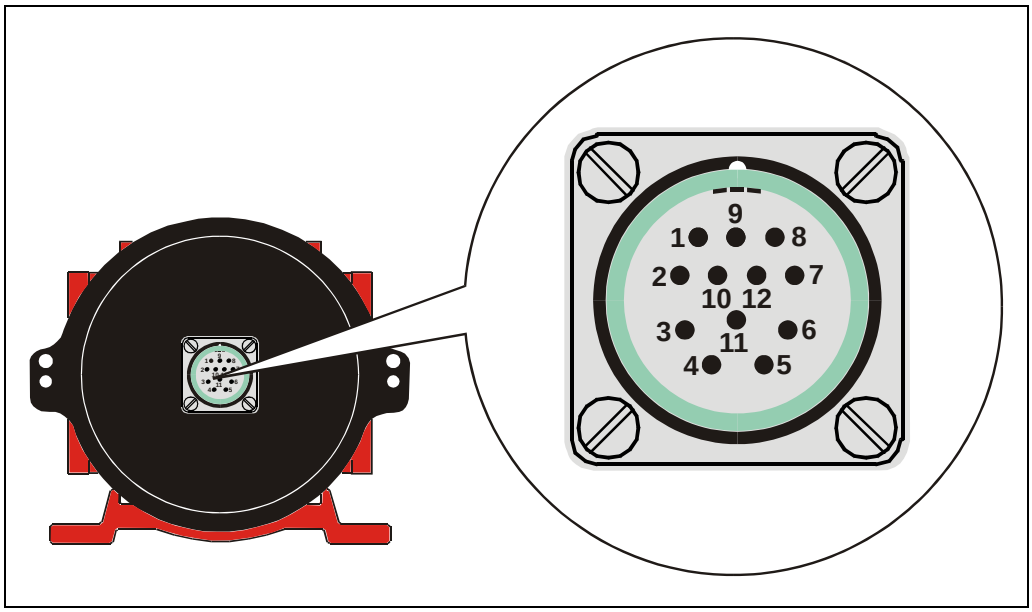
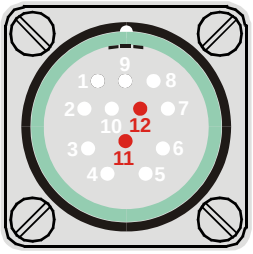
## 4.3 Connection




### 4.3.1 Supply voltage

**Pin 11** Standard: 18 – 27 V DC
Device with heating: 24 V DC (±5%)

**Pin 12** 0V, GND




Cable specification: min. 0.34 mm$^2$ (recommended 0.5 mm$^2$) and shielded.
General the cable cross section and the cable length must be well-matched.

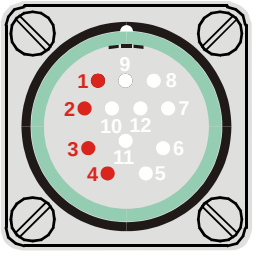
### 4.3.2 SSI interface

**Pin 1** SSI-Clock –

**Pin 2** SSI-Clock +

**Pin 3** SSI-Data +

**Pin 4** SSI-Data –




Cable specification: min. 0.25 mm$^2$ and shielded.
To guarantee the signal quality and minimization of possible environmental influences it is recommended urgently to use a shielded twisted pair cable.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### 4.3.3 Switching input / Switching output

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

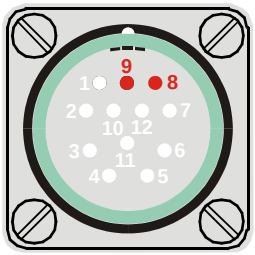
**Functions of the switching input:**

- Preset
- Switch off laser diode
- Failure quit

**Functions of the switching output:**

- Temperature
- Intensity
- Hardware-Fail
- every fail
- Speed-check
- Plausibility measured value
- Switching output position

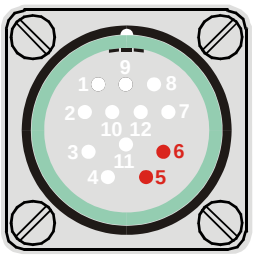
**Pin 8** Switching output
**Pin 9** Switching input




### 4.3.4 RS485 - programming interface

Via the PC software "TRWinProg" and a PC adapter the connection to the laser measuring device is established. More information's see page 15 or in the TRWinProg software manual.

**Pin 5** RS485+
**Pin 6** RS485–




Cable specification: min. 0.25 $mm^2$ and shielded.
To guarantee the signal quality and minimization of possible environmental influences it is recommended urgently to use a shielded twisted pair cable.

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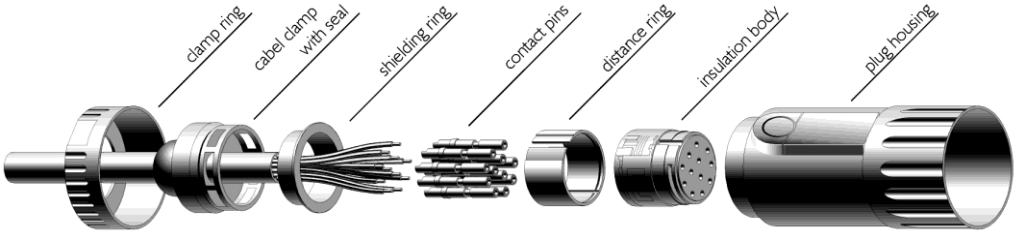
## 4.4 Shielding - Connector mounting

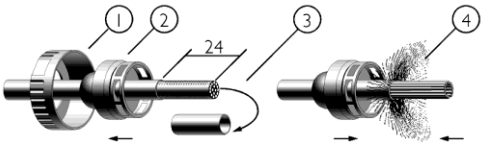



**Step A:**

**1.-2.** Push clamp ring and cable clamp with seal over cable. (If required insert sleeve order no. FC6CX004I00X is helpful)

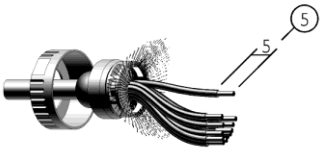
**3.** Strip cable 24mm.

**4.** Push shielding back over cable.




**Step B:**

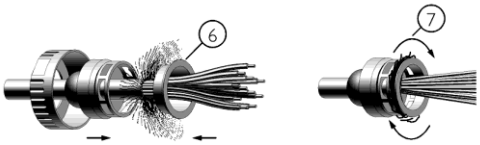
**5.** Strip cores 5mm.




**Step C:**

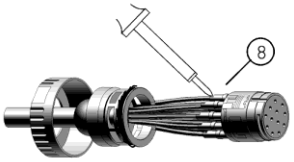
**6.** Put shielding ring on.

**7.** Twist remaining shielding around shielding ring.




**Step D:**

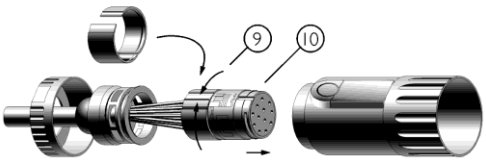
**8.** Solder wires in contacts.



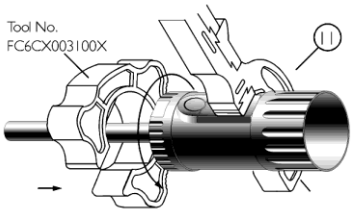

**Step E:**

**9.** Snap distance ring over insulation body.

**10.** Push insulation body into bridge of plug housing.




**11.** Screw clamp ring onto plug housing.





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## 4.5 Connection to the PC (Programming)

What will be needed by TR-Electronic?

- **Switch cabinet module Order-No.: 490-00101**

- **Programming set Order-No.: 490-00310:**

  - **Plastic case,**
    with the following components:

    – USB PC adapter V4
    Conversion USB <--> RS485

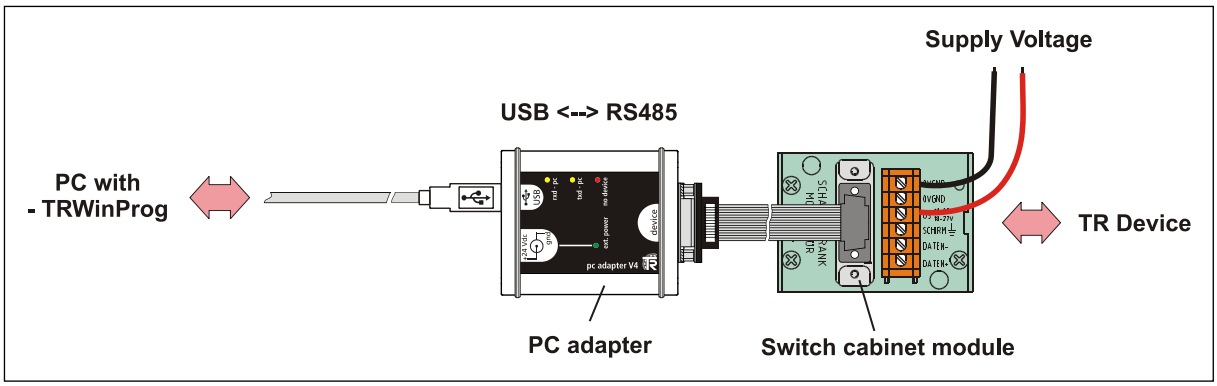
    – USB cable 1.00 m
    Connection cable between
    PC adapter and PC

    – Flat ribbon cable 1.30 m
    Connection cable between
    PC adapter and TR switch cabinet module
    (15-pol. SUB-D female/male)

    – Plug Power Supply Unit 24 V DC, 1A
    The connected device can be supplied via the PC adapter

    – Software- and Support-DVD
    - USB driver, Soft-No.: 490-00421
    - TRWinProg, Soft-No.: 490-00416
    - EPROGW32, Soft-No.: 490-00418
    - LTProg, Soft-No.: 490-00415

    – Installation Guide
    TR-E-TI-DGB-0074, German/English




*For operation ex Windows 7 the USB PC adapter HID V5 / SSI, order no.: 490-00313 / 490-00314 with installation guide TR-E-TI-DGB-0103 must be used.*

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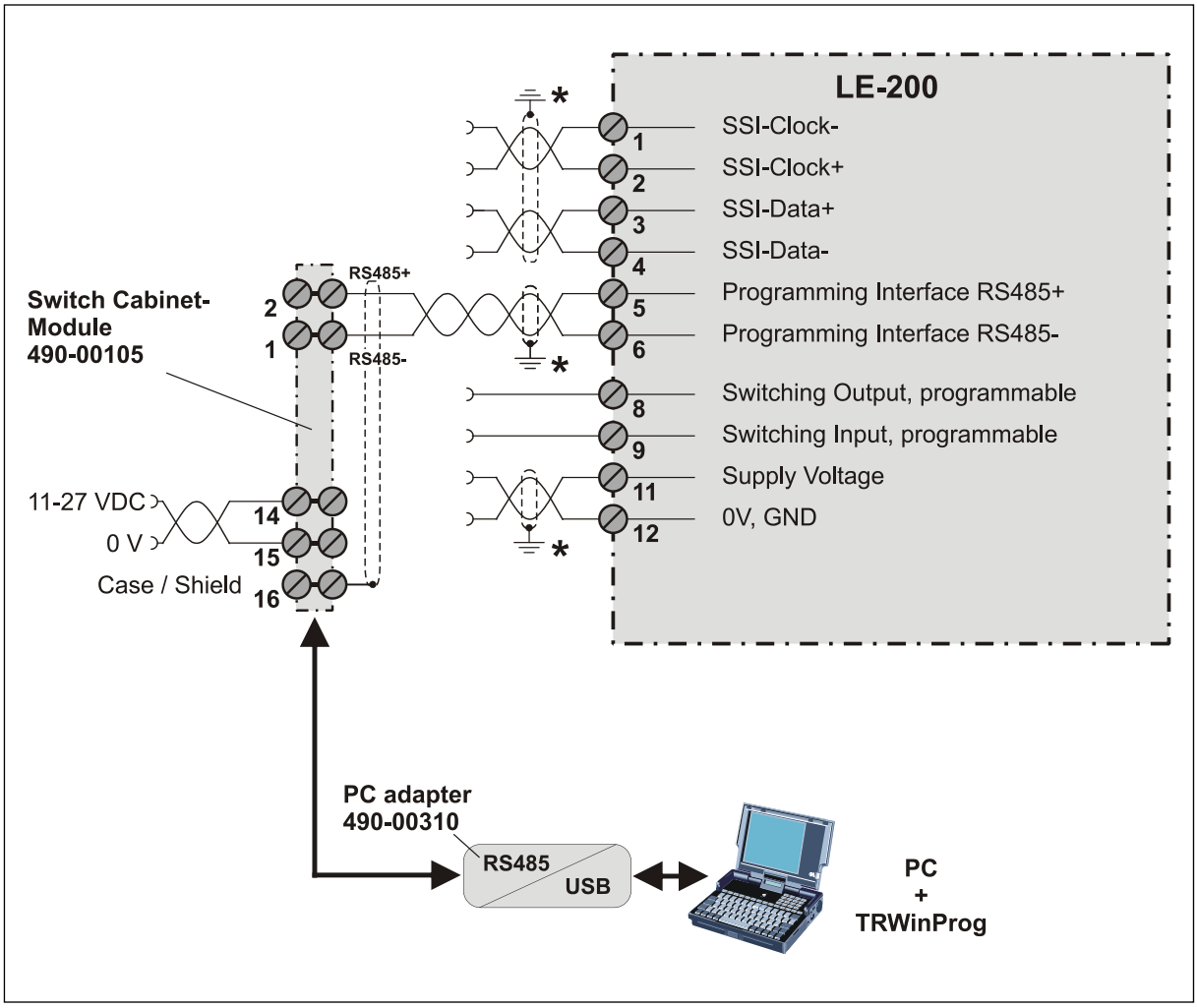
## 4.6 Wiring examples

***** Shield connection, see chapter “Shielding - Connector mounting” on page 15.

RS485 / SSI - connection with parameter setting via "TRWinProg"





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## 4.7 SSI interface

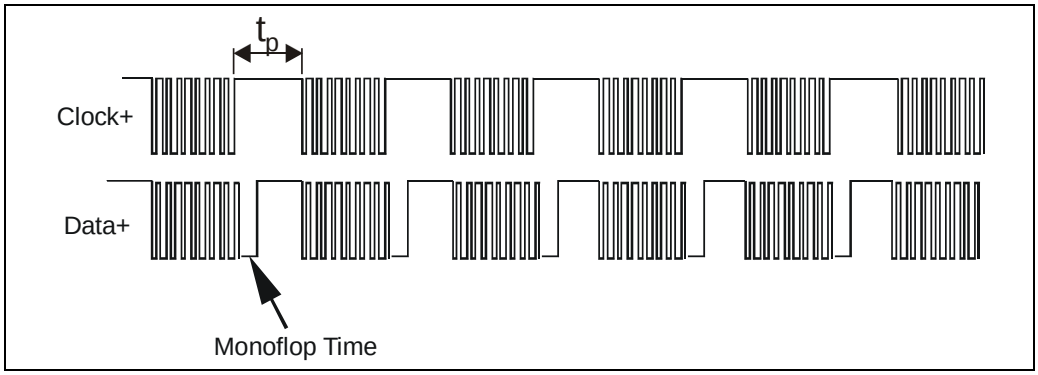
In the idle condition the signals Data+ and Clock+ are high. This corresponds the time before item (1) is following, see chart indicated below.
With the first change of the clock pulse from high to low (1) the internal-device-monoflop (can be retriggered) is set with the monoflop time $t_M$.
The time $t_M$ is set to 20 µs and determines the lowest transfer frequency of approximately 80 kHz. The upper limit frequency results from the total of all the signal delay times and is limited additional by the built-in filter circuits to approx. 820 kHz.

With each further falling clock edge the active condition of the monoflop extends by further 20µs, at last at item (4).
With setting of the monoflop (1), the bit-parallel data on the parallel-serial-converter will be stored via an internal signal in the input latch of the shift register. This ensures that the data cannot change during the transmission of a position value.

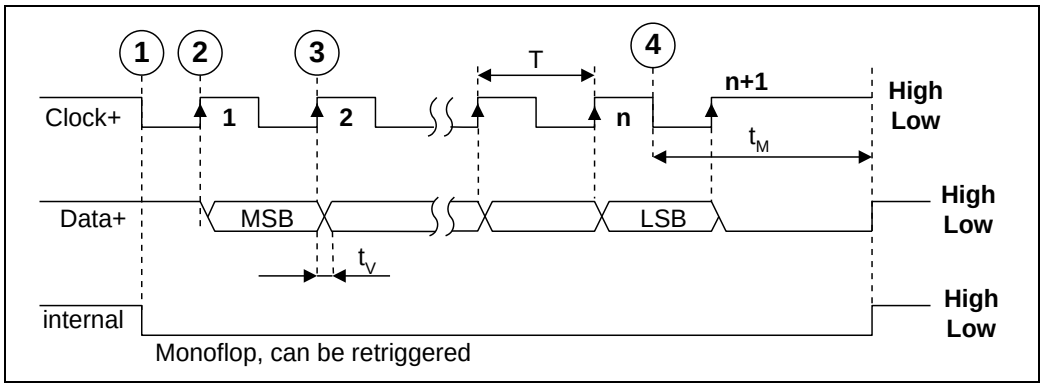
With the first change of the clock pulse from low to high (2) the most significant bit (MSB) of the device information will be output to the serial data output. With each following rising edge of the clock pulse, the next lower significant bit is set on the data output.
When the clock sequence is finished, the system keeps the data lines at 0V (Low) for the duration of the mono period, $t_M$ (4). With this, the admissible break time $t_p$ between two successive clock sequences is determined and is >20µs.

Caused be the delay time $t_v$ (approx. 100ns, without cable), the evaluation electronic must be read-in the data only at time (3). This corresponds to the second rising clock edge. For this reason the number of clock pulses corresponds the number of data bits +1.

Typical SSI - transmission sequences




SSI transmission format

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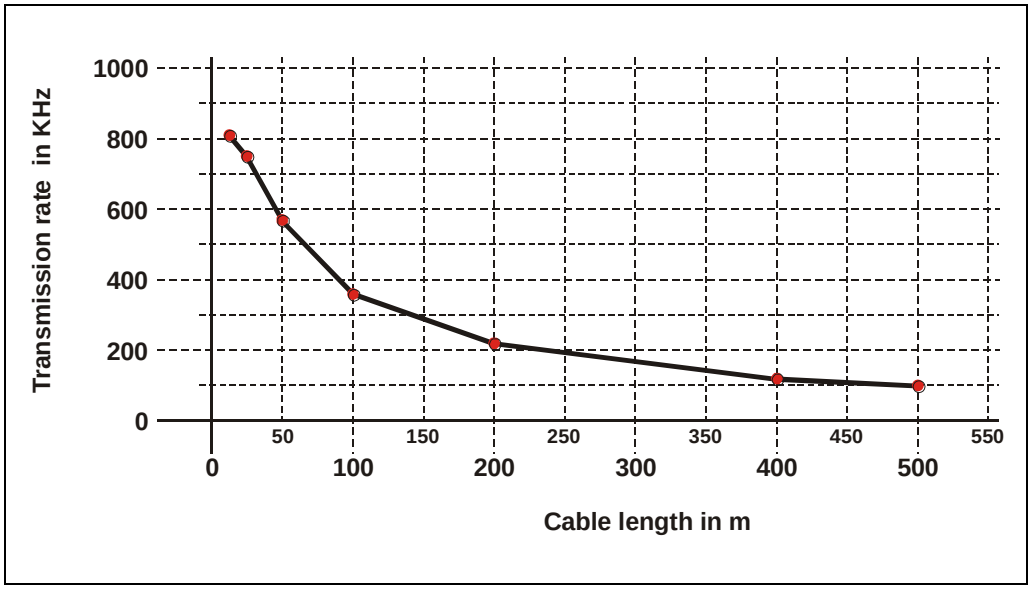
The maximum cable length depends on the SSI clock frequency and should be conditioned to the following diagram.
Pay attention, that per meter cable with an additional delay-time of approx. 6ns must be calculated.




| Cable length [m] | SSI-clock frequency [kHz] |
|---|---|
| 12,5 | 810 |
| 25 | 750 |
| 50 | 570 |
| 100 | 360 |
| 200 | 220 |
| 400 | 120 |
| 500 | 100 |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# 5 Configuration / Parameter setting via TRWinProg

## 5.1 Basic parameter

### 5.1.1 Count direction

The counting direction defines whether increasing or decreasing position values are output.

| Selection | Description | Default |
|---|---|---|
| Up | With increasing distance to the laser, values increasing | X |
| Down | With increasing distance to the laser, values decreasing | |

### 5.1.2 Resolution

Definition of the measuring system resolution.

| Selection | Default |
|---|---|
| 10 mm | |
| 1 mm | X |
| 1/10 mm | |
| 1/100 mm | |
| 1 Inch | |
| 1/10 Inch | |
| 1/8 mm | |
| Free resolution (in 1/100 mm), valid values are 1 - 65535<br>For example 1 mm corresponds the input value of 100.<br>That means the laser outputs 1 step/mm. | 100 |

### 5.1.3 Measuring-Dynamic

Measuring-dynamic is an parameter, who characterize mathematic calculation of the measure-value. With high measuring-dynamic there is no mathematic calculation on the measure-value, but the noise of the measure-value is larger, in case of small measuring-dynamic the noise is lower, but there exist a small time-delay for the measure-value.

| Selection | Default |
|---|---|
| slow | |
| mid | X |
| high | |

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### 5.1.4 Measuring-Output-Time

The Measuring-Output-Time defines the time for calculating the measuring value.

| Selection | Default |
|---|---|
| 1 ms | X |
| 2 ms | |
| 3 ms | |
| 4 ms | |
| 5 ms | |
| 6 ms | |
| 7 ms | |
| 8 ms | |
| 9 ms | |
| 10 ms | |
| 15 ms | |
| 20 ms | |
| 25 ms | |
| 30 ms | |
| 50 ms | |
| 100 ms | |
| 200 ms | |
| 500 ms | |

### 5.1.5 Physical Resolution

The physical resolution of the measuring system is the smallest possible resolution, with which the measured value can be produced.

| Selection | Default |
|---|---|
| 0.76 mm | X |
| 0.1 mm | |


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## 5.2 SSI interface

### 5.2.1 Number of data bits

The number of data bits defines the max. number of data bits which can be transferred on the SSI interface. A possibly defined error bit is not contained.

| Selection | Description | Default |
|---|---|---|
| 12 bit | Number of SSI data bits = 12 | |
| - - - | - - - | |
| 24 bit | Number of SSI data bits = 24 | X |
| 25 bit | Number of SSI data bits = 25 | |
| 26 bit | Number of SSI data bits = 26 | |
| 27 bit | Number of SSI data bits = 27 | |
| 28 bit | Number of SSI data bits = 28 | |
| 29 bit | Number of SSI data bits = 29 | |
| 30 bit | Number of SSI data bits = 30 | |
| 31 bit | Number of SSI data bits = 31 | |
| 32 bit | Number of SSI data bits = 32 | |

### 5.2.2 Code

Defines the SSI output code.

| Selection | Description | Default |
|---|---|---|
| Gray | SSI output code = Gray | X |
| Binary | SSI output code = Binary | |

### 5.2.3 Fail-Bit SSI

The SSI error bit is an additional bit in the SSI protocol and is attached after the "LSB-bit". Definition of errors see "Device state", page 27.

| Selection | Default |
|---|---|
| disabled | X |
| Temperature | |
| Intensity | |
| Hardware | |
| Every Failure | |
| Plausibility measured value | |

### 5.2.4 Output value SSI

The SSI output value specifies the value, which is output on the SSI interface.

| Selection | Description | Default |
|---|---|---|
| Position | Output of the Laser position | X |
| Intensity | Output of the Laser intensity value | |
| Speed | Output of the Laser actual speed | |
| Position + Speed | 21 bit position data, 11 bit speed. The number of data bits must be set to 32. Max. possible resolution = 0.1 mm. | |

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## 5.3 Failure-Handling

### 5.3.1 Fail Output

Determines the function of the error output (external switching output). Definition of errors see "Device state", page 27.

| Selection | Default |
|---|---|
| disabled | X |
| Temperature | |
| Intensity | |
| Hardware-Fail | |
| every fail | |
| Speed-check | |
| Plausibility measured value | |
| Switching output position | |

### 5.3.2 Level Fail Output

Specifies the active output level of the selected error, if the error occurs.

| Selection | Description | Default |
|---|---|---|
| active HIGH | Error active, Switching Output = HIGH | X |
| active LOW | Error active, Switching Output = LOW | |

### 5.3.3 Failure-quit

Determines, whether occurring error reports should be cleared automatically after eliminating the trouble.

| Selection | Description | Default |
|---|---|---|
| automatic | An occurring error report is cleared automatically after remedying of the error. | X |
| not automatic | An occurring error report can be cleared only via the external switching input (see "Function ext. Input (Switching Input)", page 25). | |


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### 5.3.4 Output value in case of an error

Determines, which data value is to be transmitted 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.

| Selection | Description | Default |
|---|---|---|
| all 0 | The position is set to "0" | X |
| all 1 | All 24 bits are set to '1' (0xFFFFFF or -1) | |
| last valid value | Output of the last valid position | |

### 5.3.5 Warning bit Temperature from

Determines, starting from which temperature the warning bit or switching output will be set.

| Selection | Description | Default |
|---|---|---|
| 47 | Message, if device temperature ≥ 47 °C | |
| 48 | Message, if device temperature ≥ 48 °C | |
| 49 | Message, if device temperature ≥ 49 °C | |
| 50 | Message, if device temperature ≥ 50 °C | X |

### 5.3.6 Warning bit Intensity under

Determines, starting from which intensity value of the laser beam the warning bit or switching output will be set.

| Input | Description | Default |
|---|---|---|
| 1 – 100 [%] | Message, if intensity value < Input value | 12 % |

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## 5.4 Preset

### 5.4.1 Function ext. Input (Switching Input)

**⚠ WARNING**

***NOTICE***

***Risk of injury and damage to property by an actual value jump when the `Preset function` is performed!***

- The *`preset function`* should only be performed at rest, otherwise the resulting actual value jump must be permitted in the program and application!

Determines, whether the switching input is to be used as
- Preset input
- Switch-off Laser-Diode (LD) or
- Failure reset - input

With connection of the switching input as Preset-input the laser is adjusted on the predefined position value in chapter "Preset-Value", page 26. With connection the switching input as LD-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 LD-switching input does not have a function.

| Selection | Description | Default |
|---|---|---|
| disabled | Function switched off, following parameters without meaning. | X |
| Preset function | External switching input is determined as Preset input. | |
| LD switching input | External switching input is used for switching-off of the laser diode. | |
| Error acknowledgement | External switching input is used as error acknowledgement. | |

### 5.4.2 Active Input-Slope

It determines whether the function of the switching input is activated with an rising or falling edge at the switching input.

| Selection | Description | Default |
|---|---|---|
| Low->High | Function release with rising edge | X |
| High->Low | Function release with falling edge | |


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### 5.4.3 Input-Active-Time

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

| Selection | Description | Default |
|---|---|---|
| 100 ms | Response time = 100 ms | X |
| 200 ms | Response time = 200 ms | |
| 500 ms | Response time = 500 ms | |
| 1000 ms | Response time = 1000 ms | |

### 5.4.4 Preset-Value

Definition of the position value to which the laser is adjusted, when the preset function is executed (see "Function ext. Input (Switching Input)", page 25).
The preset value must be programmed in the range from 0 ... measuring length (see "Range" (see "Range" in the device specific data sheet). ***Default value is "0".***

### 5.4.5 Preset reset

**⚠ WARNING**

***NOTICE***

***Risk of injury and damage to property by an actual value jump when the `clear preset function` is performed!***

- The `clear preset function` should only be performed at rest, otherwise the resulting actual value jump must be permitted in the program and application!

Via this parameter, the calculated zero-point is deleted (difference of the desired preset value to the physical laser position). After deletion of the zero-point correction the laser outputs his "real" physical position. With the adjusting = "Yes" no Preset/Adjustment can be executed.

| Selection | Description | Default |
|---|---|---|
| Yes | Clear Preset | X |
| No | No clearing | |

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## 5.5 Actual values

In this tab all required operation parameters will be displayed:

- Position, with the resolution adjusted in the basic parameters
- Intensity [%]
- Device-Temperature [°C]
- Speed, with the output format adjusted in the speed parameters
- Device state
- Hardware-Info

### 5.5.1 Position

By writing of a value into the field position the laser can be adjusted on the desired position value. The execution is carried out with transmission of the values to the laser measuring device.
The value must be programmed in the range from 0 ... measuring length (see "Range" in the device specific data sheet).

### 5.5.2 Device state

The device state displays the actual state of the device and is coded bitwise:

| Error-Code | Description |
|---|---|
| Intensity<br>Bit 0 | 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 (see chapter "5.3.4", page 23). |
| Temperature<br>Bit 1 | 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<br>Bit 2 | The bit is set, if an internal hardware error were noticed and leads to the error value output<br>(see chapter "5.3.4", page 23). |
| Laser diode switched off<br>Bit 3 | The bit is set, if the laser diode was switched off over the switching input. Serves only for information purposes. |
| Intensity warning<br>Bit 4 | 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<br>Bit 5 | 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. |
| Warning bit Plausibility<br>Bit 6 | 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. |


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### 5.5.3 Hardware-Info

The Hardware-Info refers to bit two "Hardware Error" in the Device state and specifies the hardware error in detail.

| Error-Code |
|---|
| Bit 0, Failure Fieldbus-Chip |
| Bit 1, undefined Measuring length |
| Bit 2, Failure Temperature-Sensor |
| Bit 3, Failure ext. Flash |

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## 5.6 Speed

### 5.6.1 Speed-Values

Adjusting of the velocity level. If the adjusted velocity level is exceeded, this is signalized with the setting of the switching output. For this, about the function of the switching output the output must be defined as "Speed-check" (see "Fail Output", page 23).

| Selection | Description | Default |
|---|---|---|
| 0 | Function disabled | X |
| free input: 1 - 200 | Speed in 0,1 m/s | |

### 5.6.2 Dynamic

Time constant for calculating the speed.

| Selection | Description | Default |
|---|---|---|
| Auto-Dynamic | Dynamic ranging depending from the speed level. | X |
| Range 1 | lower delay, higher noise | |
| Range 2 | middle delay, middle noise | |
| Range 3 | higher delay, lower noise | |

### 5.6.3 Output-Format

Definition of the output format for the speed which is displayed in the tab *Actual values*.

| Selection | Description | Default |
|---|---|---|
| 1 mm / sec | Output of the speed in 1 mm/s | |
| 10 mm / sec | Output of the speed in 10 mm/s | X |

### 5.6.4 Sign

Definition if the speed, which is displayed in the tab *Actual value*, is output with sign or without sign.

| Selection | Description | Default |
|---|---|---|
| no sign, always positive | Output without sign | X |
| direction depending sign | Output as value with sign | |


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# 6 Causes of Faults and Remedies

The error causes are determined in chapter "Device state", page 27. Depending on setting the error messages must be acknowledged for resetting the error, see chapter "Failure-quit", page 23.

| Error | Cause | Remedy |
|---|---|---|
| Bit 0<br>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<br>2. Clean reflecting foil<br>3. Rule out an interruption of the laser beam<br><br>If the possibility of soiling or interruption of the laser signal can be ruled out, the device must be replaced. |
| Bit 1<br>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<br>Hardware error | The device has detected an internal hardware error. | If the error occurs repeated, the device must be replaced. |
| Bit 3<br>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<br>Intensity warning | The device determined 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<br>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<br>Plausibility warning | The plausibility of the measured value couldn't be guaranteed any more. | This message is a warning and means that possibly corresponding measures must be taken, so that no system components will be damaged. |

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