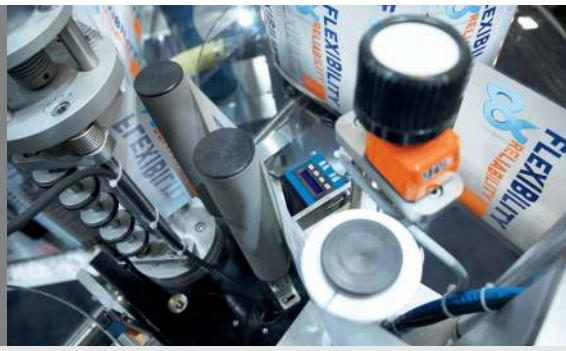
OPERATING INSTRUCTIONS



ML20

Markless Sensors

EN

SICK
Sensor Intelligence.

Contents

Contents

Contents

Contents

1 General

1.1 Information on the operating instructions

These operating instructions provide important notes on handling of the Markless sensors ML20 of SICK AG. The prerequisite for secure work is compliance with all the indicate safety notes and instructions for action.

Additionally, the work safety regulations applicable for the area of use of the Markless sensor and the general safety provisions must be complied with.

The operating instructions must be read before taking up any work! It is part of the product and must be kept in the direct proximity of the Markless sensor, accessible for staff at any time.

When passing on the Markless sensor to any third parties, also pass along the operating instructions.

NOTE!

For operation of the Markless sensor ML20, encoder impulses are required that can be generated, e.g. by a motor feedback system or the incremental encoder.

1.2 Explanation of symbols

Warnings

Warnings are marked with symbols in these operating instructions. The notes are initiated with signal words that express the scope of danger.

Always comply with the notes and act with care to avoid accident, injury and property damage.

DANGER!

... indicates a directly dangerous situation that will lead to death or severe injury if not avoided.

WARNING!

... indicates a potentially dangerous situation that may lead to death or severe injury if not avoided.

CAUTION!

... indicates a potentially dangerous situation that may lead to light or minor injury if not avoided.

ATTENTION!

... indicates a potentially harmful situation that may lead to property damage if not avoided.

Advice and recommendations

NOTE!

... emphasizes useful advice and recommendations, as well as information for efficient and trouble-free operation.

1.3 Limitation of liability

All information and notes in these instructions were assembled under observation of the applicable standards and regulations, the state of the art and our long-term insights.

The manufacturer does not assume any liability for damage due to:

- Non-observance of the operating instructions
- Other than intended use
- Use of untrained staff
- Independent conversion
- Technical changes
- Use of un-approved spare and wear parts

The actual delivery may deviate from the features and presentations described here in case of special designs, utilization of additional order options or due to the latest technical changes.

1.4 Delivery

Included in delivery:

- Markless sensor ML20
- Dummy plug for Ethernet plug
- Alignment tool
- Optional: Accessories (→ page 82, chapter 16)

Included documentation per Markless sensor:

- Quickstart

1.5 Customer service

Our customer service is available for technical information.

For your representative, see the reverse.

NOTE!

For quick processing, write down the type designation, serial number and software version before calling. Type designation and serial number can be taken from the type label. → page 13, Fig. 1. The software version can also be read out via the parameter "SWVers" at the sensor. → See page 45, Table 13.

1.6 EC declaration of conformity

→ The EC Declaration of Conformity can be downloaded online from "www.mysick.com/en/ml20".

1.7 Environmental protection

→ See page 77, chapter 13.4 "Disposal".

2 Safety

2.1 Intended use

The Markless sensor ML20 is an opto-electronic sensor intended for non-contact recognition of repeat patterns. For operation of the Markless sensor ML20, encoder impulses are required that can be generated, e.g. by a motor feedback system.

SICK AG does not assume any liability for any direct or indirect loss or damage from use of the product. This specifically applies for any other use of the product that does not correspond to the intended purpose and that is not described or mentioned in this documentation.

2.2 Non-intended use

The Markless sensor ML20 is not a safety component according to the EC Machinery Directive (2006/42/EC).

The Markless sensors must not be used in potentially explosive areas.

All uses not described as intended use are forbidden.

No accessories must be connected or installed that are not expressly specified in quantity and characteristics and has been released by SICK AG.

WARNING!

Danger from non-intended use!

Any non-intended use may lead to dangerous situations.

Therefore:

- Markless sensors must only be used according to the intended use.
- Any information in the operating instructions must be strictly complied with.

2.3 Changes and conversions

Changes and conversions at the Markless sensor or the installation may cause unexpected danger.

Written consent of the manufacturer must be procured before any technical changes and expansions are performed at the Markless sensor.

2.4 Requirements to skilled persons and operating staff

WARNING!

Danger of injury in case of insufficient qualification!

Improper handling may cause considerable personal injury and property damage.

Therefore:

- Any work must only be performed only by the persons designated for it.

The operating instructions name the following qualification requirements for the different areas of activity:

- **Instructed persons**
  were informed of the tasks assigned to them and the possible dangers in case of improper conduct in an instruction by the operator.
- **Skilled persons**
  are able to perform the work assigned to them and to independently recognize possible dangers due to their technical training, know-how and experience, as well as knowledge of the relevant provisions.
- **Electricians**
  are able to perform work at electrical plants and to independently recognize possible dangers due to their technical training, know-how and experience as well as their knowledge of the relevant standards and provisions.
  In Germany, the electrician must meet the requirements of the work safety regulations BGV A3 (e.g. Elektroinstallateur-Meister). In other countries, corresponding provisions apply that must be observed.

2.5 Work safety and special dangers

Observe the safety notes listed here and the warning notes in the other chapters of these instructions to reduce health danger and avoid dangerous situations.

2.6 Danger notes and work safety

Light source

The Markless sensor ML20 is equipped with LED lighting. The sensor corresponds to risk category 1 according to IEC 62471:2006.

No special measures are required.

3 Identification

3.1 Type label

The type label is located on the back of the Markless sensor.

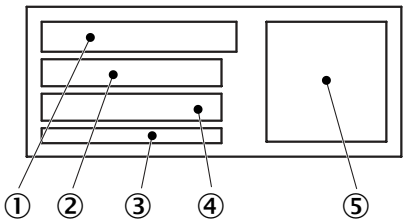


Fig. 1: Type label

1 Type designation

2 Material number

3 MAC address

4 Serial number

5 Machine-readable code

4 Structure and function

4.1 Structure

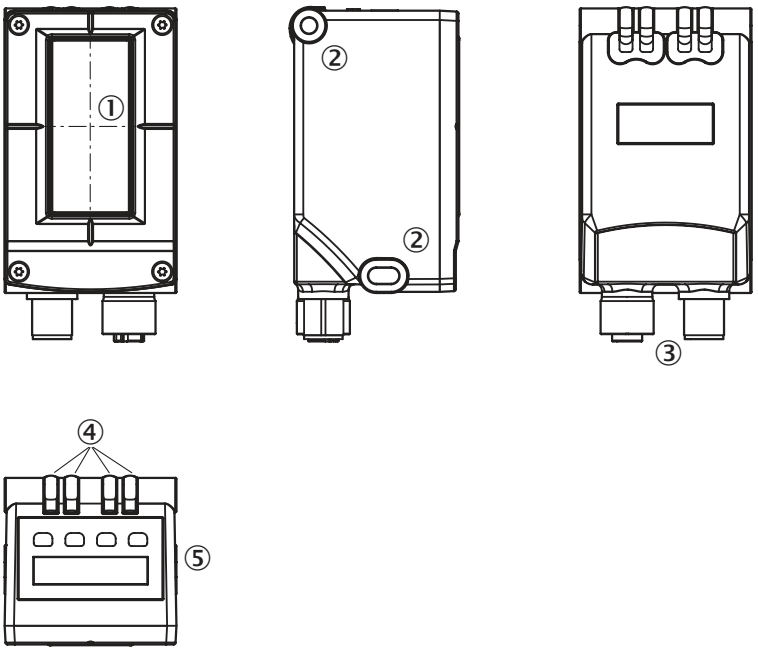


Fig. 2: Structure "Markless sensor ML20"

1 Center of the visual axis

2 Attachment bore

3 Plug M12, 12-pin/female connectorM12, 4-pin, rotatable
→ See page 26, chapter 7.4.

4 Function indicator

5 Display and operating unit

4.2 Function

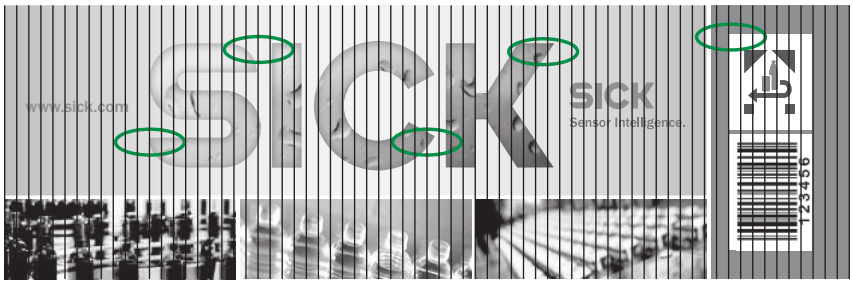


Fig. 3: Image recording from the perspective of the "Markless sensor ML20"

Vertical strokes:
Section recordings of the individual cables, corresponds to the encoder resolution (→ see page 80, chapter 15.7).

Oval marks:
High-contrast areas automatically selected by the sensor. Examples for five areas. With the same image and contrast pattern, the circles are located in precisely the same areas.

The Markless sensor ML20 is an opto-electronic sensor intended for non-contact recognition of repeat patterns.

The principle of operation is based on a line camera that continually scans for contrast differences and sharp edges in the present print image (see figure). These significant points are automatically selected by the sensor during teaching. With the same image and contrast pattern, the points are located in precisely the same areas. The sensor assesses grayscales.

A taught-in image serves as reference for subsequent recognition of a repeat contrast pattern. Print marks are no longer required.

For operation of the Markless sensor ML20, encoder impulses are required that can be generated, e.g. by a motor feedback system or the incremental encoder.

4.3 Display and operating elements

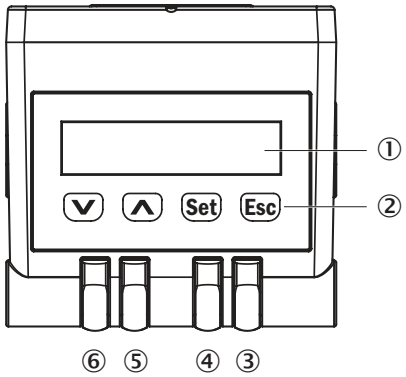


Fig. 4: Display and operating elements

1 *Display*
2 *Buttons*
3 *Function indicator (yellow) "Act"*
4 *Function indicator (green) "Link"*
5 *Function indicator (yellow) "Q"*
6 *Function indicator (green) "On"*

Function indicators (LEDs)

Function indicator	Description
Act	Indication data transfer • LED yellow: Data transfer • LED off: No data transfer
Link	Indication Ethernet connection • LED green: Ethernet connection present • LED off: No Ethernet connection present
Q	Indication switching output • LED yellow: Output high • LED off: Output low
On	Indication operating status • LED green: Regular operation/supply voltage pending • LED off: No operation

Table 1: Function indicators (LEDs)

Symbols for modes

The Markless sensor distinguishes between the modes "Operation", "Commissioning" and "Parameterization and Diagnosis".

Symbol	Description
RUN	The symbol RUN is displayed in operating mode. The symbol RUN goes out when the teach quality is displayed or during sensor update.
SET	The symbol SET is displayed in commissioning mode. Commissioning comprises the following steps: • Encoder settings • Teach mode • Offset settings
MEN	The symbol MEN is displayed in the parameterization and diagnosis mode.

Table 2: Symbols for modes

Buttons

Button	Description
(V)	• Select menu, parameter or option. • Reduce value.
(^)	• Select menu, parameter or option. • Increase value.
Set	• Push for 2 seconds: Switch to the "Menu" level. • Push briefly: – Switch to the next-lower menu level. – Save parameter change. – Confirm selection.
Esc	• Push briefly: Leave parameters without saving. Switch to the next-higher menu level. • Push longer: Leave parameters without saving. Switch to the bar graph display.

Table 3: Buttons

4.4 Display

Operating indicator

By default, the process quality is displayed in operating mode via a bar display:

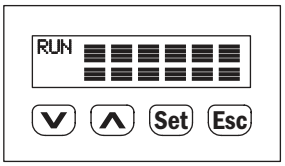


Fig. 5: Operating indicator

Parameter display

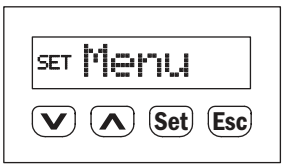


Fig. 6: Parameter display

Diagnosis display

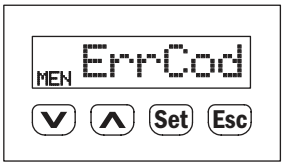


Fig. 7: Diagnosis display

4.5 Bar graph

Teach mode

In teach mode, the number of flashing bars shows the quality of teaching:

- 3 or more bars are flashing: Teaching process successful.
- Less than 3 bars are flashing: Check that the signal switches correctly. If the signal does not switch correctly, repeat teaching.

Operating mode

In operating mode, the number of bars signals process quality.

5 Transport and storage

5.1 Transport

Improper transport

ATTENTION!

Damage to the Markless sensors from improper transport!

Improper transport may cause considerable property damage.

Therefore:

- Transport must only be performed by trained workers.
- When unloading and during internal transport, always proceed with the greatest care and caution.
- Observe the symbols on the packaging.
- Remove the packaging only right before assembly starts.

5.2 Transport inspection

Improper transport

Check delivery for completeness and transport damage without delay upon receipt.

Proceed as follows in case of outwardly visible transport damage:

- Do not accept the delivery, or accept it under reservation only.
- Mark scope of damage on the transport documents or the delivery note of the transporter.
- Feed complaint.

NOTE!

Report every defect as soon as it has been recognized. Damages claims can only be asserted within the applicable complaint periods.

5.3 Storage

Store the Markless sensor under the following conditions:

- Do not keep outdoors.
- Store dry and dust-free.
- Do not expose to any aggressive media.
- Protect from solar irradiation.
- Avoid mechanic shock.
- Storage temperature: –20 to +75 °C.
- Relative humidity: max. 95 %, not condensing.
- In case of storage of more than 3 months, regularly inspect the condition of all components and the packaging.

6 Mounting

6.1 Mounting process

1. Select the mounting site for the Markless sensor according to the following chapter "Requirements to the mounting site".
2. Mount the Markless sensor via the fixing holes.
   → Dimensions see page 78, chapter 15.1.
   → Mounting aids see page 83, chapter 16.2.

6.2 Requirements to the mounting site

The mounting site must meet the following requirements:

- Technical data, → see page 78, chapter 15.
- The light spot must cover the significant area of the print image (→ see page 20, Fig. 8). Select an area with a high contrast difference as significant area. The center of the light spot is marked with a groove on the housing top.
- Scanning distance: 20 mm
  The scanning distance from the front edge of the sensor (housing edge) to the object to be detected, such as and object
- Angle: 15° (→ see page 21, Fig. 9)

NOTE!

We recommend using the included alignment tool to align the Markless sensor. → page 21, Fig. 11.

Significant areas

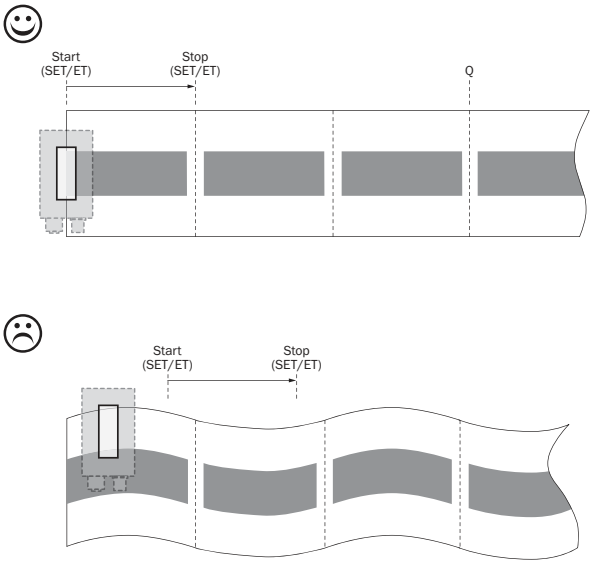
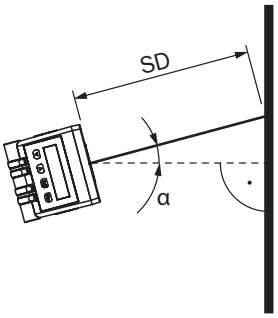


Fig. 8: Align light spot with print image

The gray rectangles correspond to the printed area.

Alignment when sensing on level areas or level material



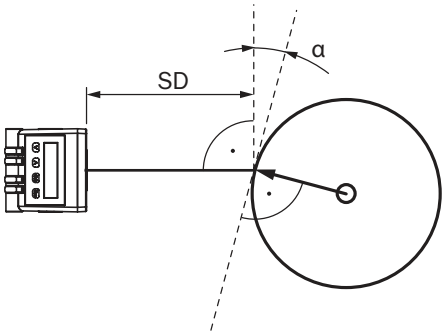
α ~ 15°; SD = Sensing distance

Fig. 9: Alignment of Markless sensor when sensing on level areas or level material

α: Angle 15°

SD: Sensing distance 20 mm

Placement when sensing round runs



α ~ 15°; SD = Sensing distance

Fig. 10: Placement of Markless sensor when sensing round runs

α: Angle 15°

SD: Sensing distance 20 mm

Application of alignment tool

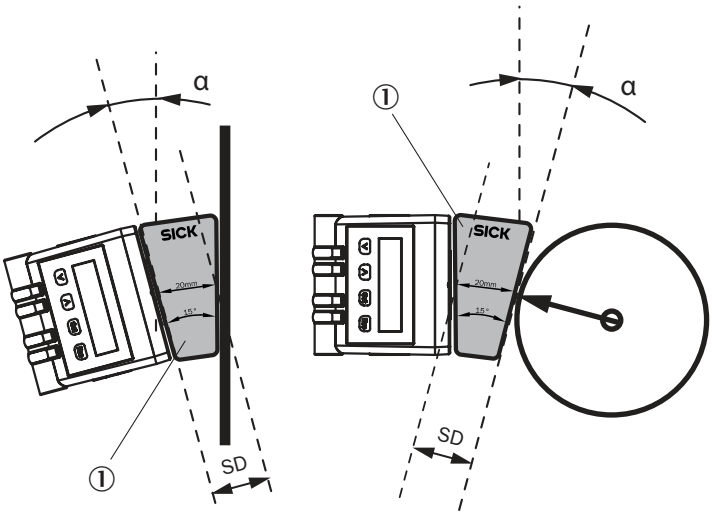


Fig. 11: Application of alignment tool

7 Electrical connection

7.1 Safety

Wrong supply voltage

ATTENTION!

Device damage from wrong supply voltage!

Wrong supply voltage may cause device damage.

Therefore:

- Markless sensor operated with safety extra-low voltage only
- The power supply must warrant secure electrical isolation (SELV/PELV) and the current must be limited to no more than 8 A.

Work under voltage

ATTENTION!

Device damage or unintended operation by work under voltage!

Work under voltage may cause unexpected operation.

Therefore:

- Only perform wiring work in the powered down condition.
- Cable connections must only be connected and disconnected with the supply voltage switched off.

7.2 Wiring notes

ATTENTION!

Malfunctions from improper wiring!

Improper wiring may cause interferences in operation.

Therefore:

- Only use shielded cables with twisted pair wires.
- Observe wiring notes accurately.

NOTE!

→ *Ready-made cables see page 82, chapter 16.1.*

All electrical connections of the Markless sensor are designed as M12 circular plug-in connector.

The protection class IP65 is only achieved with screwed plug connectors or cover flaps.

Observe the following notes for wiring:

- A proper and complete shielding concept is required for function free from interference.
- A cable shield must be applied on either side in the control cabinet and at the sensor. The cable shield of the ready-made cables is connected to a knurled nut and therefore to the sensor housing.
- Connect the cable shield across a large area with the operating ground in the control cabinet.
- Equipotential bonding currents across the cable shield must be avoided by suitable measures.
- Do not place the cable in parallel to other cables, in particular not to devices with a high electromagnetic interference, such as frequency converters.

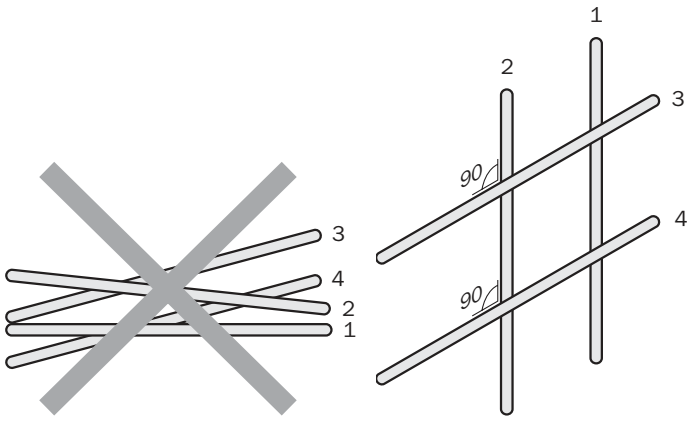


Fig. 12: Cross cables at right angles

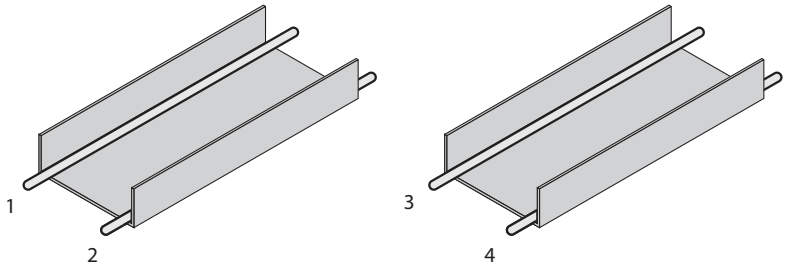


Fig. 13: Ideal placement – Place cables in different cable channels

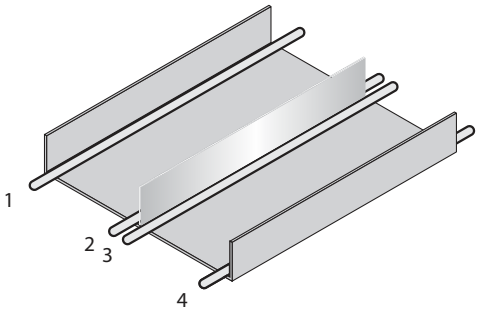


Fig. 14: Alternative installation – separate cables by metallic separation

1 Cables very sensitive to interference such as analog measuring cables

2 Cables sensitive to interference such as sensor cables, communication signals, bus signals

3 Cables which are a source of interference, such as control cables for inductive loads and motor brakes

4 Cables which are a strong source of interference, such as output cables of frequency converters, supply of welding systems, power cables

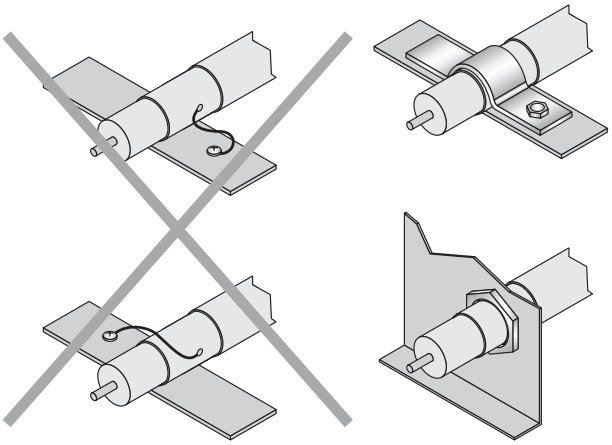


Fig. 15: Connect the shield with a short and large-area connection - ground either side

7.3 Electrically connect the Markless sensor

NOTE!

→ *Ready-made cables see page 82, chapter 16.1.*

1. Ensure voltage-freeness.
2. Turn rotatable plug unit into the desired position according to the figure if required.

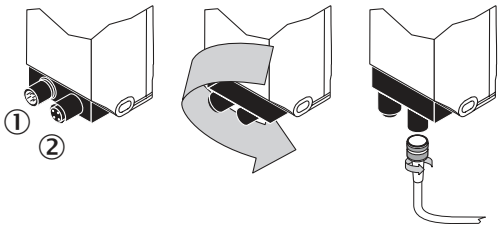


Fig. 16: Turn plug unit, perform electrical connection

1 Supply voltage, external teach signal, encoder signal and switching output

2 Ethernet

3. Connect Markless sensor according to connection diagram.

7.4 Connection diagrams

7.4.1 Connection diagram supply voltage and encoder signals

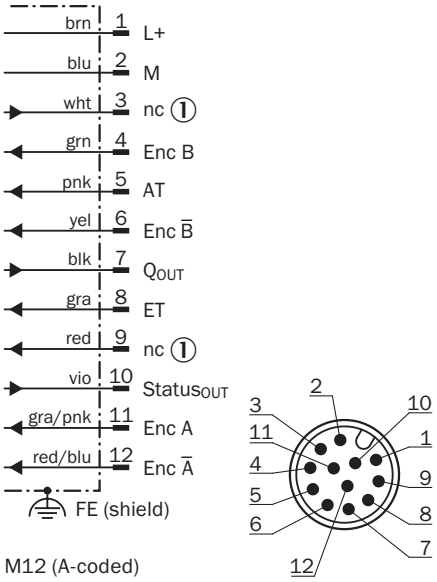


Fig. 17: Connection diagram supply voltage, external teach signal, encoder signal and switching output, plug M12, 12-pin, A-coded

1 nc: not connected

Contact	Mark	Wire color	Description
1	L+	brown	Supply voltage +12 ... +30 V DC
2	M	blue	Supply voltage 0 V
3	nc	white	Not assigned
4	Enc B	green	Encoder signal B
5	AT	pink	Blanking input
6	Enc $\overline{B}$	yellow	Encoder signal B'
7	Q_{OUT}	black	Switching output → see page 80, chapter 15.5.
8	ET	gray	External teach signal
9	nc	red	Not assigned
10	$Status_{OUT}$	violet	Status sensor → See page 80, chapter 15.5.
11	Enc A	gray/pink	Encoder signal A
12	Enc $\overline{A}$	red/blue	Encoder signal A'

Table 4: Description plug supply voltage, external teach signal, encoder signal and switching output

7.4.2 Connection diagram Ethernet

The Markless sensor has a 100Base-T Ethernet connection.

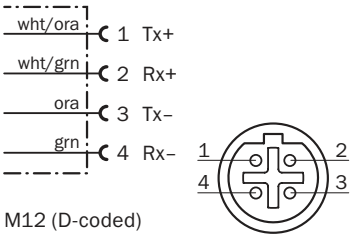


Fig. 18: Connection diagram Ethernet, female connector M12, 4-pin, D-coded

Contact	Mark	Wire color	Description
1	Tx+	white/ orange	Send data signal, not inverted
2	Rx+	white/green	Receive data signal, not inverted
3	Tx–	orange	Send data signal, inverted
4	Rx–	green	Receive data signal, inverted

Table 5: Description female connector Ethernet

8 Commissioning

Damage to the buttons

ATTENTION!

Damage to the buttons from incorrect handling!

Incorrect handling of the buttons may damage the buttons. This may make operation more difficult or impossible.

Therefore:

- Only operate the buttons with your fingers or a suitable pointer.
- Do not operate the buttons with pointed or hard objects.

8.1 Steps to be performed

1. Switch on supply voltage. At first commissioning, the display indicates "RUN". In this case, push the button Set for more than 1 second. The display shows "Setup".
2. Adjust parameters for encoder. → See following chapter.
3. Perform teach process and set identical areas for blanking if required.
   - For teaching, you may choose between the following options:
     - Start-stop teach via the menu "MAN" → see page 33, chapter 9.4.2
     - Trigger teach via the menu "TRIGG" → see page 38, chapter 9.5.3
     - Start-stop teach via an external teach signal → see page 38, chapter 9.5.3
     - Trigger teach via an external teach signal → see page 39, chapter 9.5.4
     - Start-stop teach via SOPAS Single Device or Ethernet → see page 55
     - Trigger teach via SOPAS Single Device or Ethernet → see page 56.
   - For blanking, you may choose between the following options:
     - Blanking via the menu item IDAreas → see page 41, chapter 9.7.1
     - Blanking via the AT input → see page 43, chapter 9.7.2
     - Blanking via SOPAS Single Device or Ethernet → see page 59.
4. If required, adjust offset for starting point offset
   - via the menu„Offset", → see page 40, chapter 9.6
   - via SOPAS Single Device or Ethernet, → see page 57.

NOTE!

A teach via an external signal always takes precedence over other teach methods.

The teach methods via the menu "MAN" and an external signal cannot be combined.

8.2 Adjusting encoder

NOTE!

The encoder resolution (EncRes) must be between 100 µm ... 400 µm. If required, use a parameterisable encoder. While the encoder resolution is complied with, you may also use a present motor feedback system.

Menu structure

→ See page 86, chapter 18.

Encoder settings

During commissioning, the display shows "Setup". In this setup, the settings of the encoder used are requested. The following parameters must be entered for the encoder:

- "EncTyp" (encoder type)
- "EncRes" (encoder resolution)
  → For determination of the encoder resolution, see the following section.
- "EncDir" (encoder direction)

NOTE!

For a correct signal, the rotating direction during the teach process and the encoder direction set must match.

Determine encoder resolution

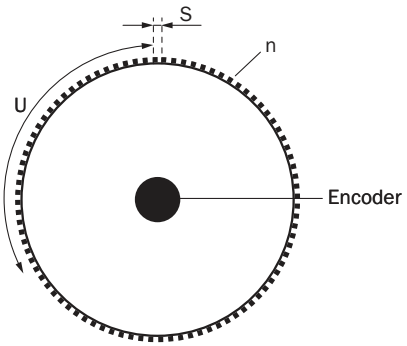


Fig. 19: Determine encoder resolution

The figure is exemplary and serves to display the encoder resolution. A role is not mandatory. The encoder resolution is the path the material covers from encoder stroke to encoder stroke.

The encoder resolution (EncRes) can be determined using the following format:

S = U/n

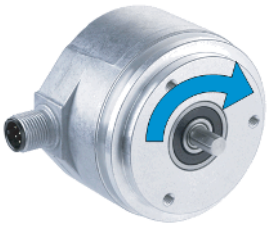
S: Encoder resolution

U: Outer diameter of the role

n: Number of encoder strokes for 360 °

Menu "Setup", encoder settings

CW



CCW

Indication	Description
EncTyp	Select encoder type. **Options** • TTL: 4.5 V... 5.5 V, TTL / RS-422 (differential) • HTL: 12 V... 30 V, HTL / Push-Pull (counter-cycle) **Factory setting** • TTL
EncRes	Adjust encoder resolution. **Adjustment range** • 100 µm ... 400 µm (in 1 µm-steps) **Factory setting** • 100 µm
EncDir	Select encoder direction. **Options** • Auto: The direction is automatically determined at the start of the teach process. • CW: Clockwise • CCW: Counter-clockwise **Factory setting** • Auto

Table 6: Menu "Setup", encoder settings

Menu "Setup" execution

The display shows "Setup".

1. Push the key Set. The parameter "EncTyp" (encoder type) is displayed.
2. Push the key Set. The current value is displayed.
3. Use the keys ^ or v to select the encoder type used.
4. Push the key Set, the parameter "EncRes" (encoder resolution) is displayed. The first digit from the left is flashing.
5. Push the key ^, to increase the number. Push the key v, to reduce the number.
6. Push the key Set. The next digit flashes.
7. Repeat steps 5 and 6 until and including the last digit. The parameter "EncDir" (encoder direction) is displayed.
8. Use the keys ^ or v to select the encoder direction.
9. Push the key Set. The prompt "Store?" is displayed.
10. Perform one of the following steps:
    - Push the key Set, to save all input for the encoder. The menu "Menu" is displayed.
    - Push the button Esc, to cancel the process.

NOTE!

The encoder values remain stored after a reset as well. You can change the encoder values subsequently in the menu "Param".

9 Operation at the sensor

Damage to the buttons

ATTENTION!

Damage to the buttons from incorrect handling!

Incorrect handling of the buttons may damage the buttons. This may make operation more difficult or impossible.

Therefore:

- Only operate the buttons with your fingers or a suitable pointer.
- Do not operate the buttons with pointed or hard objects.

9.1 Select parameter

A menu, a parameter or an option can be selected via the keys Set, ▽ and △. The menu path is indicated in the respective chapters.
→ For the entire menu structure and menu guidance, see page 86, chapter 18.

9.2 Select option

1. Use the keys Set, ▽ and △ to select the desired parameter.
2. Use the key ▽ or △ to select the desired option.
3. Perform one of the following steps:
   - Push the key Set, to save the change.
   - Push the button Esc, to cancel the process. The parameter name is displayed again.
4. Perform one of the following steps to return to the operating indicator:
   - Push the button Esc repeatedly until the operating indicator is displayed again.
   - Wait for approx. one minute. The display switches automatically back to the operating indicator without pushing any key. Settings made are also saved.

9.3 Change value

1. Use the keys Set, ▽ and △ to select the desired parameter.
2. Push the key Set. The current value of the parameter is displayed. The first digit from the left is flashing.
3. Push the key △, to increase the number. Push the key ▽, to reduce the number.
4. Push the key Set, to save the digit entered. The next digit flashes. Push the button Esc, to cancel the process.
5. Repeat steps 3 and 4 until the last digit is saved. The parameter name is displayed.
6. Push the button Esc repeatedly until the operating indicator is displayed again. Alternatively, you may also wait for approx. one minute. The display switches automatically back to the operating indicator without pushing any key.

9.4 Perform Teach-in via Display

9.4.1 Requirements

- Observe the technical specifications "Minimum format length", "Maximum format length" and "Minimum format height". → See page 78, chapter 15.
- The light spot must cover the significant area of the print image. Select an area with a high contrast difference as significant area. → See page 20, chapter 6.2.
- Scanning distance (distance sensor front edge to the object to be detected) and angle of the Markless sensor to the image must be complied with. → See page 20, chapter 6.2.
- Avoid fluctuations in distance and height.
- Do not teach in the complete format length. The teach process must end 3 % ... 5 % before the end of the format.

9.4.2 Perform Start- / Stop-Teach – menu "MAN"

Menu "MAN"

Parameter	Description
START?	Set starting point for the teach process.
STOP?	Set end point for the teach process.
Busy	Move formats through the light spot until the indication "Busy" goes out.

Table 7: Menu "MAN"

Perform teach-in, Menu "MAN"

Requirements: The encoder settings were made.

1. Select the menu "MAN".
   Menu path: Operating indicator → Set → Menu → Set → TRIGG → ▽ → MAN
   Push the key Set for at least 2 seconds to get to the "Menu".
2. Push the key Set. The parameter "Start?" is displayed.
3. Place the light spot in a significant position of the print image. This position is the starting point later. The starting point corresponds to the switching point.
4. Push the key Set. The point is stored as starting point. The parameter "Stop?" is displayed.
5. Move approx. 95 % to 97 % of a format length through the light spot in correct position in the encoder's rotating direction. Observe, that a correct signal requires that the rotating direction during the teach process and the encoder direction set must match.
6. Push the key Set. The point is stored as end point. The display indicates "Busy".
7. Move formats through the light spot until the indication "Busy" goes out. The display shows a bar graph that indicates the quality of the teach process:
   - 3 or more bars are flashing: Teaching process successful.
   - Less than 3 bars are flashing: Check that the signal switches correctly. If the signal does not switch correctly, the teach process must be repeated. → See page 33, chapter 9.4.1.
8. The bar graph flashes for another 10 format lengths and then automatically switches the indication to operating display "Quality of Run". The bar graph no longer flashes and signals the process quality. The mode RUN is displayed.

9.4.3 Perform Trigger-Teach – menu "TRIGG"

Menu "TRIGG"

Parameter	Description
Length	Enter approx. 95 % to 97 % of the format length for trigger teach
Currently entered format length	Shows the currently entered format length. Confirm or change current format length. **Input range** • 40 mm ... 1000 mm **Factory setting** • 240 mm
START?	Set starting point for the teach process.
Busy	Move formats through the light spot until the indication "Busy" goes out.

Table 8: Menu "TRIGG"

Perform teach-in, Menu "TRIGG"

Requirements: The encoder settings were made.

1. Select the menu "TRIGG".
   Menu path: Operating indicator → Set → Menu → Set → TRIGG
   Push the key Set for at least 2 seconds to get to the "Menu".
2. Push the key Set. The parameter "Length" is displayed.
3. Push the key Set. The currently entered format length is displayed.
4. Push the key Set. The first digit from the left is flashing.
5. Change value if required. → See page 33, chapter 9.3.
6. Repeat step 5 until the last figure has been saved. The parameter "Start?" is displayed.
7. Place the light spot in a significant position of the print image. This position is the starting point later. The starting point corresponds to the switching point.
8. Push the key Set. The point is stored as end point. The display indicates "Busy".
9. Move formats through the light spot until the indication "Busy" goes out. The display shows a bar graph that indicates the quality of the teach process:
   - 3 or more bars are flashing: Teaching process successful.
   - Less than 3 bars are flashing: Check that the signal switches correctly. If the signal does not switch correctly, the teach process must be repeated. → See page 33, chapter 9.4.1.
10. The bar graph flashes for another 10 format lengths and then automatically switches the indication to operating display "Quality of Run". The bar graph no longer flashes and signals the process quality. The mode RUN is displayed.

9.5 Menu "Param"

9.5.1 Parameter description

Menu "Param"

The menu "Param" can be used to activate troubleshooting, adjust blanking areas, configure the Ethernet interfaces and select the encoder type.

→ Menu structure and menu guidance, see page 86, chapter 18.

Parameter	Description
ETeach	Select Teach-process. **Options** • MAN: Start-Stop-Teach via external cable, → see page 38, chapter 9.5.3. • TRIGG: Trigger-Teach via external cable, → see page 39, chapter 9.5.4.
ErrHan	Activate and deactivate output of switching signals in spite of missing recognition. The switching output switches for 5 other formats without a complete format having been recognized. **Options** • On: Troubleshooting activated. Switching output switches when no object was detected. • Off: Troubleshooting deactivated. **Factory setting** • Off
IdArea	Use this submenu to enter blanking of identical regions of interest. Blanking of identical regions of interest can avoid incorrect switching. → See page 40, chapter .
Ethern	Configure Ethernet interface. → See page 44, chapter 9.8.
EncTyp	Select encoder type. **Options** • TTL: 4.5 V... 5.5 V, TTL / RS-422 (differential) • HTL: 12 V... 30 V, HTL / Push-Pull (counter-cycle) **Factory setting** • TTL
EncRes	Adjust encoder resolution. **Adjustment range** • 100 ... 400 µm (in 1 µm-steps) **Factory setting** • 100 µm

Menu "Param" (continued)

Parameter	Description
EncDir	Select encoder direction. **Options** • Auto • CW: Clockwise • CCW: Counter-Clockwise **Factory setting** • Auto
Reset	Perform reset. → See page 40, chapter . **Options** • Yes: Perform reset. • No **Factory setting** • No

Table 9: Menu "Param"

NOTE!

If the encoder resolution is changed, a new teach process must be performed.

9.5.2 Requirements

- Observe the technical specifications "Minimum format length", "Maximum format length" and "Minimum format height". → See page 78, chapter 15.
- The light spot must cover the significant area of the print image. Select an area with a high contrast difference as significant area. → See page 20, chapter 6.2.
- Scanning distance (distance sensor front edge to the object to be detected) and angle of the Markless sensor to the image must be complied with. → See page 20, chapter 6.2.
- Avoid fluctuations in distance and height.
- Do not teach in the complete format length. The teach process must end 3 % ... 5 % before the end of the format.

9.5.3 Perform start-stop teach via external teach signal

Requirements: The encoder settings were made.

1. Select the menu "MAN".
   Menu path: Operating indicator → Set → Menu → Set → Param → Set → ETeach → Set → MAN
   Push the key Set for at least 2 seconds to get to the "Menu".
2. Place the light spot in a significant position of the print image. This position is the starting point later. The starting point corresponds to the switching point.
3. Apply external voltage signal to the input "ET". The teach process is started. The current point is stored as starting point.
4. Move approx. 95 % to 97 % of a format length through the light spot in correct position in the encoder's rotating direction. Observe, that a correct signal requires that the rotating direction during the teach process and the encoder direction set must match.
5. Remove external voltage signal from the input "ET". The current point is stored as end point. The teach process is ended. The display indicates "Busy".
6. Move formats through the light spot until the indication "Busy" goes out. The display shows a bar graph that indicates the quality of the teach process:
   - 3 or more bars are flashing: Teaching process successful.
   - Less than 3 bars are flashing: Check that the signal switches correctly. If the signal does not switch correctly, the teach process must be repeated. → See page 33, chapter 9.4.1.
7. The bar graph flashes for another 10 format lengths and then automatically switches the indication to operating display "Quality of Run". The bar graph no longer flashes and signals the process quality. The mode RUN is displayed.

9.5.4 Perform trigger teach via external teach signal

Requirements: The encoder settings were made.

1. Select the menu "MAN".
   Menu path: Operating indicator → Set → Menu → Set → Param → Set → ETeach → ▽ → TRIGG
   Push the key Set for at least 2 seconds to get to the "Menu".
2. Push the key Set. The parameter "Length" is displayed.
3. Push the key Set. The currently entered format length is displayed.
4. Push the key Set. The first digit from the left is flashing.
5. Change value if required. → See page 33, chapter 9.3.
6. Repeat step 5 until the last figure has been saved. The parameter "ETeach" is displayed.
7. Place the light spot in a significant position of the print image. This position is the starting point later. The starting point corresponds to the switching point.
8. Apply external voltage impulse to input "ET". The teach process is started with rising flank. The current point is stored as starting point.
9. Move approx. 95 % to 97 % of a format length through the light spot in correct position in the encoder's rotating direction. Observe, that a correct signal requires that the rotating direction during the teach process and the encoder direction set must match.
10. After the entered format length has been run through, the teach process ends automatically.
11. Move formats through the light spot until the indication "Busy" goes out. The display shows a bar graph that indicates the quality of the teach process:
    - 3 or more bars are flashing: Teaching process successful.
    - Less than 3 bars are flashing: Check that the signal switches correctly. If the signal does not switch correctly, the teach process must be repeated. → See page 33, chapter 9.4.1.
12. The bar graph flashes for another 10 format lengths and then automatically switches the indication to operating display "Quality of Run". The bar graph no longer flashes and signals the process quality. The mode RUN is displayed.

9.5.5 Perform reset

1. Select the parameter "Reset" in the menu "Param".
   → See page 36, chapter 9.5 , chapter 9.5.
2. Push the key Set.
3. Select the option "yes".
4. Push the button Set, to reset the device to the delivery state. Push the button Esc, to cancel the process.

9.6 Adjust offset – menu "Offset"

NOTE!

If an offset is required, it must be entered after the areas to blanked are adjusted.
An offset is reset to 0 mm before any new teach or when blanked areas are adjusted.

Fig. 20: Setting offset (switching point deviation)

1 Offset

Menu "Offset"

Use the menu "Offset" to move the switching point for the switching output "Q".

→ Menu structure and menu guidance, see page 86, chapter 18.

Parameter	Description
Offset	Move switching point for switching output "Q" to the desired position. The switching point is the starting point of the teach process. **Adjustment range** 0 mm ... taught-in format length in mm **Factory setting** • 0.00 in

Table 10: Menu "Offset"

9.7 Blank regions of interest

NOTE!

Blanking of regions of interest can only be performed after the teach process has already been performed. In case of a repeated teach process, the blanking areas are deactivated again. The switching point offset is automatically reset to 0 mm.

Use of blanking areas can be used to edit the teach quality.

Fig. 21: Blank regions of interest

1 Starting value for blanking

2 Blanking area

3 End value for blanking

9.7.1 Submenu "IDArea" – blank regions of interest

Use the submenu "IDArea" to blank out identical regions of interest.

→ Menu structure and menu guidance, see page 86, chapter 18.

Parameter	Description
Area1	Enter the first area for blanking. Every area must have an upper and lower limit entered. **Adjustment range** • 0 ... 39.33 in
Area2	Enter the second area for blanking. **Adjustment range** • 0 ... 39.33 in
Apply?	Use the Set key to start blanking.

Table 11: Submenu "IDArea"

Enter regions of interest

You may parameterize up to two identical areas for blanking. The process for the parameters "Area1" and "Area2" is identical.

1. Select the submenu "IDArea".
   Menu path: Operating indicator → Set → Menu → Set →
   Param → Set → ETeach → ▽ → ErrHan → ▽ → IDArea
   Push the key Set for at least 2 seconds to get to the "Menu".
2. Push the key Set. The parameter "Area1" for the first area to be blanked is displayed.
3. Push the key Set. The lower value parameter "Area1" is displayed. The first digit from the left is flashing.
4. Push the key Set. "Start" for parameter "Area1" is displayed. The first figure on the left flashes.
5. Change value if required. → See page 33, chapter 9.3.
6. "End" for parameter "Area1" is displayed. The first figure on the left flashes.
7. Change value if required. → See page 33, chapter 9.3.
8. If required, repeat steps 2 to 6 for parameter "Area2".

Blank regions of interest

For the entered regions of interest to be blanked, you need to activate them via the parameter "Apply?".

1. In the submenu "IDArea", select the parameter "Apply?".
   Menu path: Operating display → Set → Menu → ▽ → Param →
   Set → ETeach → ▽ → ErrHan → ▽ → IDArea → Set → Area1 →
   ▽ → Area2 → ▽ → Apply?
2. Push the key Set. "Busy" is displayed.
3. Move formats through the light spot until the indication "Busy" goes out. The display shows a bar graph that indicates the quality of the teach process:
   - 3 or more bars are flashing: Teaching process successful
   - Less than 3 bars are flashing: Check that the signal switches correctly. If the signal does not switch correctly, the teach process must be repeated. → See page 33, chapter 9.4.1.
4. The bar graph flashes for another 10 format lengths and then automatically switches the indication to operating display "Quality of Run". The bar graph no longer flashes and signals the process quality. The mode RUN is displayed.

Deactivate blanking

Blanking can be deactivated as follows:

- Perform a new teach process.
- Using the submenu "IDArea". This is where the teach data from the saved teach image are re-calculated.

Deactivate a blanking via the submenu "IDArea" as follows:

1. In the submenu "IDArea", select the parameter "Area1" or "Area2".
2. Set the upper and lower value to "0 mm".
3. Push the key Set. The teach data are re-calculated from the saved teach image.

9.7.2 Indicate regions of interest via the external signal "AT"

NOTE!

The specification for the blanking areas via an external signal at input "AT" is only possible concurrently during the teach input.

NOTE!

The starting and end values of the blanking areas can be read out after teaching in the submenu "IDArea".

Fig. 22: Blank regions of interest

1 Starting value for blanking

2 Blanking area

3 End value for blanking

For blanking via the input "AT", set the signal during teaching to "High". In operation, the regions of interest are blanked for which a high signal was applied at the "AT" input during teaching.

You may blank no more than two regions of interest. If the high signal is pending more often, other regions of interest are not blanked.

The area between the blanked areas must be at least 40 mm.

9.8 Submenu "Ethern"

NOTE!

Changes in the submenu "Ethern" are only assumed after restart of the device.

The submenu "IPAdr" is used to set the Ethernet configuration.
→ For more information on the Ethernet interface, see page 47, chapter 11.

→ Menu structure and menu guidance, see page 86, chapter 18.

Parameter	Description
IPAdr	Enter IP address. **Factory setting** • MSB: 192 • Byte2: 168 • Byte1: 100 • LSB: 100
SubMas	Enter IP network mask. **Factory setting** • MSB: 255 • Byte2: 255 • Byte1: 255 • LSB: 0
D-Gate	Enter standard gateway. **Factory setting** • MSB: 0 • Byte2: 0 • Byte1: 0 • LSB: 0

Table 12: Submenu "Ethern"

Enter IPAdr, SubMas and D-Gate

The parameters "IPAdr", "SubMas" and "D-Gate" are entered identically. Input is described for the IP address here.

1. Select the parameter "IPAdr" in the menu "Ethern".
2. Push the key Set. The current value for the "Most significant Byte" is displayed. The first digit from the left is flashing.
3. Push the key ^, to increase the number. Push the key v, to reduce the number.
4. Push the key Set, to save the digit entered. The next digit flashes.
5. Repeat steps 3 and 4 until the last digit is saved. The value of the next byte is displayed.

Enter IPAdr, SubMas and D-Gate (continued)

6. Repeat steps 3 to 5 for the second, third and fourth byte (least significant byte).
7. After confirming your input for the value of the fourth byte with Set, the parameter "IPAdr" is displayed.

9.9 Menu "Diagno"

Use the menu "Diagno" to request information on the Markless sensor.

→ Menu structure and menu guidance, see page 86, chapter 18.

Parameter	Description
ErrCod	Shows the current error code if an error is pending. If no error is pending, "NoErr" is displayed. → For error codes, see page 71, chapter 13.1.
QoT (Quality of Teach-in)	Shows the teach process quality. **Display** • 3 or more bars: Teaching process successful. • Less than 3 bars: Check that the signal switches correctly. If the signal does not switch correctly, the teach process must be repeated. → See page 33, chapter 9.4.1.
TeaLen	Shows the taught-in format length in mm.
ActLen	Shows the current format length in mm.
IP Adr	Shows the current IP address.
EncPos	Shows the current encoder position. **Indication area** • 0 ... 16383 • A "+" signals that the current rotating direction matches the taught-in rotating direction. • A "-" signals that the current rotating direction is opposite to the taught-in rotating direction. **Unit** Strokes
SWVers	Shows the software version.
SerNum	Shows the serial number.
MAC Id	Shows the MAC address.

Table 13: Menu "Diagno"

10 Operation via Ethernet TCP/IP

Operating and integration versions

The Markless sensor ML20 supports the SOPAS communication protocol CoLa-B via TCP/IP with the Ethernet interface.

For external applications to control teach processes, read process data or parameterize the sensor, the following versions are available.

- The configuration program SOPAS Single Device by SICK can be used to make all settings of the sensor, perform teach processes and check diagnosis data. The configuration program SOPAS ET can be downloaded online from "www.mysick.com/en/ml20". → For operation of the sensor via SOPAS see page 47, chapter 11.
- The SOPAS Communication Library (SCL) can be used to integrate the Markless sensor ML20 into a present software component. The SOPAS Communication Library (SCL) can be downloaded online from "www.mysick.com/en/ml20". The SCL provides a comprehensive API to operate the sensor and is available for the programming languages Java® and Microsoft.Net®.
- If you cannot use the SOPAS Communication Library (SCL), the layers of the SOPAS communication protocol must be re-formed. The specification is available from the relevant SICK agent.

Abbreviations

- SOPAS: SICK Open Platform for Applications and Standards
- Cola-B: Command Language Binary

11 Operation via SOPAS Single Device (Ethernet interface)

You can parameterize the Markless sensor via the Ethernet interface with the SICK configuration software SOPAS Single Device. SOPAS Single Device is a partial function of the configuration program SOPAS (SOPAS ET).

NOTE!

The configuration program SOPAS ET can be downloaded online from "www.mysick.com/en/ml20".

11.1 IP network configuration

IP network configuration – Delivery configuration

The Markless sensor is delivered with the following IP network configuration:

- Static IP address
- IP address: 192.168.100.100
- IP network mask: 255.255.255.0
- Standard gateway: 0.0.0.0

NOTE!

If you change the IP configuration of the sensor , you must switch the supply voltage off and on again.

11.2 Integration of the Markless sensor in the network

1. Connect the Markless sensor to your PC via an Ethernet cable.
2. Start the configuration program SOPAS Single Device.
3. Dialog window „Welcome to SOPAS" is displayed.

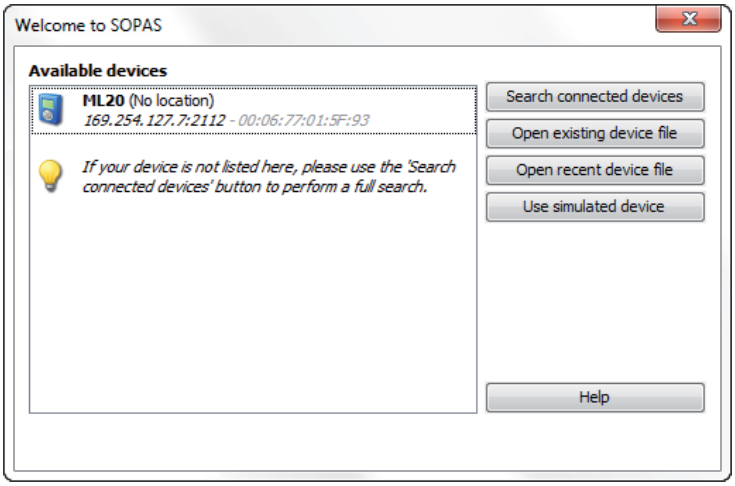


Fig. 23: Window „Welcome to SOPAS".

4. In the window "Available devices", click the button "ML20".
5. The user interface of the Markless sensor is displayed.

Assign IP address

The Markless sensor has the function "Auto-IP". By default, a connected Markless sensor is automatically detected and is the sensor automatically assigned an IP address. If the sensor during the scanning process no IP address is assigned, the following window will be displayed.

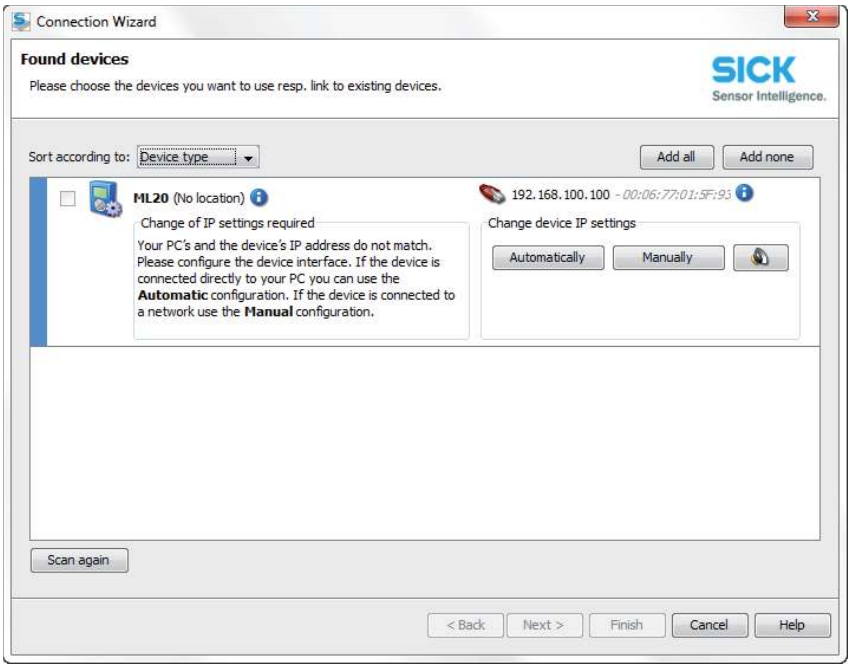


Fig. 24: Window „Found devices – Change device IP settings"

Assign IP address automatically

1. Click the button „Automatically".
2. The dialog window with the message "The device will be updated with the following fix IP settings".
3. Click the button "Yes" to assume the configuration.
4. The user interface of the Markless sensor is displayed.

Assign IP address manually

1. Click the button „Manually".
2. The following dialog window is displayed.

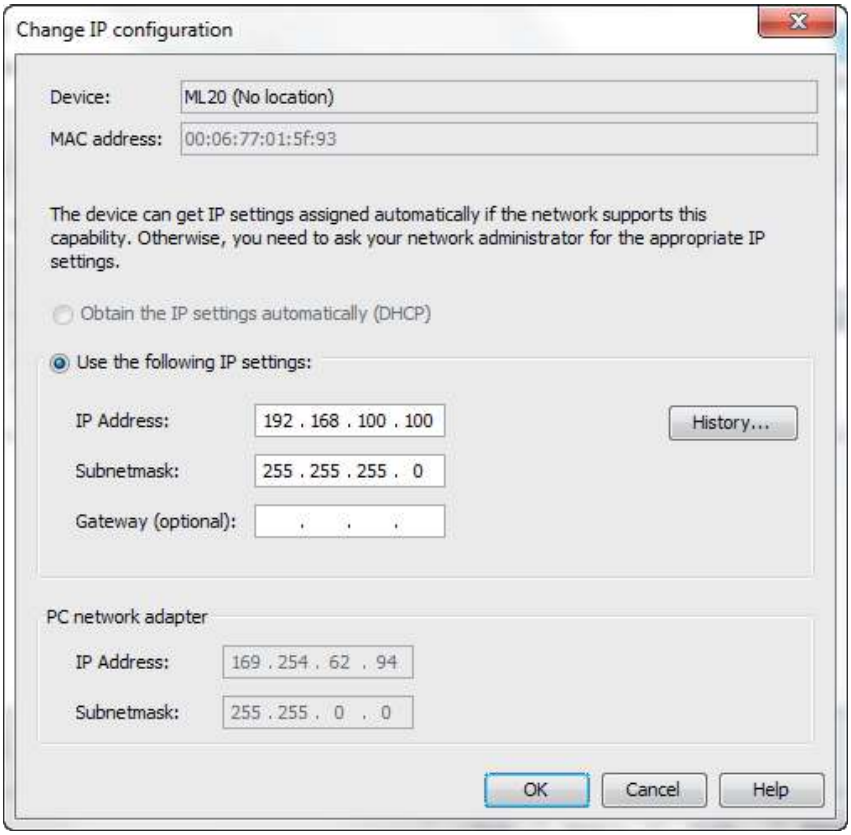


Fig. 25: Window „Change IP configuration"

3. Enter the desired IP address of the sensor.
4. Click the button „OK".
5. The user interface of the Markless sensor is displayed.

11.3 Ethernet parameter list

NOTE!

This chapter describes the parameters displayed on the main page and in the menus. Placement and graphics correspond to the presentation in SOPAS Single Device.

Left window – Tab "Context help"

By default, the left window displays a context help for the individual parameters. The tab "context help" can be activated and deactivated in the menu "View".

Left window – Tab "Wizards"

Using the wizard "Set up ML20" in the tab "Wizards", you can take the Markless sensor into operation easily. Click the button "Set up ML20", to start the wizard. Follow the instructions step by step.

Main page

The main page offers an overview of the teaching quality, teaching image, process quality, process image and the currently measured format length.

Right window

Call the respective menu in the right window by clicking the arrow.

Acceptance of parameter changes

Changes in the field "Ethernet settings" are only saved when you click the icon "Save device data" in the tool bar. Changes in the other menus are saved automatically.

11.3.1 Main page

Window "Teach quality"

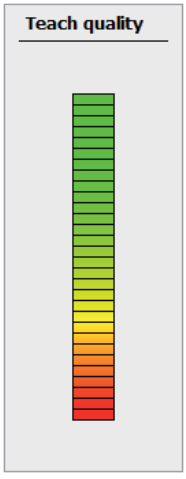


Fig. 26: Main page – Window "Teach quality"

Parameter description

Parameter	Description
Teach quality	Indication of the quality of the taught-in image. The indication corresponds to the bar graph display on the display. **Reading/writing access** • Read only **Indication area** • Green corresponds to 6 bars on the display. Red corresponds to 0 bars on the display.

Table 14: Main page – Window "Teach quality"

Window "Teach image"

Fig. 27: Main page – Window "Teach image"

Parameter description

Parameter	Description
Call teach-in image	Open taught-in image After successful teaching, click the button "Call teach-in image" to open the taught image. You may use the image for inspection. The taught image is no longer available in the sensor after the following processes: restart, after requesting the process image, after a new teach process
Open image	Open an image already saved on the PC.
Save as	Save taught image in a directory.

Table 15: Main page – Window "Teach image"

Window "Process quality"

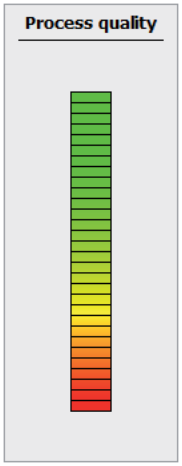


Fig. 28: Main page – Window "Process quality"

Parameter description

Parameter	Description
Process quality	Indication of the current process quality. The indication corresponds to the bar graph display on the display. **Reading/writing access** • Read only **Indication area** • Green corresponds to 6 bars on the display. Red corresponds to 0 bars on the display.

Table 16: Main page – Window "Process quality"

Field "Live image"

Fig. 29: Main page – Window "Live image"

NOTE!

Once the process screen is called, the teach screen can no longer be requested.

Parameter description

Parameter	Description
Load live image	Click the button "Load live image" to inform the sensor that an image of the next recognized format length is to be recorded at the next switching process. You may use the process image, e.g. for process control.
Open image	Open an image already saved on the PC.
Save as	Save process image in a directory.

Table 17: Main page – Window "Live image"

Field "Currently measured format length"

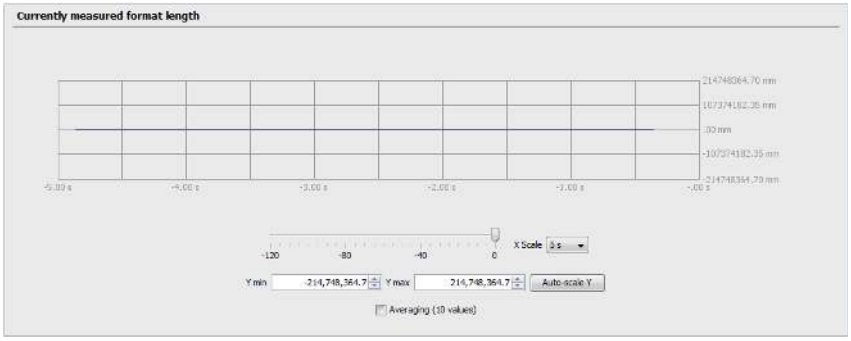


Fig. 30: Main page – Window "Currently measured format length"

Parameter description

The view "Currently measured format length" is used to read the currently determined format length in mm. This is a plot across time. The switching output is requested every 200 ms. If the sensor does not record a new measured value, e.g. in case of standstill of the material or during a return run, the last measured value remains in the plot.

Parameter	Description
X-Scale	Select time resolution of the X-axis. **Reading/writing access** • Reading and writing **Unit** • s
Y min / Y max	Enter minimum and maximum value for the Y axis. **Reading/writing access** • Reading and writing **Unit** • mm
Auto-Scale Y	Click the button "Auto-Scale Y" to adjust the indication to the ideal area.
Averaging (10 values)	Average formation across the last 10 measurements **Reading/writing access** • Reading and writing

Table 18: Main page – Window "Currently measured format length"

11.3.3 Teach

Window "Start / Stop teach"

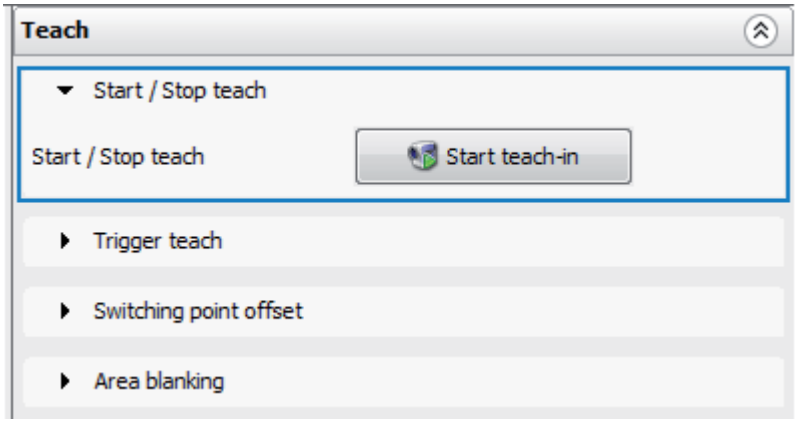


Fig. 31: Menu "Teach" – Window "Start / Stop teach"

Perform a start-stop teach as follows:

1. Place the light spot in a significant position of the print image. This position is the starting point later. The starting point should correspond to the switching point.
2. In the field "Start/Stop Teach", click the button "Start teach-in". The point is stored as starting point. A dialog window is displayed.
3. Move approx. 95 % to 97 % of a format length through the light spot in correct position in the encoder's rotating direction. Observe, that a correct signal requires that the rotating direction during the teach process and the encoder direction set must match.
4. Click the button "Stop" in the dialog window. The point is stored as end point. The display indicates "Busy".
5. Move formats through the light spot until the indication "Busy" goes out and a success message is displayed in SOPAS Single Device. The display shows a bar graph that indicates the quality of the teach process:
   - 3 or more bars are flashing: Teaching process successful.
   - Less than 3 bars are flashing: Check that the signal switches correctly. If the signal does not switch correctly, the teach process must be repeated.
6. The bar graph flashes for another 10 format lengths and then automatically switches the indication to operating display "Quality of Run". The bar graph no longer flashes and signals the process quality. The mode RUN is displayed.

Parameter description

Parameter	Description
Start / Stop teach	Click the button "Start teach-in" to assume the current image positions as starting and end points. **Reading/writing access** • Read only

Table 19: Menu "Teach" – Window "Start / Stop teach"

Window "Trigger teach"

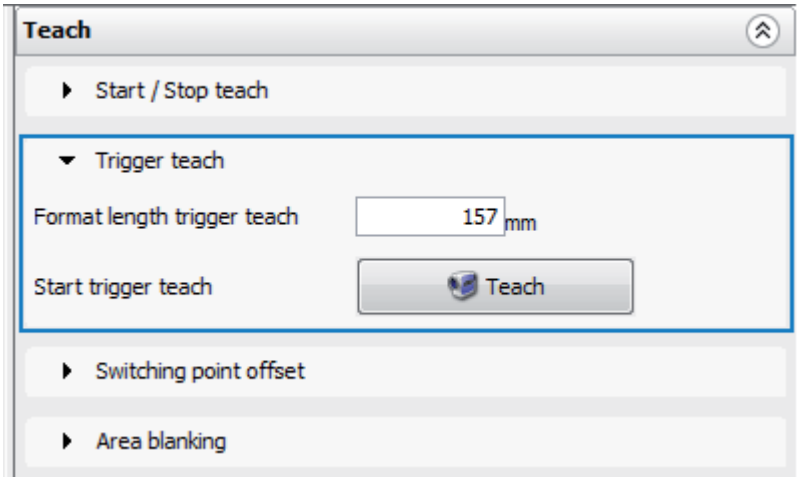


Fig. 32: Menu "Teach" – Window "Trigger teach"

Benefits trigger teach

The trigger teach offers the following benefits towards other teach procedures:

- A trigger teach can be performed during the process.
- You may specify the desired length in a trigger teach.

Perform trigger teach

Perform a trigger teach as follows:

1. Enter approx. 95 % to 97 % of the format length.
2. Place the light spot in a significant position of the print image. This position is the starting point later. The starting point should correspond to the switching point.
3. Click the button "Teach". The point is stored as starting point.
4. The teach process is automatically terminated after the length set. The display indicates "Busy".
5. Move formats through the light spot until the indication "Busy" goes out and a success message is displayed in SOPAS Single Device. The display shows a bar graph that indicates the quality of the teach process:
   - 3 or more bars are flashing: Teaching process successful.
   - Less than 3 bars are flashing: Check that the signal switches correctly. If the signal does not switch correctly, the teach process must be repeated.
6. The bar graph flashes for another 10 format lengths and then automatically switches the indication to operating display "Quality of Run". The bar graph no longer flashes and signals the process quality. The mode RUN is displayed.

Parameter description

Parameter	Description
Format length trigger teach	Enter approx. 95 % to 97 % of the format length for trigger teach. **Reading/writing access** • Reading and writing **Input range** • 40 mm ... 1000 mm **Factory setting** • 240 mm
Start trigger teach	Click the button "Teach" to start trigger teach.

Table 20: Menu "Teach" – Window "Trigger teach"

Window "Switching point offset"

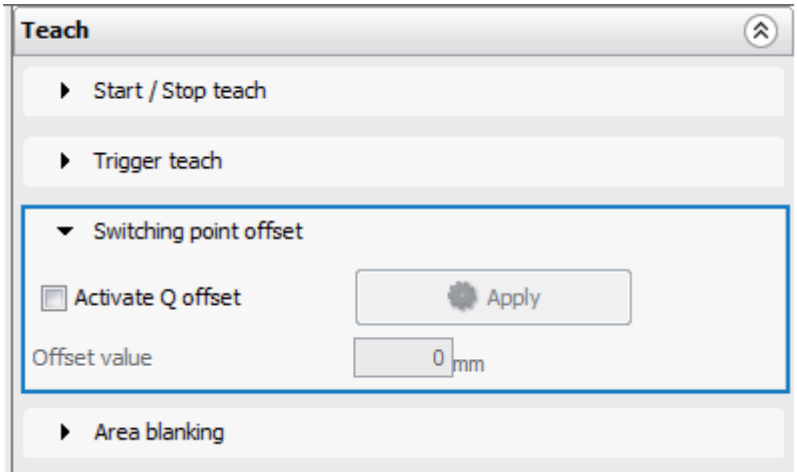


Fig. 33: Menu "Teach" – Window "Switching point offset"

Move switching point

Move the switching point for the switching output "Q" to the desired position as follows:

1. Release function "Switching point offset" via the parameter "Activate Q offset". Check the check box.
2. Set offset value. There are the following options:
   - Enter offset value in the text field.
   - Move the green line in the figure with the mouse pointer to the desired offset value.
3. Click the button "Apply". The offset value is saved in the sensor.

Fig. 34: Main page – Window "Teach image" – move switching point

1 Switching point (offset) (green line)

Parameter description

Parameter	Description
Apply	Click the button "Apply" to save the entered offset value in the sensor. The function "Switching point offset" must be released via the parameter "Activate Q offset" first.
Activate Q offset	Release or lock switching point offset. **Reading/writing access** • Reading and writing **Options** • Activated • Deactivated **Factory setting** • Deactivated
Offset value	Enter offset value for switching point offset. The zero point is the starting point of the teach process. **Reading/writing access** • Writing and reading **Input range** • 0 ... taught-in format length in mm **Factory setting** • 0

Table 21: Menu "Teach" – Window "Switching point offset"

Window "Area blanking"

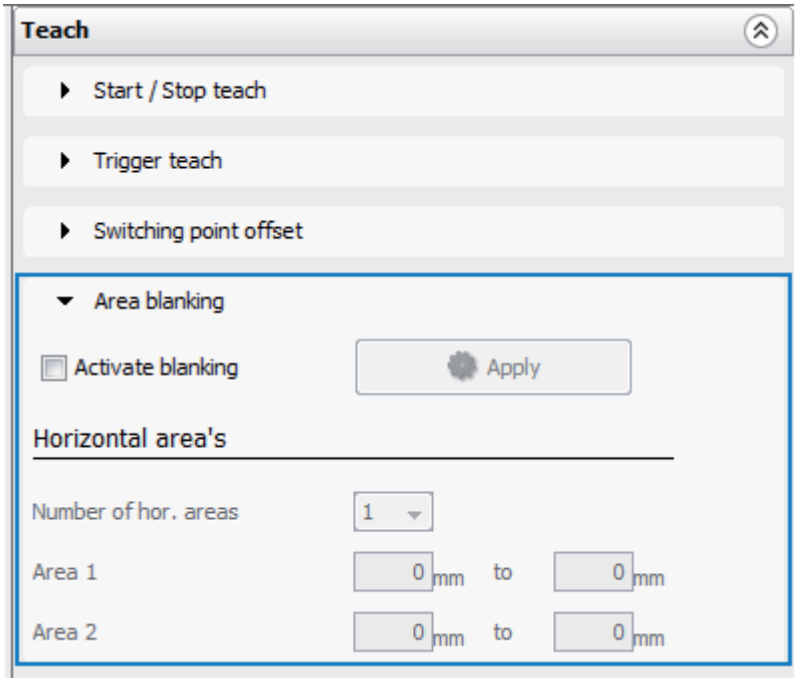


Fig. 35: Menu "Teach" – Window "Area blanking" – Activate area blanking and enter starting and end values

Window "Teach image" – Area blanking

Fig. 36: Menu "Teach" – Window "Teach image" – Specify starting and end values by moving the red line with the mouse pointer.

1 Starting value for blanking (left red line)

2 Blanking area (red area)

3 End value for blanking (right red line)

Select regions of interest

Blank a region of interest as follows:

1. Release function "Area blanking" via the parameter "Activate blanking". Check the check box.
2. Use the parameter "Number of hor. areas" to indicate the number.
3. Set starting and end values for the blanking area. There are the following options:
   - If required, also enter the starting and end value for the parameter "Area 2" in the text field. If required, also enter the starting and end value for the parameter "Area 2" in the text field.
   - In the field "Teach image", move the red lines to the desired starting and end values with the mouse pointer.
4. Click the button "Apply". The display shows "busy"; operation via SOPAS Single Device can be used to block.
5. Move formats through the sensor's light spot until the indication "Busy" goes out and a success message is displayed in SOPAS Single Device.

NOTE!

If you deactivate blanking, a prompt will appear to ask if the teach data are to be recalculated. Click the button "Yes" if you want to recalculated the teach data. Click the button "No" if you want to perform a new teach. This is required to collect information from the blanking areas.

Parameter description

Parameter	Description
Apply	Click the button "Apply" to assume the values entered in the fields "area 1" and "area 2" and activate area blanking. A possible offset value must be entered after parameterization of the "Area blanking".
Activate blanking	Release or lock area blanking. **Reading/writing access** • Reading and writing **Factory setting** • Empty

Parameter description

Parameter	Description
Number of blanking areas	Enter number of areas to be blanked. The zero point is the starting point of the teach process. **Reading/writing access** • Reading and writing **Options** • 1 • 2 **Factory setting** • 1
Area 1	Enter starting and end values for the first blanked area. **Reading/writing access** • Reading and writing **Input range** • 0 ... taught-in format length in mm **Factory setting** • 0
Area 2	Enter starting and end values for the second blanked area. **Reading/writing access** • Reading and writing **Input range** • 0 ... taught-in format length in mm **Factory setting** • 0

Table 22: Menu "Teach" – Window "Area blanking"

11.3.4 Device Information

Menu "Device Information"

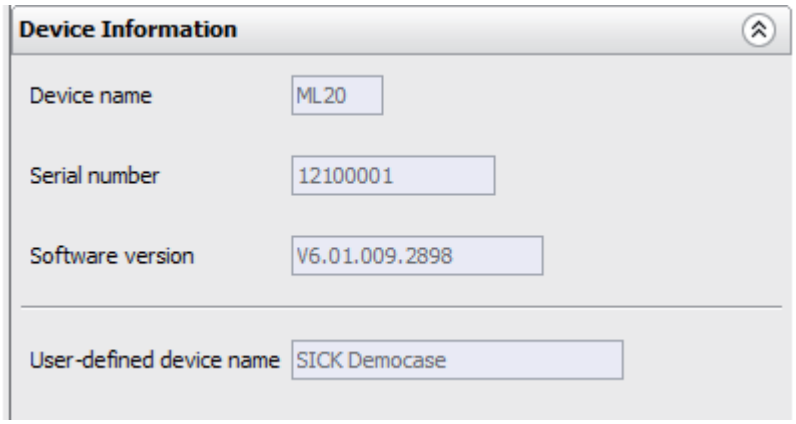


Fig. 37: Menu "Device Information"

Parameter description

Parameter	Description
Device name	Indication of the device designation, here "ML20" **Reading/writing access** • Read only
Serial number	Display of the serial number **Reading/writing access** • Read only
Software version	Display of the software version **Reading/writing access** • Read only
User-defined device name	Enter device name, such as mounting site to identify the device. The device name can only be entered in the user level "Service". • Select menu "Tools" > Menu "Login device". The window "Login" is opened. • Select user level "Service". Enter password "esick". **Reading/writing access** • Reading and writing **Factory setting** • No location

Table 23: Menu "Device Information"

11.3.5 Setting – Teach

Window "Teach settings"

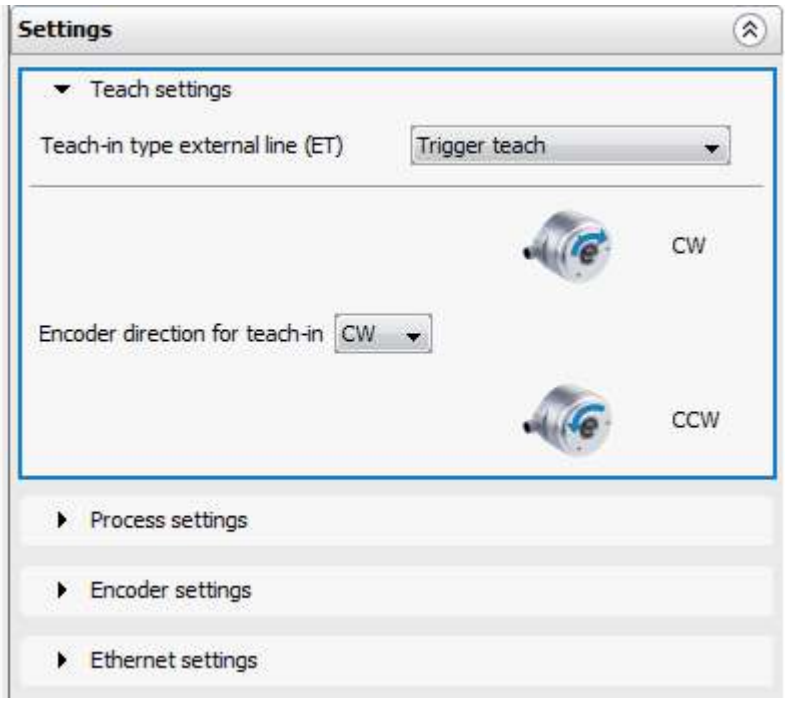


Fig. 38: Menu "Setting" – Window "Teach settings"

Parameter description

Parameter	Description
Teach-in type external line (ET)	Select teach type via external cable. **Options** • Start- / Stop-Teach • Trigger-Teach **Reading/writing access** • Read only
Encoder direction for teach-in	Select encoder direction for teach process **Reading/writing access** • Writing and reading **Value range** • Auto • CW (Clockwise) • CCW (Counter-clockwise) **Factory setting** • Auto

Table 24: Menu "Settings" – Window "Teach settings"

11.3.6 Settings – Process

Window "Process settings"

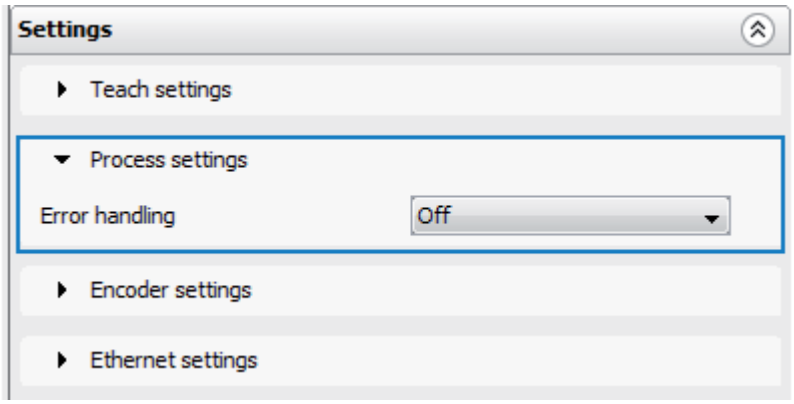


Fig. 39: Menu "Setting" – Window "Process settings"

Parameter description

Parameter	Description
Error Handling (ErrHan)	Activate and deactivate output of switching signals in spite of missing recognition. The switching output switches for 5 other formats without a complete format having been recognized. **Reading/writing access** • Reading and writing **Options** • Off • On **Factory setting** • Off

Table 25: Menu "Settings" – Window "Process settings"

11.3.7 Settings – Encoder

NOTE!

The encoder resolution (EncRes) must be between 100 µm ... 400 µm. If required, use a parameterisable encoder. While the encoder resolution is complied with, you may also use a present motor feedback system.

Window "Encoder settings"

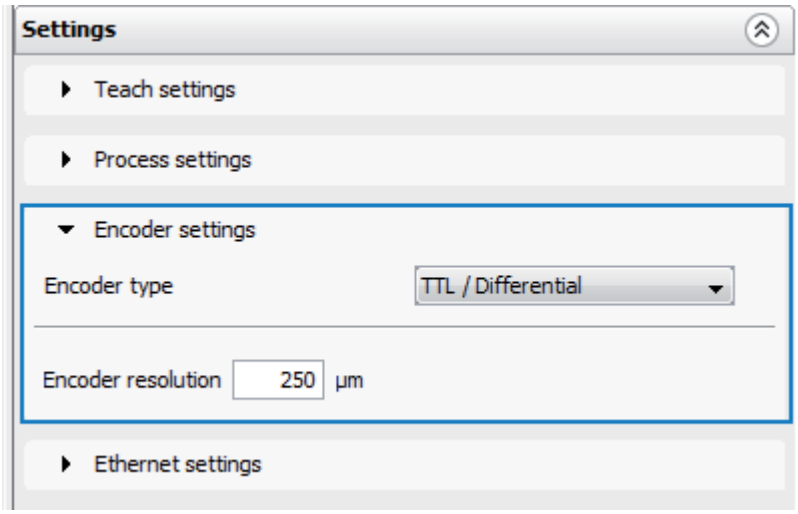


Fig. 40: Menu "Settings – Window "Encoder settings"

Parameter description

Parameter	Description
Encoder type	Select encoder type. **Reading/writing access** • Reading and writing **Options** • TTL (Differential) • HTL (Push Pull) **Factory setting** • TTL (Differential)
Encoder resolution	Enter encoder resolution **Reading/writing access** • Reading and writing **Input value** • 100 µm ... 400 µm (in 1 µm-steps) **Factory setting** • 100 µm

Table 26: Menu "Settings – Window "Encoder settings"

NOTE!

If the encoder resolution is changed, a new teach process must be performed.

11.3.8 Settings – Ethernet

NOTE!

Changes in the field "Ethernet settings" are only saved when you click the icon "Save device data" in the tool bar.

Window "Ethernet settings"

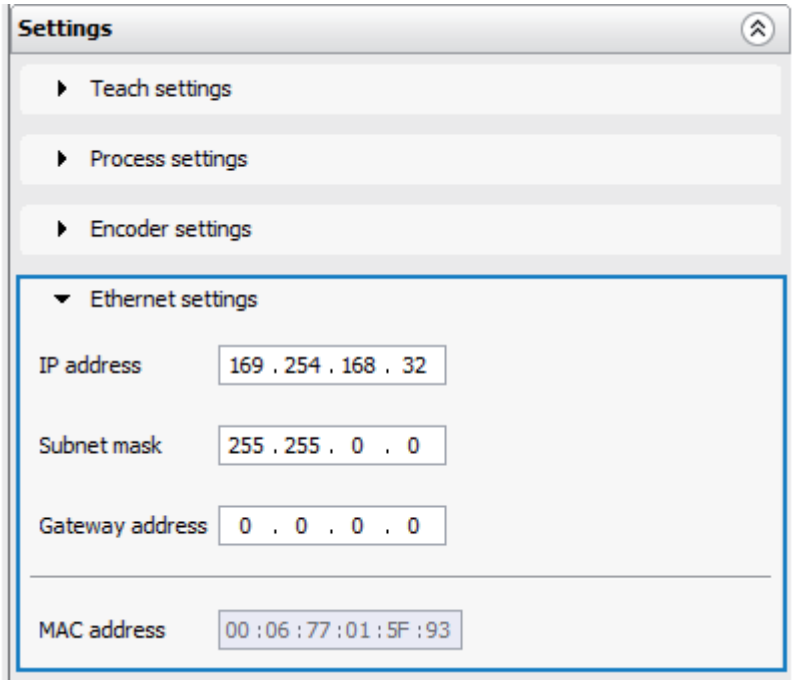


Fig. 41: Menu "Settings" – Window "Ethernet settings"

Parameter description

Parameter	Description
IP address	Enter IP address. **Reading/writing access** • Reading and writing **Input value** • 0 ... 255 per digit **Factory setting** • 192.168.100.100
Subnet mask	Enter subnet mask. **Reading/writing access** • Reading and writing **Input value** • 0 ... 255 per digit **Factory setting** • 255.255.255.0

Parameter description (continued)

Parameter	Description
Gateway address	Enter gateway address (standard gateway). **Reading/writing access** • Reading and writing **Input value** • 0 ... 255 per digit **Factory setting** • 0.0.0.0
MAC address	Display MAC address **Reading/writing access** • Read only **Factory setting** • E.g. 00:06:77:01:3F:80 (one-time address)

Table 27: Menu "Settings" – Window "Ethernet settings"

11.3.9 Import / Export

Menu "Import / Export"

Fig. 42: Menu "Import/Export"

Parameter description

Parameter	Description
Export	Save all teach data as a *.ml20 file. The teach data comprise selected high-contrast areas, offset, blanking areas, teach image. **Reading/writing access** • Read only
Import	Loading saved teach data. When importing the teach data, the saved teach image and all saved settings are transferred to the sensor on their own. The sensor only receives the necessary settings, such as blankings, offset and the selected high-contrast areas for format recognition. The entire teach image is no longer required by the sensor and therefore not transmitted. **Reading/writing access** • Read only
Apply	Load teach data into the sensor.

Table 28: Menu "Import/Export"

NOTE!

Once a process image is called, no export is possible.

11.3.10 Monitoring

Menu "Monitoring"

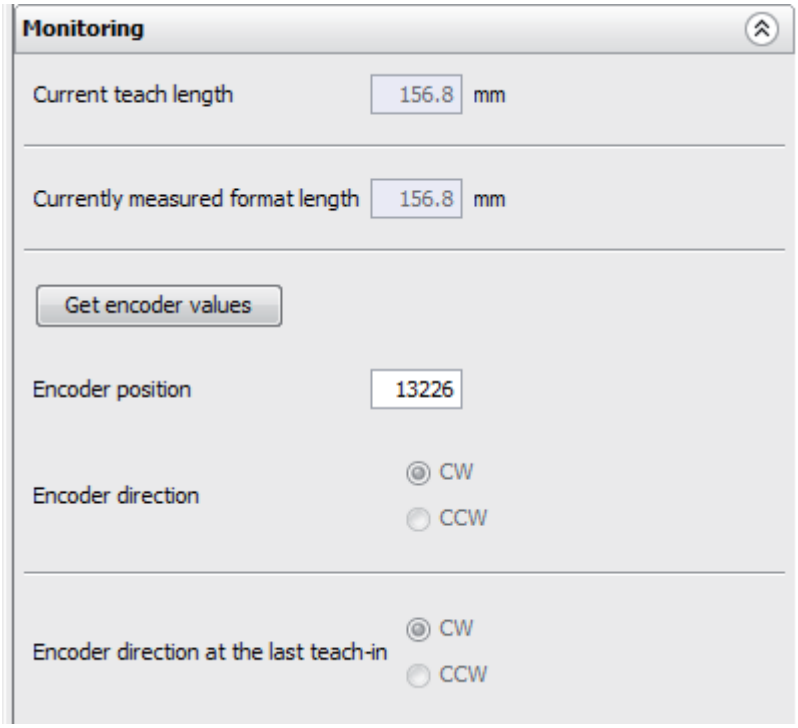


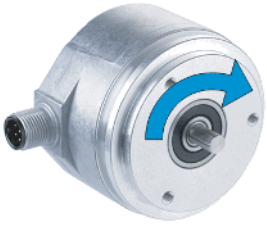
Fig. 43: Menu "Monitoring"

Parameter description

Parameter	Description
Current teach length	Indication of the currently taught-in format length in mm **Reading/writing access** • Reading and writing **Value range** • 0 mm ... 39.33 in
Currently measured format length	Shows the currently measured format length. Confirm or change current format length.
Get encoder values	Use the button "Get encoder values" to read the current encoder position and the rotating direction.

Parameter description

CW



CCW

Parameter	Description
Encoder position	Indication of the current encoder value **Reading/writing access** • Read only **Unit** • Approx. 0.6 mm/step **Value range** • 0 ... 16383
Encoder direction	Indication of the current rotating direction of the encoder **Reading/writing access** • Read only **Options** • CW: Clockwise • CCW: Counter-Clockwise
Encoder direction at the last teach-in	Indication of the encoder rotating direction at the last teach process **Reading/writing access** • Read only **Options** • CW: Clockwise • CCW: Counter-clockwise

Table 29: Menu "Monitoring"

11.4 Update device software (firmware update)

Update the device software as follows:

1. Load the current device software (*.ssp-file) for all ML20 versions from the Internet at "www.mysick.com/en/ml20".
2. Log on to SOPAS Single Device with the user level "Service" and the password "service" (menu path: Tools > Login device).
3. Select the menu item "Firmware update" in SOPAS Single Device (menu path: Communication > Firmware update).
4. Perform the steps according to the update wizard.

12 Cleaning and maintenance

12.1 Cleaning

ATTENTION!

Device damage from improper cleaning!

Improper cleaning may cause device damage.

Therefore:

- Do not use any cleaning agents with aggressive contents.
- Do not use any pointed objects for cleaning.

Regularly clean the front screens with a lint-free cloth and plastic cleaning agent.

The cleaning agent mainly depends on the ambient conditions.

12.2 Maintenance

The Markless sensor requires the following maintenance work at regular intervals:

Interval	Maintenance work	To be performed by
Cleaning interval depends on ambient conditions and climate	Cleaning the housing, specifically the front screen	Specialist
Every 6 months	Check screw and plug connections at regular intervals.	Specialist

Table 30: Maintenance plan

13 Troubleshooting

The following table and the following chapter describe possible interferences and measures for removal.

Contact the manufacturer in case of interferences that cannot be removed based on the following description. For your representative, see the reverse.

Warnings

Warnings can only occur during a teach process. In case of a warning, the teach process will still be performed completely. If the teach result is insufficient, the teach process must be performed again.

Warnings are displayed in the parameter "ErrCod" with the mark "Wrn" and a number. → See page 45, chapter 9.9.

Errors

Errors may occur during the teach process and from other events, such as a short-circuit. In case of an error, the teach process is interrupted. If valid teach data are present already, they will be used.

Errors are displayed in the parameter "ErrCod" with the mark "Err" and a number. → See page 45, chapter 9.9.

13.1 Possible error indications

Error code indication on the display	Possible causes (display SOPAS Single Device)	Troubleshooting
NoErr	There is no error.	–
Wrn011	The taught format length exceeds 1000 mm.	Repeat teach process with a smaller teach area. → See page 33, chapter 9.4.1.
Wrn012	Sensor signal is overmodulated due to excess light exposure.	Check mounting. → See page 20, chapter 6.
Wrn013	Too-low contrast in the taught-in format.	Check mounting. → See page 20, chapter 6. If required, select another image area with higher contrast.
Wrn015	Taught-in format exceeded the actual format length.	Repeat teach process with a smaller teach area.
Err001	There is a short-circuit at the output Q_{OUT} or $Status_{OUT}$.	Remove short-circuit.
Err005	Firmware update not performed correctly or interrupted. Primary boot image corrupt.	Repeat firmware update.
Err010	The taught format length undercuts 40 mm.	Repeat teach process with a larger teach area.
Err014	Image speed during the teach process too fast.	Repeat teach process at a reduced speed.
Err016	Blanked area is too large or too few image marks were found.	Select smaller blanked area. Repeat teach process.
Err017	Taught image has no image features.	Repeat teach process.

Error code indication on the display	Possible causes (display SOPAS Single Device)	Troubleshooting
Err018	Label cannot be clearly recognized at the selected point.	Change angle or position of the sensor.
Err101	Device/operation is locked.	Contact your SICK agent. For addresses, see addresses on the reverse of these operating instructions.

Table 31: Possible error indications

13.2 Troubleshooting instruction

Possible causes for the error

The possible errors can be summarized in the following groups.

- Error caused by combination of Markless sensor – encoder
- Error caused by mounting or teach
- Error caused by the system
- Error caused by network connection and SOPAS Single Device

13.2.1 Error caused by combination of Markless sensor – encoder

Frequent error causes

Frequent causes for Markless sensor malfunctions are:

- Incorrectly connected encoder
- Incorrectly configured encoder / sensor
- Unsuitable encoder.

Check wiring

The following encoder cables must be connected to the Markless sensor:

- Encoder type "HTL": Cables A and B
- Encoder type "TTL": Cables A, A‘, B and B‘

→ For the connection diagram of the Markless sensor, see page 26, chapter 7.4.1.

Check mounting

→ See page 73, Fig. 44 and page 20, chapter 6.

Check encoder settings

→ For setting up of the encoder, see page 29, chapter 8.2.
→ For the menu structure, see page 86, chapter 18.

Check the following items:

- The encoder type set at the Markless sensor must match the type of the connected encoder. The options available are "HTL" or "TTL.
  - Encoder type set for sensor: → See page 30, Table 6, parameter "Enc-Typ" or page 65, Table 26, parameter "Encoder type".
  - Encoder type of the connected encoder: → See data sheet.
- The encoder resolution set at the Markless sensor must match the stroke width of the encoder. → See page 30, Table 6, parameter "EncRes" or page 30, Table 6, parameter "Encoder resolution".
  The encoder resolution is determined according to the following section.

Determine encoder resolution

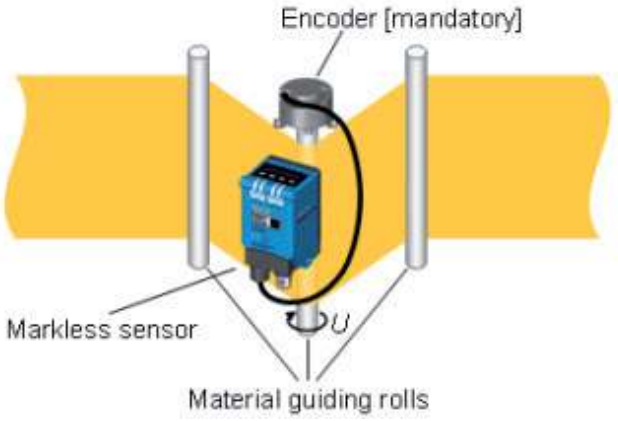


Fig. 44: Mounting of encoder

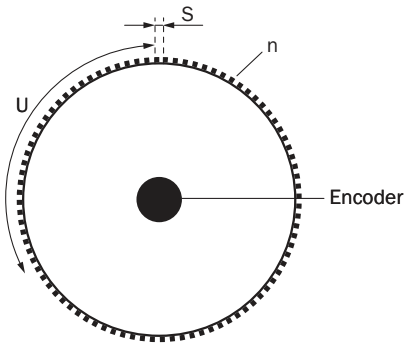


Fig. 45: Determine encoder resolution

The encoder resolution (EncRes) can be determined using the following format:

S = U/n

S: Encoder resolution

U: Outer diameter of the role

n: Number of encoder strokes for 360 °

Check function

The correct function and therefore correct wiring and setting are checked via the displayed encoder position.
→ See page 45, Table 13, parameter "EncPos" of page 70, Table 30.

- Rotating direction CW (Clockwise):
  Counter increases in the grid of the encoder resolution.
- Rotating direction CCW (Counter-Clockwise)
  Counter decreases in the grid of the encoder resolution.

13.2.2 Error caused by mounting or teaching

Teach quality too low

If the teach quality is too low, less than 3 bars flash in the display.

Check the individual items according to the following table.

Item to be examined/cause	Examination	Troubleshooting
Material is highly glossy.	Check sensor distance and angle. → See page 20, chapter 6.2.	If required, do not use the specified distance and angle. E.g. tilt the sensor more or less.
The sensor is not installed in the correct height. Sensor does not record the printed area correctly. E.g. no label edge is recorded, or the contrast is too low.	Read teach image via SOPAS Single Device and check. → See page 51, Fig. 26.	Correct sensor height. → See page 20, chapter 6.2.
The taught format length is too long or too short. The taught format length must correspond to 95 % ... 97 % of the format length.	The menu "Diagno" shows the messages "Wrn11" and "Wrn15". Check teach length. → See page 45, Table 13, parameter "TeaLen" and "ActLen".	• Perform a trigger teach with specified length via SOPAS Single Device. → See page 57, Table 20. • Repeat teach and observe the taught format length.
The material was not moved in front of the sensor correctly throughout the teach process.	Read teach image via SOPAS Single Device and check. → See page 51, Fig. 26.	Repeat teach. Ensure that the material is not moved slanted or in waves or at the wrong angle in front of the sensor. → See page 20, Fig. 8.
The rotating direction during the teach process does not match the set encoder direction. For a correct signal, the rotating direction during the teach process and the encoder direction set must match.	Check rotating direction via the parameter "EncDir" in menu "Diagno". The number value must change. A "+" must be displayed before the number value. The "+" signals that the rotating direction during the teach process and the current rotating direction match. "–" shows that the two rotating directions do not match. The switching output Q is LOW.	Repeat teach. Move the material in the other rotating direction.

Table 32: Error caused by mounting and teach

13.2.3 Error caused by the system

Check the individual items according to the following table.

Item to be examined/cause	Example	Troubleshooting
Material slippage is too large.		
Material stretch is too large.		
Image features are not identical. The formats differ in details.	The image features are in the same place, but there is a writing change.	Replace the material. Repeat teach.
Large-area material is used and the background is irregular, e.g. contaminated.	The guide roller is contaminated.	Clean guide roller. Repeat teach.
EMC electromagnetic interference of the system is too high.	EMC electromagnetic interference of the system is too high, e.g. frequency converter.	• Check wiring → page 22, chapter 7.2. • Always use shielded and twisted cables for the sensor. → For ready-made cables, see page 82, chapter 16.1.

Table 33: Error cause in the system

13.2.4 Error caused by network connection and SOPAS Single Device

NOTE!

We recommend having the network integration of the Markless sensor performed by your network administrator.

Check the individual items according to the following table.

Item to be examined/cause	Examination	Troubleshooting
The sensor is not connected to a network via a network cable.	• The LED "Link" must be lit at the sensor (Ethernet connection OK). • The LED "Act" must be lit at the sensor (data transfer).	
The IP-configuration of the sensor is not correct.		Check sensor IP configuration. → See page 44, chapter 9.8.
The network settings in SOPAS Single Device are incorrect.	On the page "IP communication" (menu path: network assistant > page "IP communication"), check the following information. → See page 48, chapter 11.2.	
After input of a new IP address, the supply voltage of the sensor is not switched off and on again (restart). The sensor assumes the new IP address only after the sensor is restarted.	Check sensor IP configuration. → See page 45, chapter 9.9, parameter "IP Adr".	After verification of the IP configuration, switch the supply voltage off and on again.

Item to be examined/cause	Examination	Troubleshooting
The IP configuration is not compatible with the present network.	• Check settings for IP address, subnet mask and gateway. → See page 44, chapter 9.8. • Use the diagnostics tool "ping" to check if the sensor is correctly integrated into your IP network. The sensor must open with an Echo-ICMP package (Echo Request). The LED "Activity" must be lit at the sensor.	Contact your network administrator.
SOPAS Net Scan Timeout too low for the connected network.	Check value for parameter scan timeout [ms]". Factory setting is 500 [ms].Path: Network configuration > IP-configuration > Extended.	Increase value for parameter "scan timeout [ms]", e.g. 4000.
An older SOPAS ET version is used than version 02.36.	SOPAS ET > Menu "Help" > Info	Download the current SOPAS ET version from www.mysick.com/en/ml20.
The wrong device manager was used The sensor is marked with the symbol (–) in SOPAS Single Device.		www.mysick.com/en/ml20 offers the device manager to match the firmware (*.sdd-file) for download. Install device driers in SOPAS Single Device.

Table 34: Error caused by network connection and SOPAS Single Device

13.2.5 Error cause from firmware update

The firmware update was not completed properly or interrupted. The display continues to show the message "Update" after canceling or terminating the update in SOPAS Single Device.

Perform one of the following steps:

- Repeat update process.
- Switch the sensor's supply voltage off and on again (restart). After restart, the display may show the error message "Err005". The sensor continues to work under the previous firmware version, but the firmware update must be repeated.
  The error message is displayed after every restart until a firmware update has been successfully completed.
- If the sensor shows the message "Update" alternatingly with an upwards counting percentage after a restart, wait until the indication reaches 100 percent and the indication goes out.

13.3 Return

Include the following with your return for efficient processing and quick determination of the cause:

- Information on a contact.
- A description of the application.
- A description of the error that occurred.

13.4 Disposal

Observe the following items for disposal:

- Do not dispose of the device in the household waste.
- Dispose of the device according to the respective country-specific regulations.

14 Repair

Repairs must only be performed by the manufacturer. Manipulation and changes of the sensor void the manufacturer's warranty.

15 Technical data

NOTE!

You may download, save and print the online data sheet with technical specifications, dimensions and connection diagrams online from "www.mysick.com/en/ml20".

15.1 Dimensions

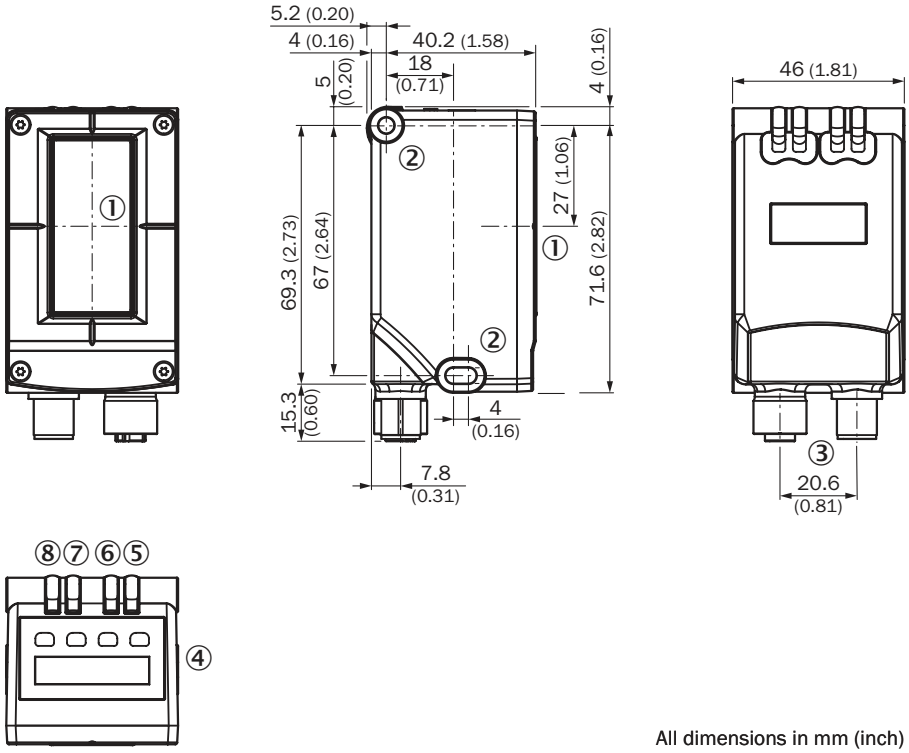


Fig. 46: Dimensions Markless sensor ML20

1 *Center of the visual axis*
2 *Fixing hole, Ø 4.2 mm*
3 *Plug M12, 12-pin/female connectorM12, 4-pin, rotatable by 90°.*
4 *Display and buttons*
5 *Function indicator (green) "On"*
6 *Function indicator (yellow) "Q"*
7 *Function indicator (green) "Link"*
8 *Function indicator (yellow) "Act"*

15.2 Optics/features

Light source [1]	LED, white
Wave length	400 nm ... 700 nm
Light spot size	60 mm x 3 mm
Sensing distance:	20 mm
Sensing distance tolerance	± 2.5 mm
Setting	Start-stop teach, trigger teach
Format length (min.)	40 mm
Format length (max.)	1.000 mm
Format height (min.)	34 mm
Tolerance lateral offset	± 5 mm
Initialization time	< 10 s
Repeatability [2]	0.6 mm
Storage time (ET)	≥ 2 s, non-volatile storage

1) Average service life 100,000 h at T_U = +25 °C.

2) Statistical error 2 σ

Table 35: Optics/features

15.3 Supply

Supply voltage V_S [1]	12 V DC ... 30 V DC
Power consumption (without load)	< 6 W
Residual ripple	< 5 V_{SS} within the permissible supply voltage V_S (Must not exceed or undercut V_s tolerances.)

1) Thresholds: Operation in short-circuit protected grids max. 8 A.

Table 36: Supply

15.4 Inputs

Input, teach-in (ET)	• PNP • Teach: U = 12 V ... < V_S • RUN U = 2 V ...
Input, blanking input (AT) [1]	• PNP • Blanked U = 12 V ... < U_V • Free running U = 2 V ...
Protective circuits	V_S connections, reverse polarity protected, interference pulse suppression

1) Blanking of identical regions of interest

Table 37: Inputs

15.5 Outputs

Switching output (Q_{out})	PNP • HIGH = U_V – ≤ 2 V, Switching signal for 5 mm • LOW < 0.5 V
Protective circuits	Output Q_{out} Short-circuit protected
Maximum output current	< 100 mA (total I_{out} = Q + $Status_{OUT}$)
Status sensor ($status_{out}$)	• HIGH: Current format length is within the average format length ± 2,4 mm [1)] • LOW: Current format length deviates from average format length by more than ± 2,4 mm [1)]

1) The average format length corresponds to the average of the last 8 measured format lengths.

Table 38: Outputs

15.6 Interfaces

Ethernet TCP/IP	Configuration interface
Communication protocol	CoLa-B (Command Language Binary)

Table 39: Interfaces

15.7 Encoder

Encoder resolution	100 µm ... 250 µm (in 1 µm)
Encoder input	• Differential: 4.5 V ... 5.5 V / TTL / RS-422 • Single Ended: 12 V ... 30 V / HTL / counter-cycle

Table 40: Encoder

15.8 Ambient conditions

Protection class	III, for operation with safety extra-low voltage (SELV/PELV)
Electromagnetic compatibility	EN 61000-6-2, EN 55011, class A
Ambient temperature range	–10 °C ... +55 °C
Storage temperature range	–20 °C ... +75 °C
Ambient light safety	30,000 lx
Enclosure rating	IP 65
Max. movement speed	7 m/s
Vibration resistance (sine)	EN60068-2-6
Noise	EN60068-2-64
Shock resistance/impact load	EN 60086-2-27

Table 41: Ambient conditions

15.9 Constructional setup

Dimensions	→ See page 78, chapter 15.1.
Weight	325 g
Materials	Housing: Metal
Connections [1]	• Plug M12, 12-pin • Ethernet connection M12, 4-pin
Indication	6 points with a 5 x 7 point matrix

1) Use twisted and shielded cables.

Table 42: Constructional setup

16 Accessories

16.1 Connection systems

16.1.1 Cable sockets with cables

Description	Cable socket M12, 12-pin, straight, 5 m, shielded, twisted-pair cores
Type	DOL-1212-G05MAS02
Part no.	6042754

Description	Cable socket M12, 12-pin, angled, 5 m, shielded, twisted-pair cores
Type	DOL-1212-W05MAS02
Part no.	6044109

16.1.2 Connection cable

Description	Connection cable M12. 12-pin, plug straight/socket straight, 5 m, shielded, twisted-pair cores
Type	DOL-1608-G05MAS02
Part no.	6045234

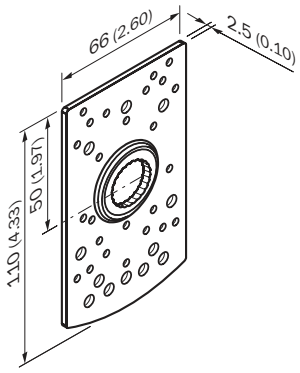
16.1.3 Ethernet cables

Description	Ethernet cables, 4-core, shielded, M12-plug straight 4-pin (D-coded), RJ-45-plug 8-pin, 5 m
Type	Connection cable (plug-plug)
Part no.	6034415

Description	Ethernet cables, 4-core, shielded, M12-plug angled 4-pin (D-coded), RJ-45-plug 8-pin, 5 m
Type	Connection cable (plug-plug)
Part no.	6039488

16.2 Mounting system

16.2.1 Plate for universal terminal holder

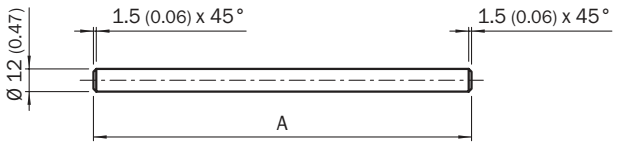


All dimensions in mm (inch)

Fig. 47: Plate for universal terminal holder

Description	Plate N04 for universal terminal holder, steel zinc-plated, including universal terminal holder and fastening material.
Type	BEF-KHS-N04
Part no.	2051610

16.2.2 Mounting rods



All dimensions in mm (inch)

Fig. 48: Mounting rods, straight

Description	Mounting rods, straight, 200 mm, steel, zinc-plated, no attachment material
Type	BEF-MS12G-A
Part no.	4056054

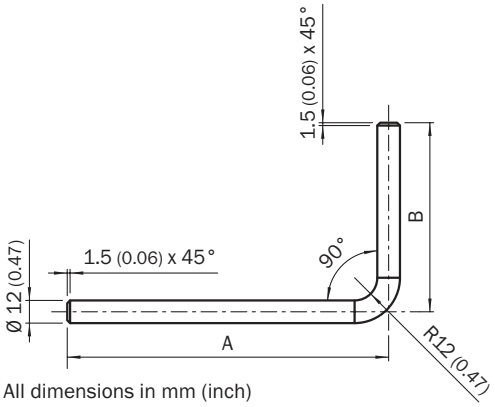


Fig. 49: Mounting rod, L-shaped

Description	Mounting rod, L-shaped, 250 x 250 mm, steel, zinc-plated, no attachment material
Type	BEF-MS12L-B
Part no.	4056053

17 Licenses

LwIP 1.4 according to the Modified BSD license is used in the Markless sensors see http://savannah.nongnu.org/projects/lwip/

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18 Menu structure

18.1 Menu "Setup"

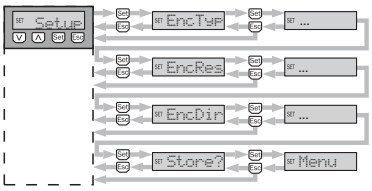

Fig. 50: Menu "Setup"

→ *See page 28, chapter 8 "Commissioning".*

18.2 Menu overview, menu "MAN" and menu "TRIGG"

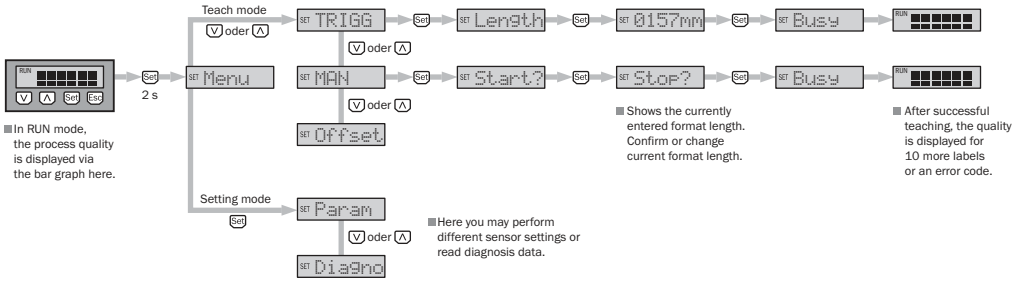

Fig. 51: Menu overview; menu "MAN" and menu "TRIGG"

→ *See page 33, chapter 9.4.2, menu "MAN"*

→ *See page 34, chapter 9.4.3, menu "TRIGG"*

18.3 Submenu "Ethern"

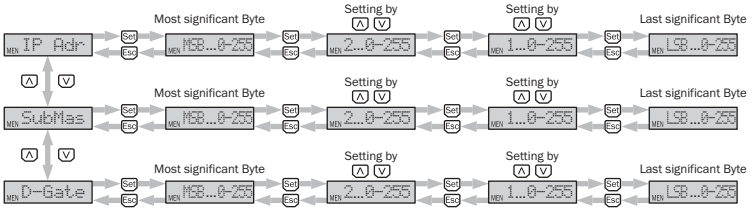

Fig. 52: Menu "Ethern"

→ *See page 44, chapter 9.8.*

18.4 Menu "Param" and "Diagno"

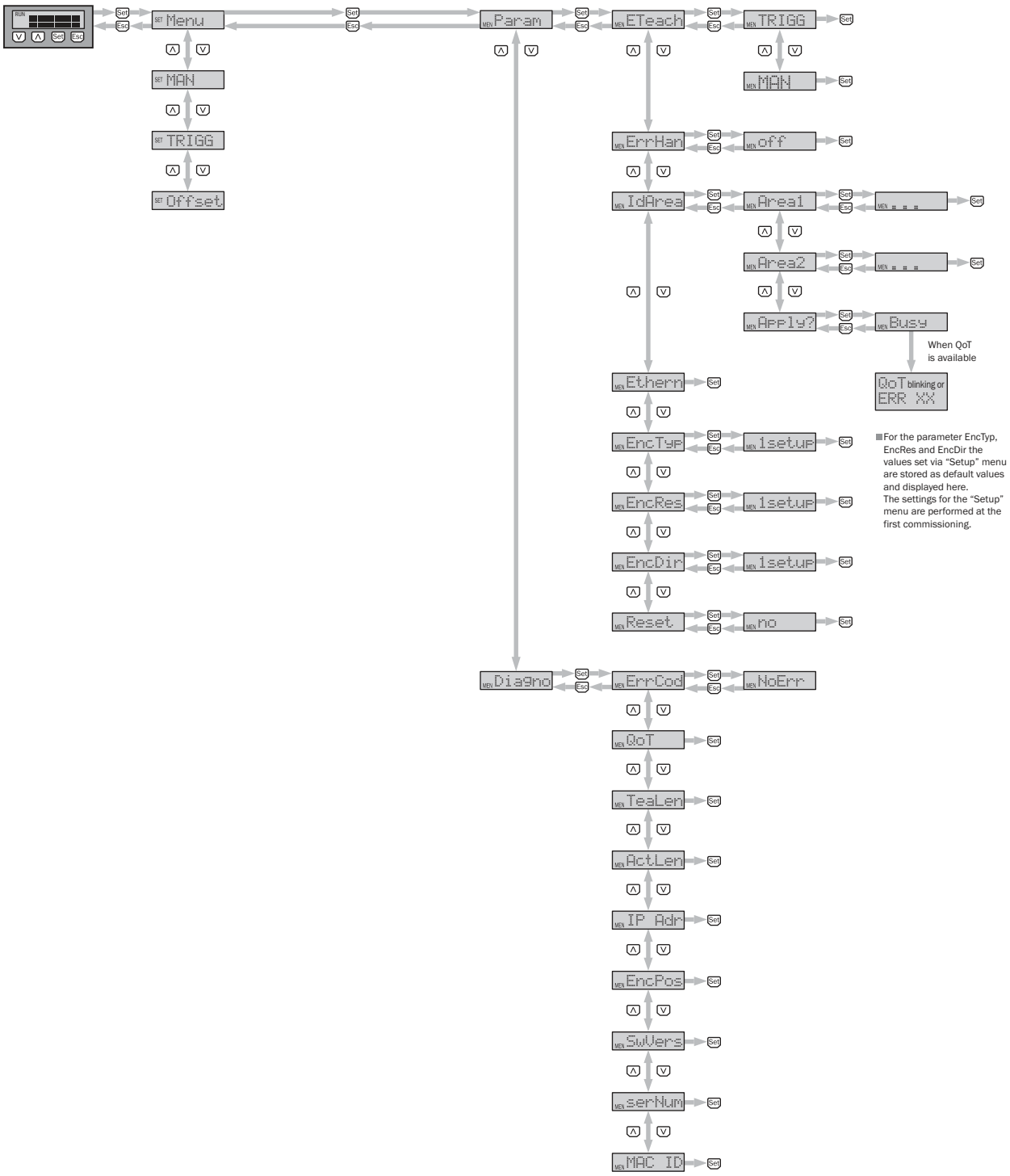

Fig. 53: Menu "Param" and "Diagno"

→ *See page 36, chapter 9.5.1, menu "Param"*
→ *See page 45, chapter 9.9.*

Index

8015061/WL29/2012-10-19 · (2012-10) · A4 4c int38

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