Operating Instructions
Silopilot FMM50

Electromechanical level system

Endress+Hauser [EH]

People for Process Automation
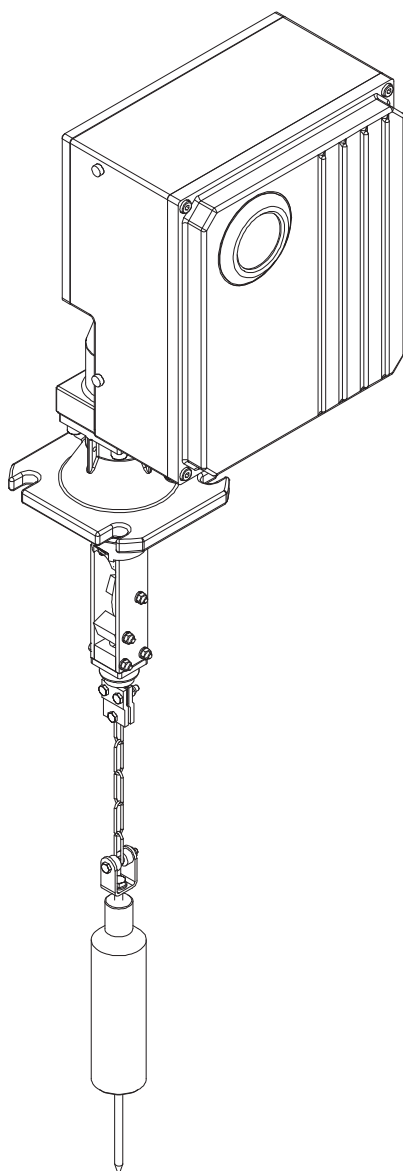
- Make sure the document is stored in a safe place so that it is always available when working on or with the device.
- To avoid danger to individuals or the facility, read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser Sales Center will supply you with information on modifications or updates to the Operating Instructions.

Table of contents

1   Document information

1.1   Purpose of the document

These Operating Instructions contain all the information that is required in the various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, servicing and disposal.

1.2   Document conventions
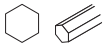
1.2.1   Safety symbols

Symbol	Meaning
⚠ **DANGER**	DANGER! This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
⚠ **WARNING**	WARNING! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
⚠ **CAUTION**	CAUTION! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE	NOTE! This symbol contains information on procedures and other facts which do not result in personal injury.

1.2.2   Electrical symbols

Symbol	Meaning
⎓	Direct current A terminal to which DC voltage is applied or through which direct current flows.
∼	Alternating current A terminal to which (sinusoidal) alternating voltage is applied or through which alternating current flows.
⏚	Protective earth connection A terminal which must be connected to earth before any other connections may be established.

1.2.3   Tool symbols

Symbol	Meaning
	Flat-blade screwdriver
	Allen screw
	Open-ended wrench

1.2.4 Symbols for certain types of information

Symbol	Meaning
✅	Permitted Indicates procedures, processes or actions that are permitted.
✅✅	Preferred Indicates procedures, processes or actions that are preferred.
❌	Forbidden Indicates procedures, processes or actions that are forbidden.
🛈	Tip Indicates additional information.
📖	Reference to documentation Refers to the corresponding device documentation.
📄	Reference to page Refers to the corresponding page number.
🖼	Reference to graphic Refers to the corresponding graphic number and page number.
1. , 2. , 3. ...	Series of steps
✔	Result of a sequence of actions
？	Help in the event of a problem
👁	Visual inspection

1.2.5 Symbols in graphics

Symbol	Meaning	Symbol	Meaning
1, 2, 3 ...	Item numbers	1. , 2. , 3. ...	Series of steps
A, B, C ...	Views	A-A, B-B, C-C ...	Sections
⬟EX	Hazardous area	⬟EX	Safe area (non-hazardous area)

1.3 Documentation

🛈 For an overview of the scope of the technical documentation associated with the device, see:
  - The W@M Device Viewer: enter the serial number from the nameplate (www.endress.com/deviceviewer)
  - The *Endress+Hauser Operations App*: enter the serial number from the nameplate

1.3.1   Standard documentation

Document	Purpose and content of the document
Technical Information TI00395F	**Planning aid for your device** The document contains all the technical data pertaining to the device and provides an overview of the accessories and other products that can be ordered for the device.

The document types listed are available:
- In the Download Area of the Endress+Hauser website: www.endress.com → Downloads

1.3.2   Supplementary device-dependent documentation

Depending on the approval, Safety Instructions (XA) are supplied with the device on delivery. These Safety Instructions (XA) are an integral part of the Operating Instructions.

Feature 010	Approval	Safety Instructions
BA	ATEX II 1/2D Ex ta/tb IIIC T99 °C Da/Db IP6X	XA00425F
	ATEX II 2D Ex tb IIIC T99 °C Db IP6X	

The document types listed are available:
- In the Download Area of the Endress+Hauser website: www.endress.com → Downloads

2 Basic safety instructions

2.1 Requirements for personnel

The personnel for installation, commissioning, diagnostics and servicing must meet the following requirements:
- Trained, qualified specialists: must be qualified for this specific function and task
- Authorized by the plant owner/operator
- Familiar with national regulations
- Before starting work: read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application)
- Follow instructions and comply with basic conditions

Operating personnel must meet the following requirements:
- Instructed and authorized according to the requirements of the task by the facility's owner-operator
- Follow the instructions in this manual

2.2 Designated use

Application and media

The device described in these Operating Instructions is designed exclusively for level measurement in bunkers or silos with dusty, fine-grain or coarse-grain bulk solids or in tanks containing liquids. Depending on the device version ordered, the device can also be used in an explosive environment.

If the limit values specified in the "Technical Data" and the conditions listed in the instructions and additional documentation are observed, the device may be used exclusively for the following measurements:
- Detected process variable: level
- Calculable process variable: volume

To ensure that the device remains in proper operating condition while it is in operation:
- Only use the device in media to which the process-wetted materials are adequately resistant.
- Comply with the limit values in the "Technical Data".

Incorrect use

Non-designated use can compromise safety. The manufacturer is not liable for damage caused by improper or non-designated use.

Clarification of borderline cases:
- In the case of special fluids and media used for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of wetted materials, but does not accept any warranty or liability.

Danger of burns from contact with surfaces!
- If fluid temperatures are high, ensure protection against contact to prevent burns.

2.3 Occupational safety

When working on and with the device:
- Wear the required personal protective equipment according to national regulations.

2.4 Operational safety

Risk of injury
- The device may only be operated if it is in proper technical condition free from errors and faults.
- The operator is responsible for the trouble-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers:
- If, despite this, modifications are required, consult with Endress+Hauser.

Repair

To ensure continued operational safety:
- Carry out repairs on the device only if they are expressly permitted.
- Observe national regulations pertaining to the repair of an electrical device.
- Only use original spare parts and accessories from Endress+Hauser.

Hazardous area
To eliminate danger to persons or the facility when the device is used in the hazardous area (e.g. explosion protection):
- Check the nameplate to verify whether the ordered device can be used as intended in the hazardous area.
- Observe the specifications in the separate supplementary documentation, which is an integral part of these Operating Instructions.

2.5 Product safety

This state-of-the-art measuring device is designed in accordance with good engineering practice to meet operational safety standards, has been tested, and left the factory in perfect functioning order.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity.
Endress+Hauser confirms this by affixing the CE mark to the device.

3   Product description

3.1   Product design

3.1.1   Complete device
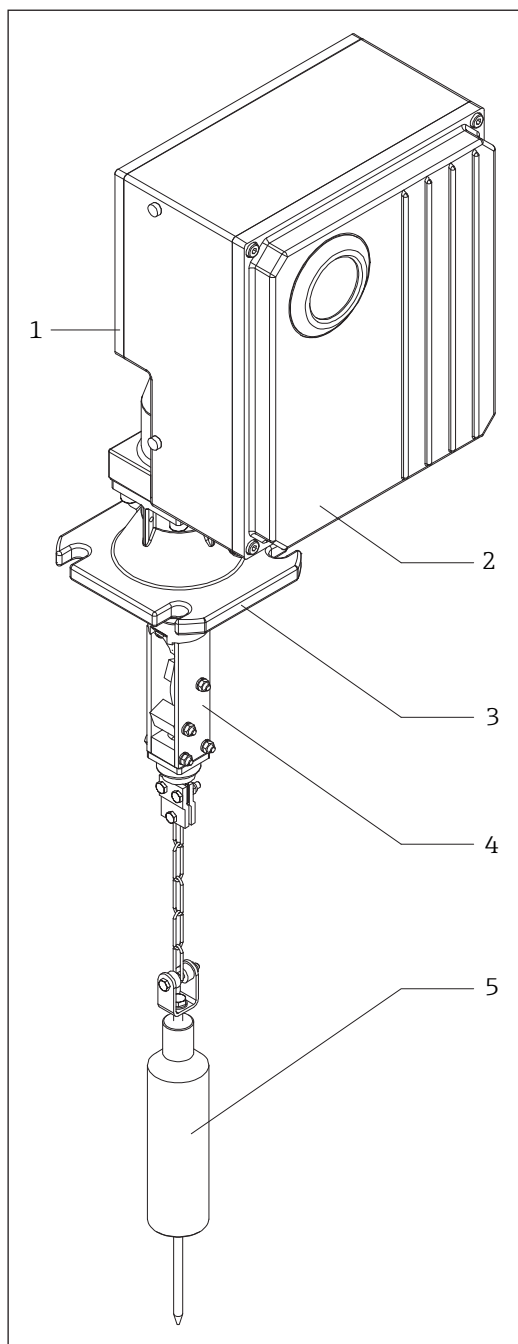
⊞ *1   Structure of the FMM50*

1   Process side (spool compartment)
2   Electronics side (electronics compartment)
3   Process connection (DN100 PN16, hole sizes as per EN 1092-1)
4   Wiper
5   Sensing weight

3.1.2 Process side
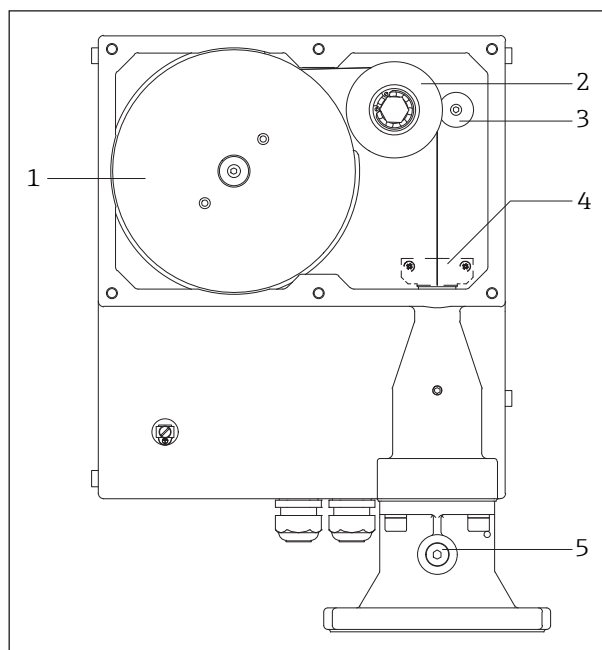
🖳2 *Process side of the FMM50*

1 Tape reel with measuring tape
2 Counting wheel
3 Tape guide
4 Guide plate (not used since 2016)
5 Purge air connection

3.1.3 Electronics side
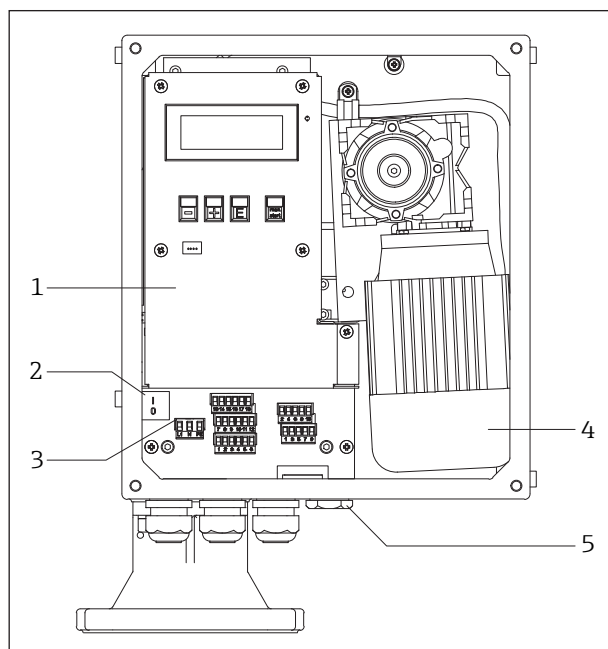
🖳3 *Electronics side of the FMM50*

1 Electronics
2 ON/OFF switch
3 Terminals
4 Motor/gearbox combination
5 Optional external start button

3.1.4   Wiper
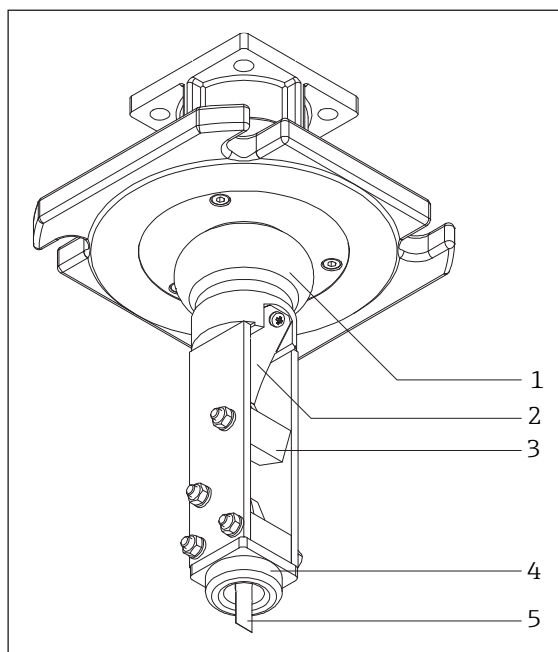
🖼4   *Wiper of the FMM50*

1   Bellows
2   Tape-wire scraper
3   Scraper block
4   End guide
5   Measuring tape

3.1.5   Sensing weights
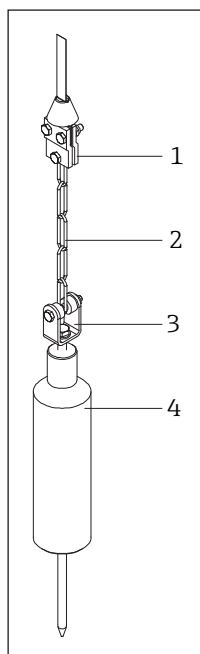
🖼5   *Sensing weight of the FMM50 (here: steel/stainless steel)*

1   Tape border
2   Chain
3   Rotating bush
4   Sensing weight

3.1.6 Process connection

*1 Minimum dimension for installing the wiper mechanism and the standard weight
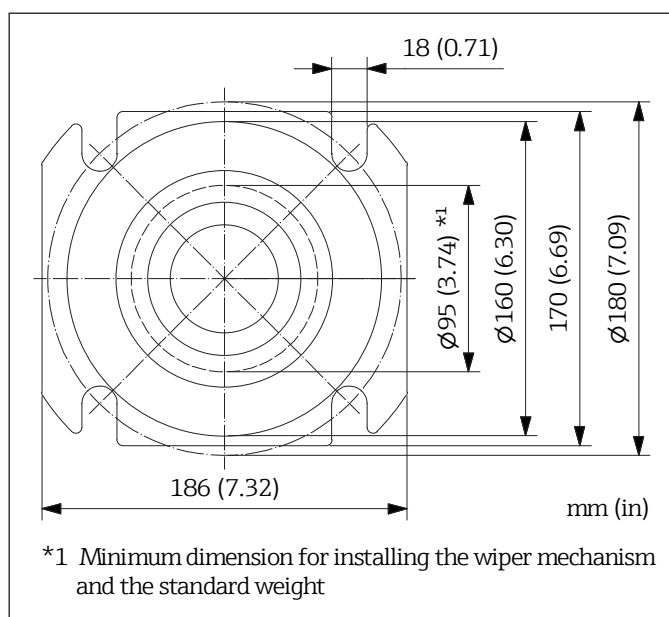
🖭6　　*Process connection diagram of the FMM50*

3.2　Measuring principle

The FMM50 works according to a simple measuring principle:

1. When a measurement starts (manually or automatically), a sensing weight is lowered by a motor and spring action causes the wiper to be moved slightly out of its end position. As the weight is lowered, the measuring tape passes over a counting wheel which sends a pulse to the electronics every 5 cm.

2. When contact is made with the medium, the freely suspended motor switches from its working position - in which it is held by the downward force of the sensing weight - to its rest position. This is detected by the electronics and the motor is switched off.

3. The sensing weight is pulled up again and counter pulses are detected once more.

4. As soon as the sensing weight reaches the measuring device, it causes the wiper to move to its top position which is detected by the electronics.

5. The motor is switched off, the measuring cycle is ended and the measured value, which depends on the configuration, is output:
   - Display value on the LC display
   - Current value at the 4-20 mA current output
   - Relay switching (e.g. for the "top position" or "measuring" function)
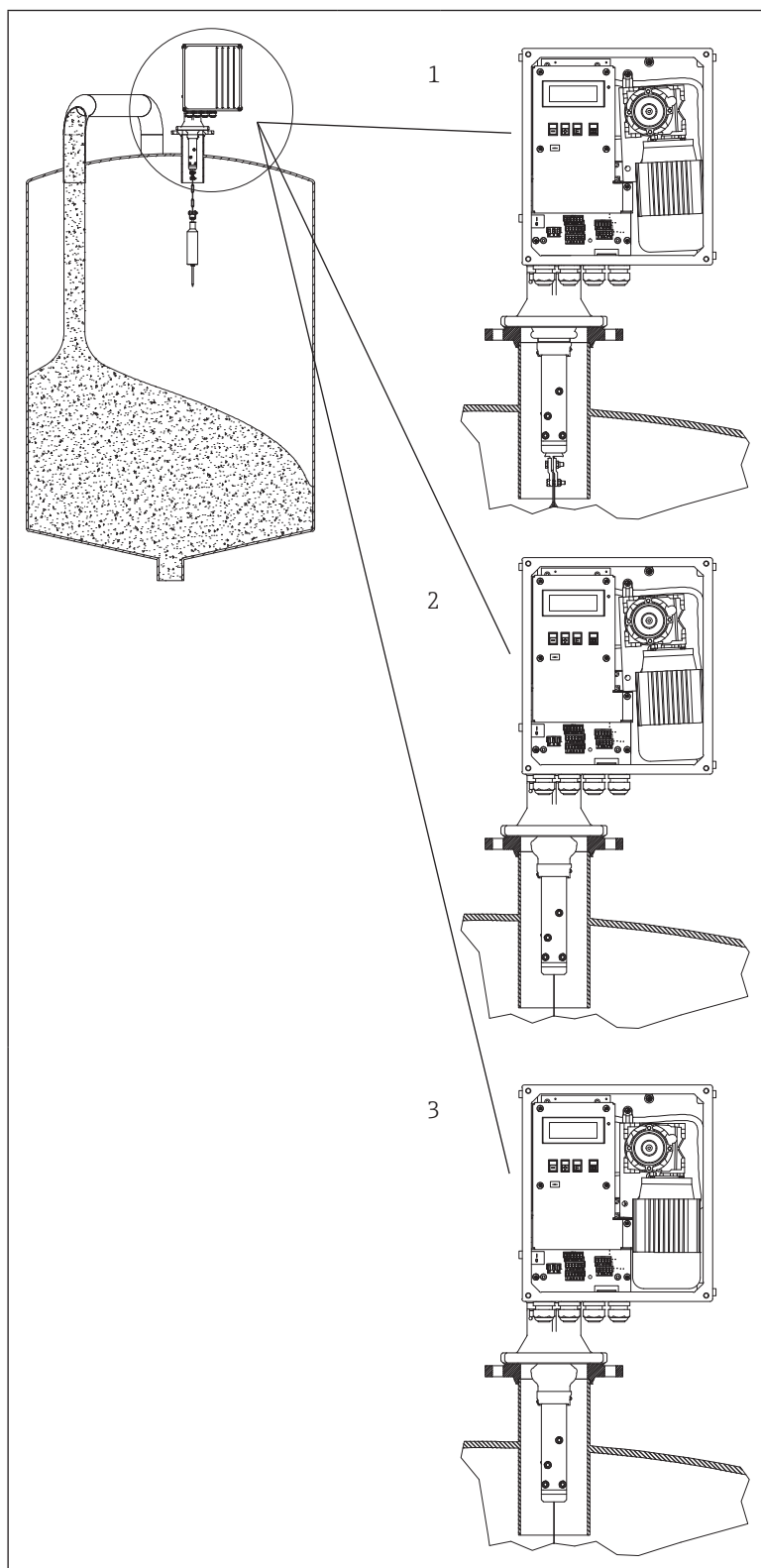
🖼 *7   Measuring principle of the FMM50*

1   Sensing weight in the top position
2   Sensing weight when lowered (run-down) or raised (run-up)
3   Sensing weight on reaching the surface of the medium

4   Incoming acceptance and product identification

4.1   Incoming acceptance
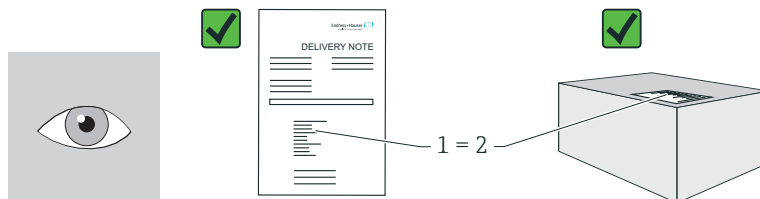
Is the order code on the delivery note (1) identical to the order code on the product sticker (2)?
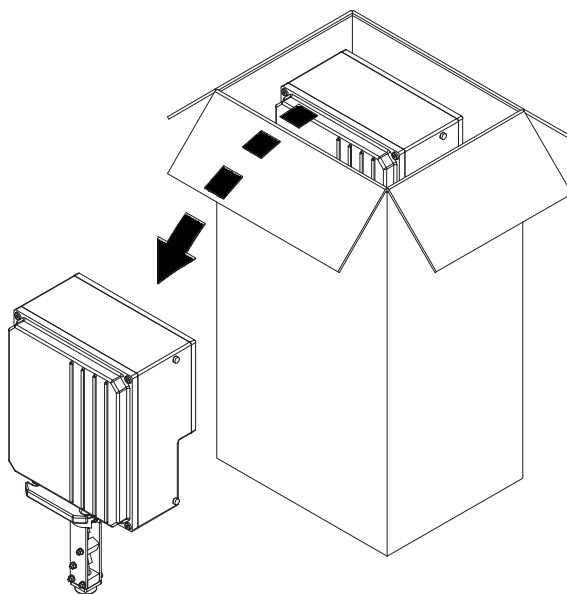
Are the goods undamaged?
Do the data on the nameplate correspond to the order specifications and the delivery note?

ℹ️ If one of the conditions is not satisfied, contact your Endress+Hauser Sales Center.

4.2   Product identification

You can identify your measuring device in the following ways:
• Using the nameplate specifications
• Using the order code with a breakdown of the device features on the delivery note
• Enter serial numbers from nameplates in *W@M Device Viewer*
  (www.endress.com/deviceviewer): all the information about the measuring device is displayed.
• Enter the serial number from the nameplates in the *Endress+Hauser Operations App*

For an overview of the scope of the Technical Documentation provided, refer to the following:
• The "Documentation" chapters
• The *W@M Device Viewer*: enter the serial number from the nameplate
  (www.endress.com/deviceviewer)
• The *Endress+Hauser Operations App*: enter the serial number from the nameplate

4.3   Nameplate
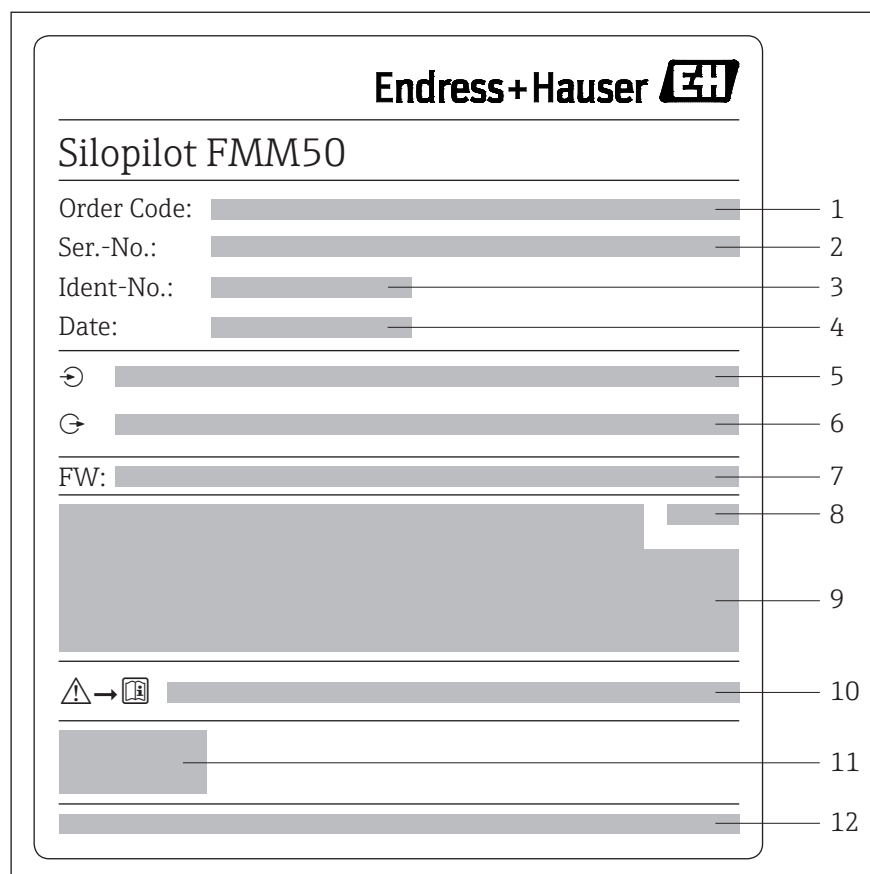
8   Example of a nameplate

1   Order code
2   Serial number
3   Ident code
4   Date of manufacture: year-month (date code)
5   Electrical connection data (input parameters)
6   Electrical connection data (output parameters)
7   Firmware
8   Degree of protection
9   Ambient temperature range and text for approval (if applicable)
10   Related Operating Instructions and Safety Instructions (if applicable)
11   CE mark
12   Place of manufacture

5   Storage and transportation

5.1   Storage and transportation conditions

Observe the following when storing the device:
- Store in the original packaging to ensure protection from shock.
- Protect from direct sunlight to avoid unacceptably high surface temperatures.
- Storage temperature: −40...+80 ℃ (−40...+176 ℉), preferably at +20 ℃ (+68 ℉)
- Store in a dry and dust-free atmosphere.
- Do not store outdoors.

5.2   Transporting the product

NOTICE

Transport the measuring device by the housing; no strain should be put on the wiper.

Comply with the following instructions when transporting the device:
- Transport the measuring device to the measuring point in the original packaging.
- Only mount wiper extensions and sensing weights once the device is at the place of installation.
- Comply with safety instructions and transportation conditions for devices over 18 kg (39.6 lbs).

5.3   Disposal of packaging

All packaging materials are environmentally friendly and 100% recyclable:
- Packaging:
  - Box, multi-part (quantity depends on the wiper and sensing weight used) in accordance with European Packaging Directive 94/62/EC; recyclability is confirmed by the RESY symbol on the packaging.
  - PP plastic inserts for fixing the device
  - PE-LD bag for the sensing weight and wiper extension if applicable
- Dunnage: cardboard

6 Installation

6.1 Installation conditions

6.1.1 Installation position

Select the installation location on the bunker or silo ceiling such that product falling inside during filling or cornices (product accumulating on container wall) collapsing inward are prevented from covering the sensing weight or damaging the measuring tape.

Take due account of the shape and location of the product inflow cone and the outflow funnel within the container. The measuring path should not pass too close to any internal fixtures or struts so that the measuring tape will not brush against them if the sensing weight swings around.

The length of the wiper should be selected such that the sensing weight can move freely when the tape is run up or down, and does not come close to the edges of a connection for example. The sensing weight should be located in the middle between the container wall and filling curtain when it is run up and down.
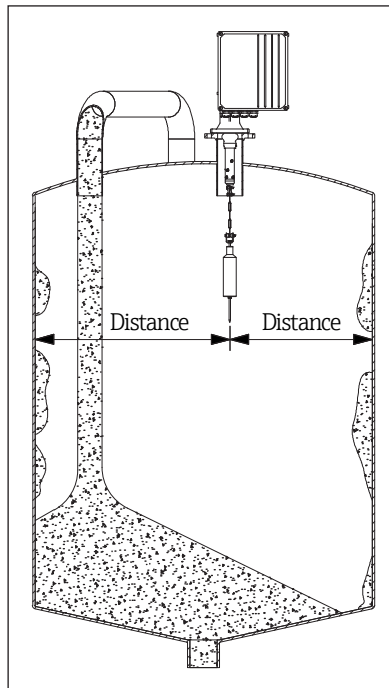
9   Installation positions

NOTICE

Incorrect measurements cannot be ruled out if the sensing weight cannot run free and unobstructed during the measurement.

Normally, the measuring device is mounted on a counter flange DN100 PN16 (bore dimensions as per EN 1092-1) or a flange of the same connection dimensions (→ 🖻6).

The counter flange must be mounted in such a way that it is perfectly horizontal so that the device can also be mounted horizontally onto it (maximum angle of inclination 2°). A suitable mounting aid (bubble level) can be found inside versions with a powder-coated housing. When the electronics cover is opened, this can be used for alignment.
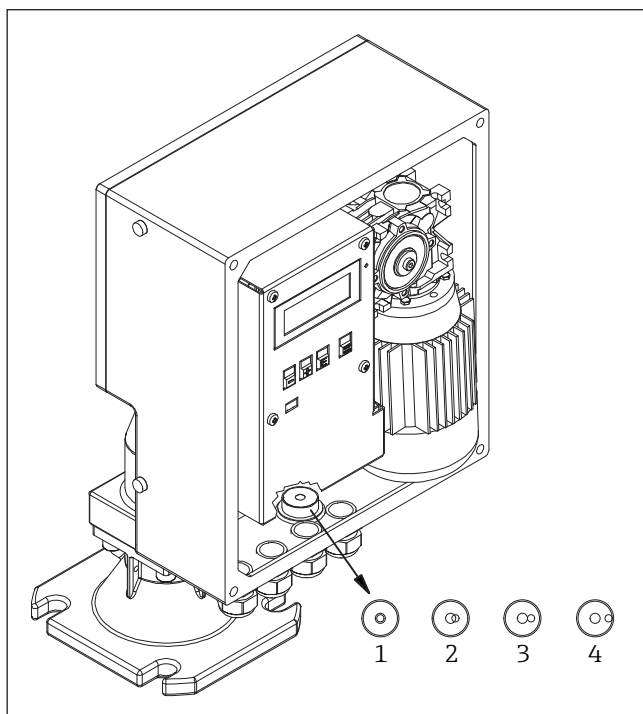
10   Bubble level

1   Device is horizontal (ideal)
2   Device is inclined at 1˚
3   Device is inclined at 2˚ (maximum angle of inclination)
*4   Device is inclined at more than 2˚ → **not permitted***

6.1.2 Ambient and process requirements

The maximum process temperature at the device (from the lower edge of the process adapter) is +70 °C (+158 °F) and must be taken into consideration when mounting.

$T_{P, max} (= T_{A, max}) \leq +70\ °C\ (+158\ °F)$

$-20\ °C \leq T_{P, max} \leq +230\ °C$
$(-4\ °F \leq T_{P, max} \leq +446\ °F)$
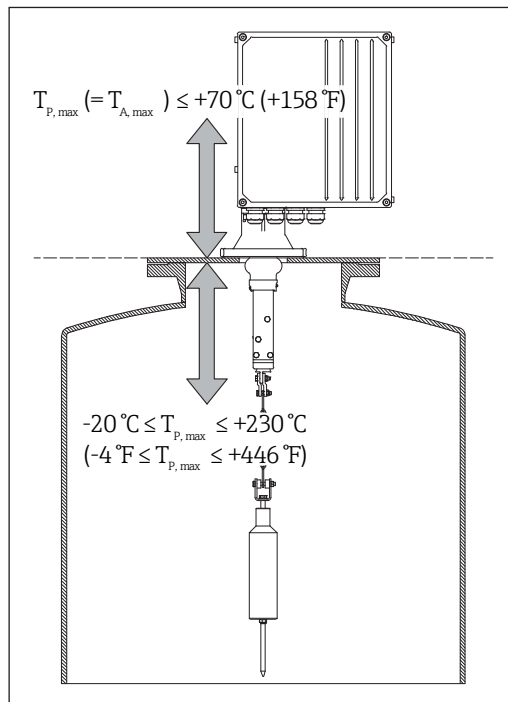
🔲 *11 Process and ambient temperature requirements*

T_A *Ambient temperature*
T_P *Process temperature*

If process temperatures are higher around the place of installation, suitable measures must be taken to ensure these temperature conditions are respected.

An extension of the process connection nozzle can be used to stay within the temperature parameters as this would cause the process temperature to be reduced to the ambient temperature range. Here, the length of the connection nozzle is based on the specific process and ambient conditions.
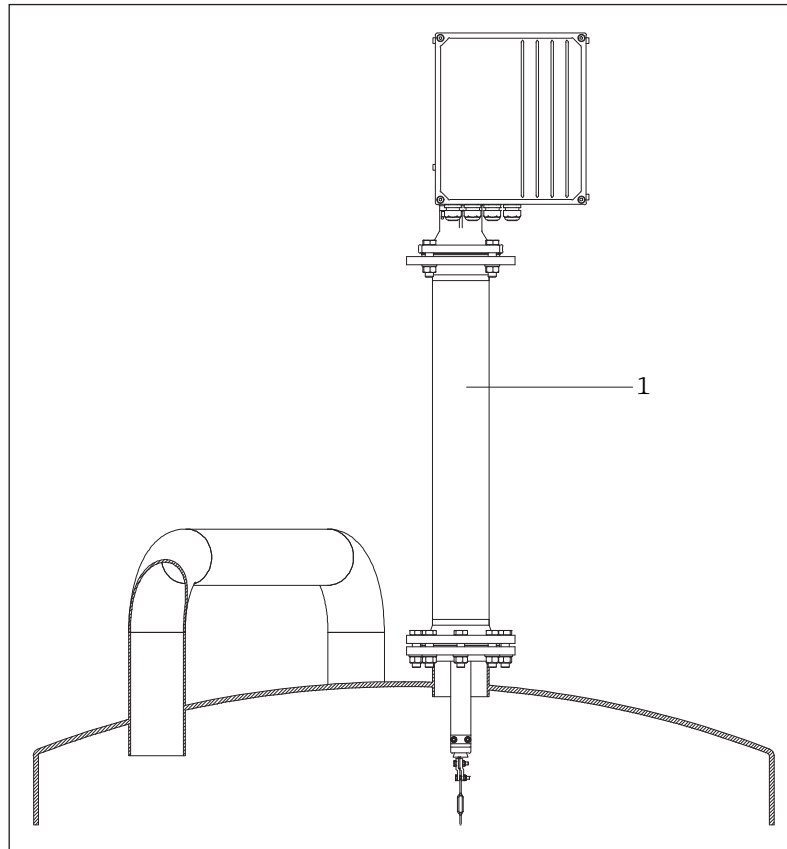
12 Suggested installation to respect ambient temperatures at the device

1   Process adapter extension

ℹ️ We recommend that the process connection nozzle has the following minimum
length:
  • Min. 500 mm for process temperatures up to +150 ℃ (+302 ℉)
  • Min. 1000 mm for process temperatures up to +230 ℃ (+446 ℉)

ℹ️ Process adapter extensions that are 790 mm long and designed for use with the
1000 mm wipers are available as accessories (→ 🖺88).

ℹ️ • You can order longer wipers as a device option if you are using process nozzles that
are longer than 230 mm (length of the standard wiper)(see order code).
  • Alternatively, you can extend the chain between the tape border and sensing
weight; corresponding material is available as an accessory
(→ 🖺88).
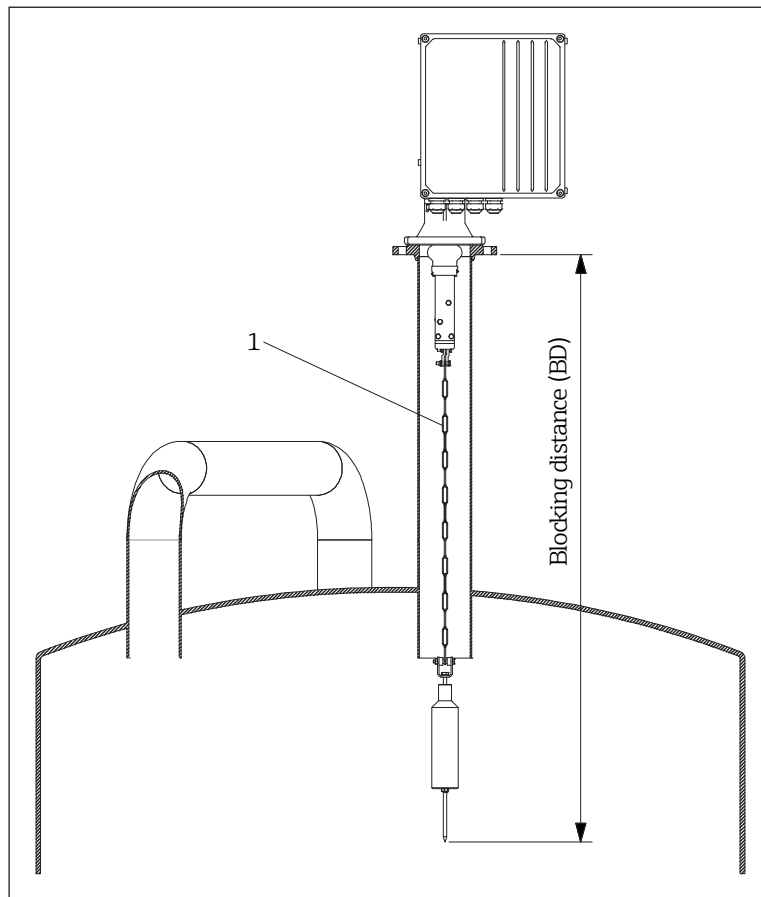
🔲 *13   Mounting with longer process nozzles*

1   Extended chain

When installing outside, please fit a protective hood or mount a weather protection cover.

ℹ️ A suitable protective hood for optimum use with the measuring device is available as an accessory (→ 🔖88).

6.2   Mounting the measuring device

6.2.1   Required tool

- To open the device:

  🔧 5 mm across flats (AF)

- For the process connection: use the appropriate installation tool
- For the sensing weight:

  🔧 10 mm across flats (AF)

ℹ️ To mount the device on a standard counter flange DN100 PN16 (bore dimensions as per EN 1092-1), two ring wrenches or open-end wrenches measuring 24 mm AF are needed to mount the four M16 screws.

6.2.2 Preparing the measuring device

1. Remove all remaining transport packaging.

For devices with an extended wiper (500/1000 mm):

2. Mount the wiper
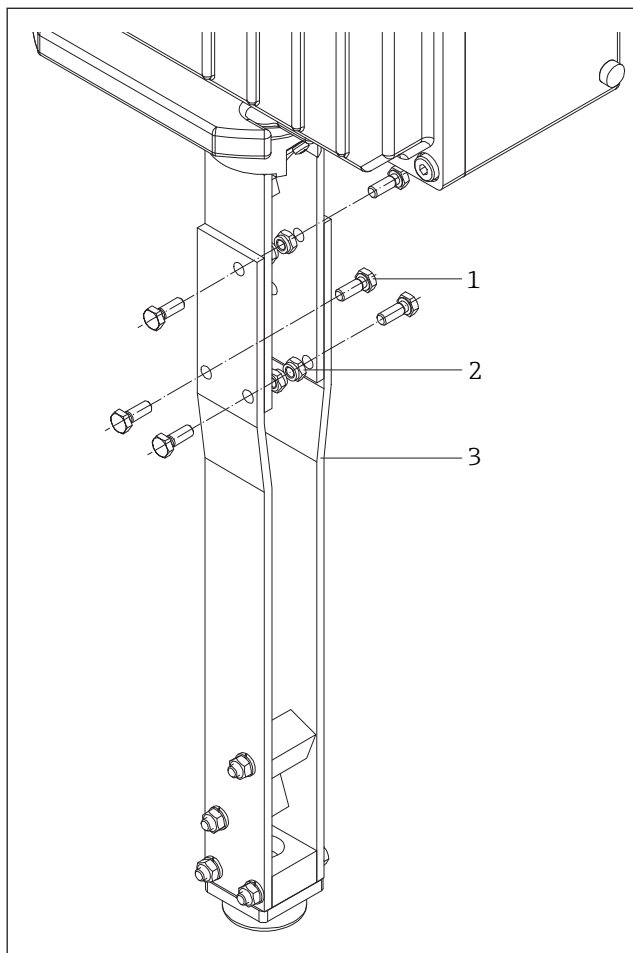
🖼14   *Mounting the wiper extension*

1   Hexagonal-headed bolt M6
2   Hexagonal nut
3   Wiper extension

3. Remove the transportation lock on the electronics side (to the right of the motor/gearbox combination)
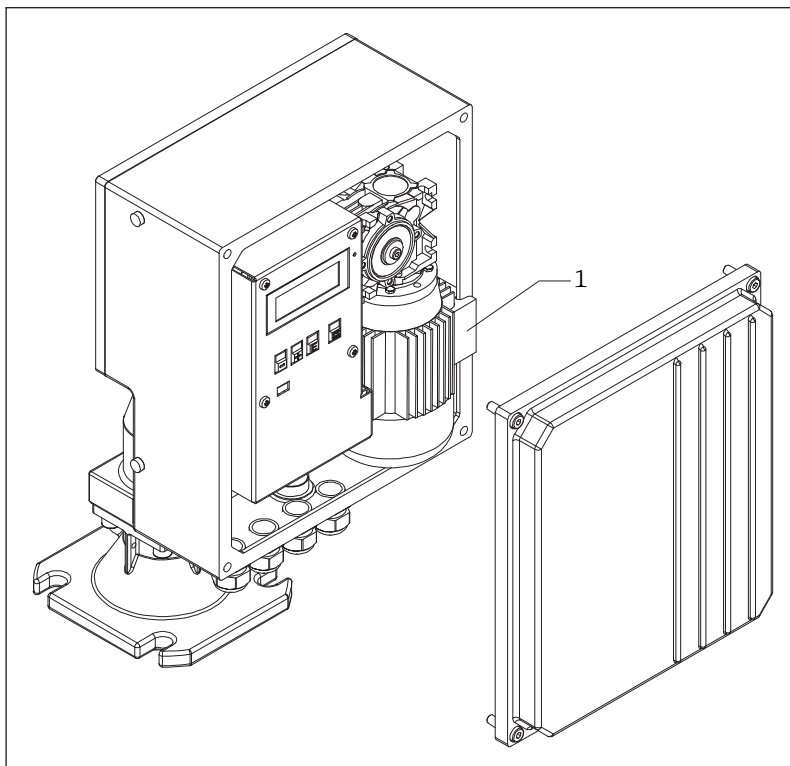
🖼15   Removing the transportation lock

1   Transportation lock

NOTICE

If the transportation lock is not removed, this can cause unforeseeable responses on the part of the device.

For devices with a large sensing weight (such as a cage weight, bell weight or oval float):

4. Use or provide structural support measures and lower the tape border an appropriate distance before mounting.
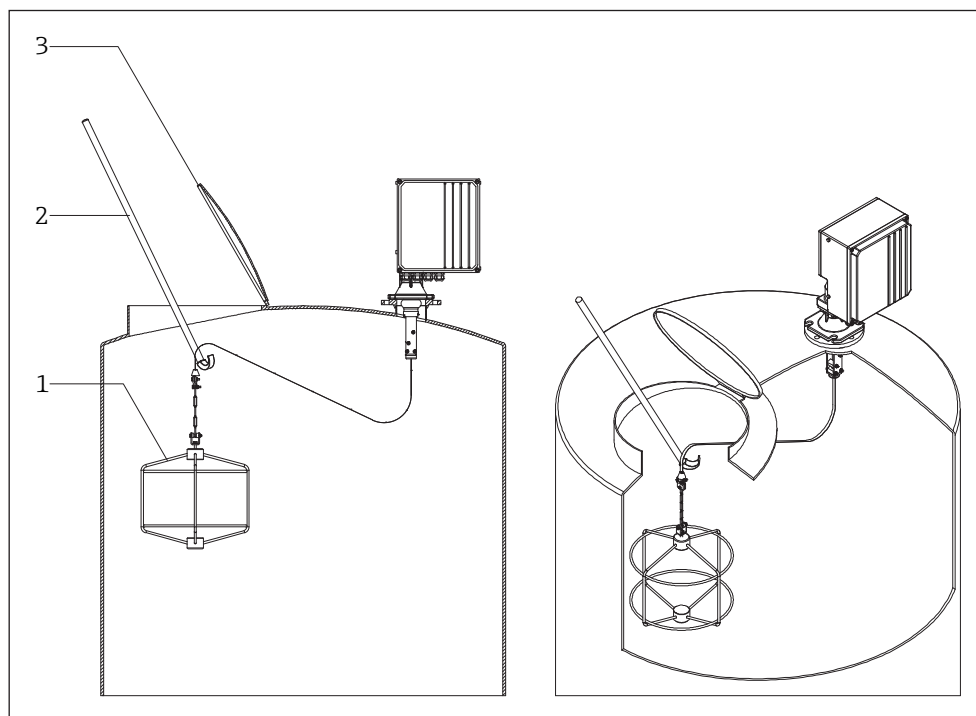
🖾 16 *Mounting large sensing weights*

1 Sensing weight (here: cage).
2 Rod with hook
3 Entry hatch or similar

6.2.3 Mounting the measuring device

1. Fit the measuring device on the process connection and align it in such a way that
   • the housing is horizontal (maximum angle of inclination 2°),
   • the cable entries (and the external start button where applicable) are accessible, and
   • the display is directed towards the user.

ℹ️ A suitable mounting aid (bubble level) can be found inside versions with a coated housing. When the electronics cover is opened, this can be used for alignment (→ 🖾10).

NOTICE

When introducing the measuring tape, make sure not to crease it as this reduces the operating life of the tape.

2. Fix the measuring device with four suitable screws.

NOTICE

When installing the Silopilot in bunkers or silos with strong dust formation, slight positive pressure can be generated at the Silopilot by connecting a compressed air line to the mounting flange (airflow quantity as required). This can be used to keep the spool compartment clean. A G¼ female connection is provided for this purpose (→ 🖾11).

3. Mounting the sensing weight

NOTICE

The sensing weight must be outside the connection when the measuring tape is wound up. The maximum height of the connection is dictated by the length of the wiper. This height is 230 mm if a standard wiper is used. 500 mm and 1000 mm wiper lengths are also available (see order code). Other lengths are available as special versions on request.
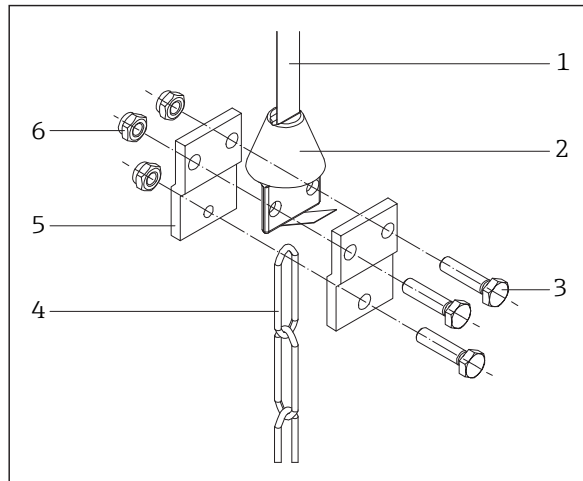
⊠ 17   Mounting the sensing weight

1   Measuring tape
2   Tape border
3   M6 hexagonal-headed bolt
4   Chain
5   Clamping bracket
6   Hexagonal nut

6.3   Post-installation check

Is the device damaged (visual inspection)?	❑
Does the measuring device meet the measuring point specifications? For example: • Process temperature (→ ⊠11) • Process pressure (→ 🗎101) • Ambient temperature (→ ⊠11) • Measuring range (see order code)	❑
Has the correct wiper been selected? • Is the sensing weight freely suspended in the process (→ ⊠12)	❑
Has the correct mounting location been selected? • The sensing weight can be lowered down to the zero point (empty calibration) without obstruction (→ ⊠9)	❑
Is the device adequately protected from precipitation and direct sunlight? • Use the weather protection cover (→ ⊠88)	❑

7 Electrical connection

7.1 Connection conditions

7.1.1 Required tool

- To open the device:
  - 5 mm across flats (AF)
- For the cable entries:
  - 30 mm AF for device versions without certification
    27 mm AF for device versions with Ex certification
- For the terminals:
  - 0.6x3.5mm
- When using stranded cables: crimper for wire end ferrule
- For potential equalization:
  - 1.0x6.5mm

7.1.2 Connecting cable requirements

The connecting cables provided by the customer must meet the following requirements.

Electrical safety
In accordance with applicable national regulations.

Permitted temperature range
- −20...+70 °C (-4...+158 °F) for device version without heater
- −40...+70 °C (-40...+158 °F) for device version with heater

Power supply cable
A standard installation cable is sufficient.

Signal cable
A standard installation cable is sufficient.

Cable diameter
- M25 × 1.5 with cable ϕ 9 to 17 mm (0.35 to 0.67 in) for device version without approval
- M25 × 1.5 with cable ϕ 9 to 13 mm (0.35 to 0.51 in) for device version with Ex approval
- Wire cross-sections 0.2 to 2.5 mm^2 (24 to 12 AWG)

Cable glands

> ⚠️ **WARNING**
- Observe the maximum thermal load of the cables and lines introduced.
- The gland is only admissible for the connection of fixed-installation lines and cables. The operator must ensure corresponding strain relief.
- Mount the cable gland so that it is protected against mechanical damage ("low" degree of mechanical risk – impact energy: 4 Joule).

7.1.3 Preparing the measuring device

1. Remove the dummy plug if present.

> **NOTICE**

Housing not sealed tight! Operational reliability of the measuring device could be compromised. Use suitable cable glands that match the degree of protection.

If the measuring device is supplied with cable glands:

2. Observe the cable specifications.

7.2   Connecting the measuring device
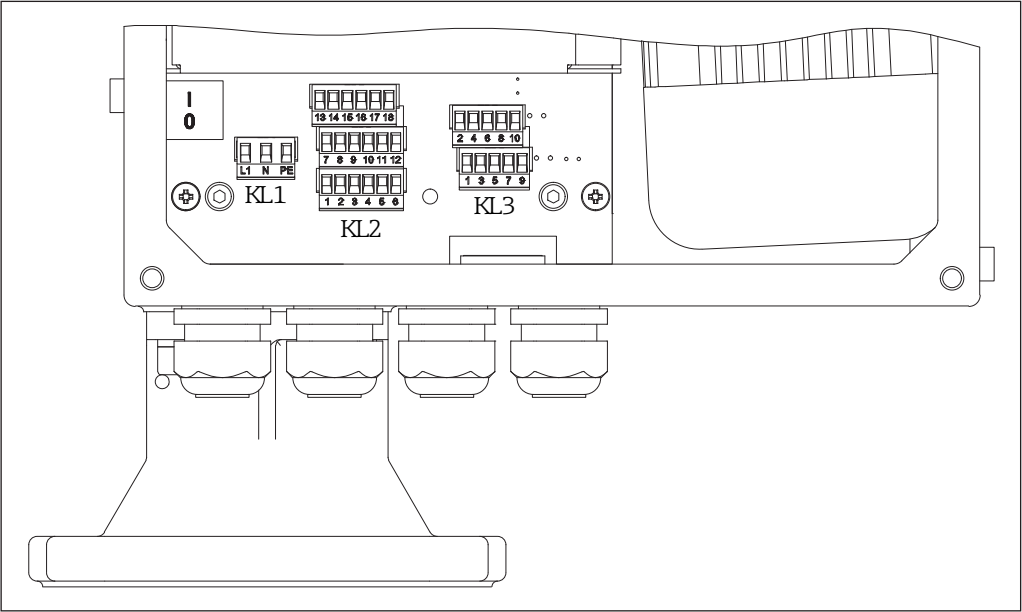
🖼 *18   Terminal assignment of the FMM50*

NOTICE

Electrical safety is compromised by an incorrect connection!
• Have electrical connection work carried out by appropriately trained specialists only.
• Observe applicable national installation regulations.
• Comply with local workplace safety regulations.
• If using in hazardous areas, observe the information in the device-specific Ex documentation.

7.2.1   Connecting the signal cables

Signal input and current output
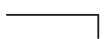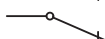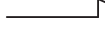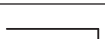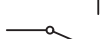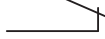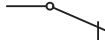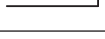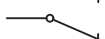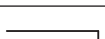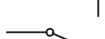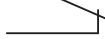
Order code	Terminal assignment		
None	3.1	(+)	Input 1, active
	3.2	(−)	
	3.3	(+)	Input 2, active
	3.4	(−)	
	3.5		Input 1, passive
	3.6		
	3.7		Input 2, passive
	3.8		
	3.9	(+)	Current output
	3.10	(−)	

1. Unscrew the housing cover on the electronics side (large cover)
2. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
3. Strip the cable and cable ends. In the case of stranded cables, also fit ferrules.
4. Connect the cable in accordance with the terminal assignment.
5. Firmly tighten the cable glands.
6. Reverse the procedure to reassemble the measuring device.

> **NOTICE**
> - The signal inputs (active/passive) can only be used alternatively. An input can only be assigned as either active or passive.
> - In the case of the device version with an external start button, this button is connected to the passive signal input 1. Only signal input 2 (active or passive) is then available.
> - A start pulse must be present for at least 200 ms for it to be evaluated.

Relay output

Order code	Terminal assignment		
Output - option A, B	2.1		Relay 1
	2.2		
	2.3		
	2.4		Relay 2
	2.5		
	2.6		
Output - option B	2.7		Relay 3
	2.8		
	2.9		
	2.10		Relay 4
	2.11		
	2.12		
	2.13		Relay 5
	2.14		
	2.15		
	2.16		Relay 6
	2.17		
	2.18		

> - Contact rating of relay outputs (potential-free changeover contacts; 2 or 6 units, depending on the device version): 250 VAC, 6 A
> - Current output load: max. 600 Ω
> - Contact load of passive signal inputs:
>   - U = max. 30 VDC
>   - P = max. 0.3 W

7.2.2   Connecting the power supply cables

Order code	Terminal assignment		
Power supply - option 1, 2	1.1	L1 (~)	Power supply
	1.2	N (~)	
	1.3	PE (⊥)	

1. Unscrew the housing cover on the electronics side (large cover)
2. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
3. Strip the cable and cable ends. In the case of stranded cables, also fit ferrules.
4. Connect the cable in accordance with the terminal assignment.
5. Firmly tighten the cable glands.
6. Reverse the procedure to reassemble the measuring device.

> Voltage ranges for the supply voltage (depending on the device version):
> - 180...253 VAC, 50/60 Hz
> - 90...127 VAC, 50/60 Hz

7.2.3   Ensuring potential matching

Potential matching should be connected to the outer ground terminal of the measuring device.

> For devices intended for use in hazardous locations, please observe the guidelines in the Ex documentation (XA).
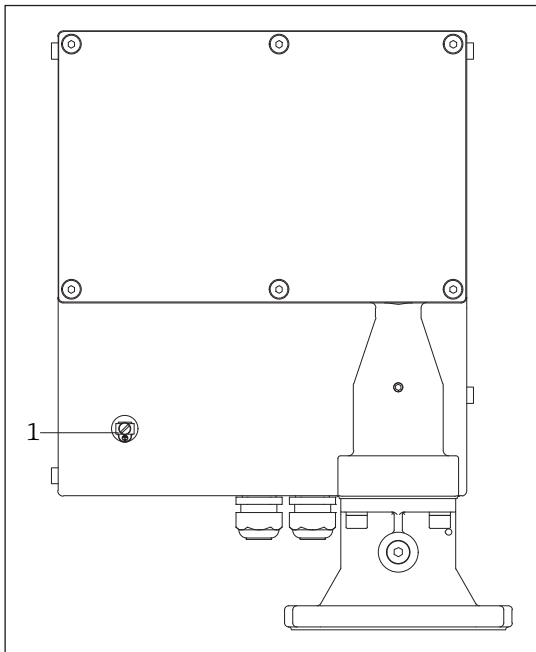
19   Connecting the potential matching

1   Potential matching terminal

NOTICE

- For optimum electromagnetic compatibility, the potential matching line should be as short as possible.
- The recommended minimum cable cross-section is 2.5 mm^2.

⚠ WARNING

The potential matching should be included in the local potential matching.

7.3 Ensuring the degree of protection

The measuring device meets all the requirements for IP67 protection (for closed housing) or IP65 (for closed housing and device option with external start button).

To guarantee the degree of protection, carry out the following steps after the electrical connection:

1. Check that the housing seals are clean and fitted correctly. Dry, clean or replace the seals if necessary.
2. Tighten all housing screws and screw covers.
3. Firmly tighten the cable glands.
4. Insert suitable dummy plugs into unused cable entries.

7.4 Post-connection check

Are cables or the device undamaged (visual inspection)?	❑
Do the cables comply with the requirements (→ 🔖27)?	❑
Do the cables have adequate strain relief?	❑
Are all cable glands installed, securely tightened and leak-tight?	❑
Does the supply voltage match the specifications on the nameplate (→ 🔖16)?	❑
Is the terminal assignment (→ 🔖28) correct?	❑
If supply voltage is supplied: does information appear on the display (→ 🔖38)?	❑

8 Operating options

8.1 Overview of operating options
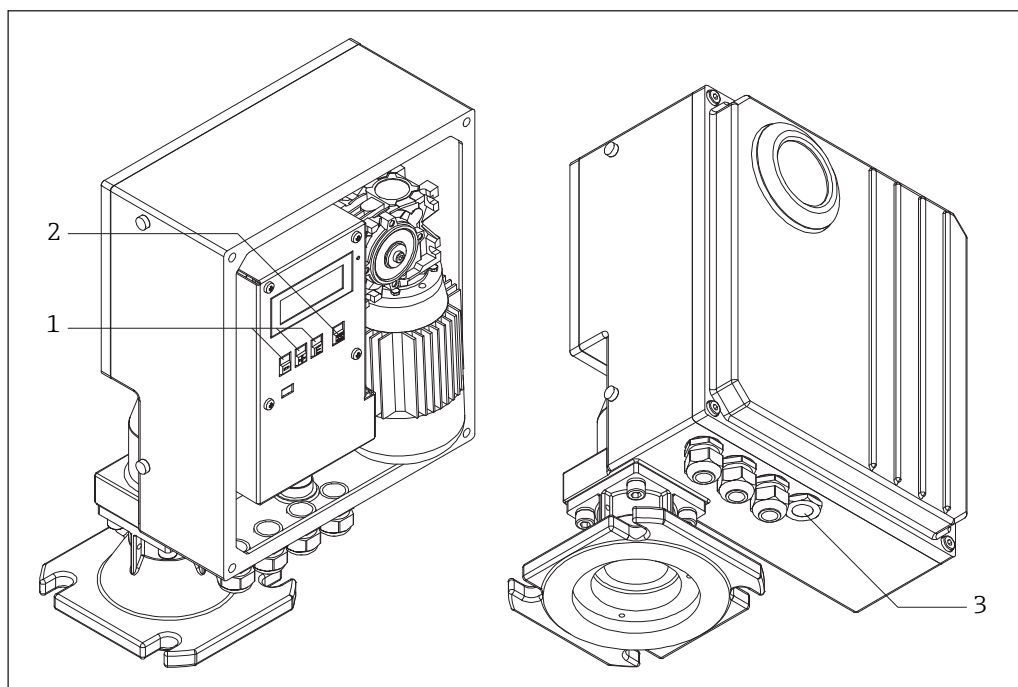
🖻 *20   Options for operating the measuring device*

1   Operating keys to configure the measuring device
2   Button to start a measurement manually
3   External button to start a measurement manually

8.2   Structure and function of the operating menu

ℹ️ For an overview of the operating menu with menus and parameters (→ 🖹106)

Function group		Function		Parameter (numerical value or options for selection)
00 basic setup	→	001 empty calibr.	→	**Value:** 1 m … upper range value
	→	002 block distance	→	**Value:** 0.23…5 m
↓	→	…	→	…
01 inputs and outputs	→	010 input 1	→	**Options:** not used, bolting, start measurement
	→	011 polarity input 1	→	**Options:** NO contact, NC contact
↓	→	…	→	…
02 measurement param.	→	020 measurement type	→	**Options:** single cycle, periodical, manual
	→	021 time interval	→	**Value:** 1…60 [time unit in function 022]
↓	→	…	→	…
…	→	…	→	…

🖼 *21   Schematic structure of the operating menu*

8.3   Access to the operating menu via the local display

8.3.1   Operational display
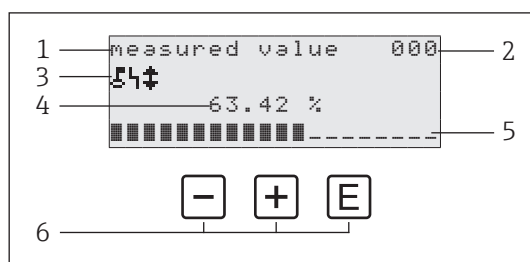
1   Name of function
2   Function number
3   Display symbols
4   Measured value and unit
5   Bargraph indicator of measured value
6   Operating elements

Operating options

Key	Meaning
E	Switch to group selection
+	No function
−	

NOTICE

- The operational display essentially corresponds to the measured value display (function 000).
- The operational display appears automatically after the start-up procedure. Only then can a measurement operation commence.
- During initial commissioning (→ 📖38), function 060 "language" and function 083 "distance unit" appear once only. Afterwards, the measured value display appears.

🛈 For an overview of the operating menu with the menus and parameters (→ 📖106)

Symbols on the display

- **Lock** 🔒
  This lock symbol is displayed when the measuring device is locked and no entries can be made (→ 📖37).
- **Alarm** ⌐
  This alarm symbol is shown when the device is in an alarm condition (error condition). A flashing symbol indicates that a fault has occurred.
- **Hand** ✚
  This symbol flashes when the device is in the "manual" measurement mode. When the ⊟ or ⊞ button is pressed, the symbol disappears and the direction selected (run up ↑ run down ↓) is shown.

8.3.2   Navigation view

```
       ┌─────────────────────────────┐
       │ group selection      00→    │
  1 ───│ ✓basic setup                │
       │  inputs and outputs         │
       │  measurement param.         │
       │                             │
       │       ┌─┐  ┌─┐  ┌─┐         │
       │       │─│  │+│  │E│         │
       │       └─┘  └─┘  └─┘         │
  2 ───│─────────────────────────────│
       └─────────────────────────────┘
```
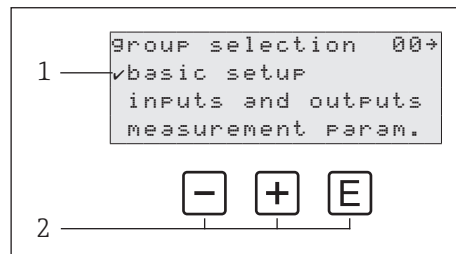
1   Function groups
2   Operating elements

Operating options

Key	Meaning
−	Moves the active function group down
+	Moves the active function group up
E	Switches to the active function group

🛈 - The active choice of function group (here "basic setup") is indicated by a ✔ in front of the menu text.
   - For an overview of the operating menu with the menus and parameters (→ 📖106)

8.3.3   Edit view

Entering a value	Selecting a value

1 ── empty calibr.   001 ── 2
3 ──   20.000 m
4 ── distance flange to
    min. filling
 	
    [−] [+] [E]
5 ───────────
	1 ── input 1 010 ── 2
	    ✓not used
	3 ── bolting
	    start measurement
	
	    [−] [+] [E]
	5 ───────────

1   Function name
2   Function number
3   Numerical value or selection
4   Help text
5   Operating elements

Operating options

Key	Meaning
[−]	**Entering a value** • Activates the edit mode • Changes the displayed character (9, 8, 7, ... , Z, Y, X, ...) **Selecting a value** Moves the active option down
[+]	**Entering a value** • Activates the edit mode • Changes the displayed character (0, 1, 2, ... , A, B, C, ...) **Selecting a value** Moves the active option up
[E]	• Navigation to the right within a function group • In the edit mode: - Change to the next character - At the end, accept the entry by switching to the next function

ℹ️ For an overview of the operating menu with the menus and parameters (→ 📖106)

Editing options
You can choose from the following characters when editing:
• Numerical values: 0 - 9 and "." (period) as the separator in the unit selected
• Tag number (function 080): additionally letters A - Z and "-" (minus)
• Navigation characters:
  - "←" goes one or more spaces to the left
  - "→" goes one or more spaces to the right

8.3.4   Operating elements

Key	Meaning
$\boxed{-}$	**Entering a value** Activates the edit mode and reduces the value **Selecting a function group or a value** Moves the active option down
$\boxed{+}$	**Entering a value** Activates the edit mode and increases the value **Selecting a function group or a value** Moves the active option up
$\boxed{E}$	• Navigation to the right within a function group • In the edit mode: accept the value entered
$\boxed{-}+\boxed{+}$	Navigation to the left within a function group
$\boxed{+}+\boxed{E}$	Increases the contrast of the liquid crystal display
$\boxed{-}+\boxed{E}$	Decreases the contrast of the liquid crystal display
$\boxed{-}+\boxed{+}+\boxed{E}$	• Enables or disables hardware locking (→ 🖹37) • Operating keys $\boxed{-}$, $\boxed{+}$ and $\boxed{E}$ have no function on their own • "man. start" and external start button are not locked
man. start or external start button	The measurement procedure starts if the device is in the display mode (function 000)

8.3.5   Navigating and selecting from list

Different operating elements are used to navigate through the operating menu.
The function group (00, 01, 02, etc.) and the function number (000, 001, 002, etc.) appear on the top left of the display.

ℹ️ For an overview of the operating menu with the menus and parameters (→ 🖹106)

Example 1: Configuring safety distance

1. $\boxed{E}$ → Switch to group selection (always starts with **basic setup 00**, **inputs and outputs 01** and **measurement parameters 02**)

2. $\boxed{-}/\boxed{+}$ → Change the function group to be selected until the **safety settings 04** function group can be selected

3. $\boxed{E}$ → Select the **safety settings 04** function group; the first function in this group (**output on alarm 040**) is displayed

4. $\boxed{E}$ → Switch to the next function(s) of the function group until the desired function (here **Safety distance 042**) is displayed

5. $\boxed{-}/\boxed{+}$ → Edit mode is activated, the first character starts flashing, enter the desired character string

6. $\boxed{E}$ → Accept the entry and change to the next function

8.3.6 Disabling write protection via the access code

If the ⬚ symbol appears on the local display and in front of the input values in the functions, configuration is protected by an access code. No more values can be entered or changed in the entire operating menu with the exception of the **unlock parameter 074** function.

If write access is locked via local operation, it can be unlocked by entering the access code via the relevant access option.

1. Select the **unlock parameter 074** function
2. Enter the access code
   100   → Write protection is disabled
   <>100   → Write protection is enabled

ℹ️ If the keypad is locked, the ⬚ symbol also appears on the display. However in this case the **unlock parameter 074** = 100.

8.3.7 Enabling and disabling the keypad lock

If the ⬚ symbol appears on the local display and in front of the input values in the functions, configuration is protected by a keypad lock. No more values can be entered or changed in the entire operating menu.

The keypad lock is enabled and disabled as follows.
1. Press the ⊟+⊞+ᴇ keys while the device is in the **measured value 000** mode
   → The keypad lock is enabled
2. Press the ⊟+⊞+ᴇ keys again while the device is in the **measured value 000** mode
   → The keypad lock is disabled

ℹ️ If write protection is enabled via the access code, the ⬚ symbol appears on the display. However in this case the **unlock parameter 074** is <> 100.

9 Commissioning

9.1 Function check

Before commissioning the device, make sure that the post-installation and post-connection checks have been performed.
- "Post-installation check" checklist (→ 🖹26)
- "Post-connection check" checklist (→ 🖹31)

9.2 Switching on the measuring device

ℹ️ If nothing appears on the local display or a diagnostic message is displayed, see the "Diagnostics and troubleshooting" chapter (→ 🖹64).

The first time the device is switched on, the following appears on the display:

Initialization phase

```
Initialization


Jan 06 2015
```

The device type, device version (hardware and software) and the order code are displayed

```
M FMM50
V01.06.10

A1A1A1AA11A1
```

1. This screen appears the first time the device is switched on
   → Set the operating language

```
language         060
✓English
 Deutsch
 Francais
```

2. This screen also only appears the first time the device is switched on
   → Set the distance unit

```
distance unit    083
✓m
 ft
 in
```

The display switches to the measured value screen

```
measured value   000

      63.42 %
███████████_____
```

ℹ️ A measurement must first be performed before it is possible to obtain a measured value that is valid for the current measuring point.

9.3 Setting the operating language

```
language         060
✓English
 Deutsch
 Francais
```

With the "language 060" function, you select the language for the text on the display:
- Deutsch
- English
- Français
- ニホソゴ (Katakana, Japanese)

Default value: English

9.4   Configuring the measuring device

The measuring device is configured via the individual function groups and the associated functions in the groups (→ 🖺33).

basic setup (00)	→	Device functions for adapting the measuring device to the application, for example by entering the full and empty calibration (→ 🖺40)
inputs and outputs (01)	→	Device functions for changing the behaviour of the inputs and of the relay outputs, for example by specifying the relay output functions (→ 🖺47)
measurement param. (02)	→	Device functions for adapting the measuring device to the measurement requirements, for example by specifying the time interval for periodic measurement (→ 🖺41)
current output (03)	→	Device functions for changing the current output, for example by selecting the magnify function (→ 🖺45)
safety settings (04)	→	Device functions for adapting the measuring device to the safety requirements, for example by selecting the behaviour of the current output in an alarm condition (→ 🖺57)
linearization (05)	→	Device functions for adapting the measuring device to the application with regard to measured value generation, for example by selecting to display a volume in a technical unit (→ 🖺53)
display (06)	→	Device functions for changing the display format of the measuring device, for example by selecting the menu language (→ 🖺46)
diagnostics (07)	→	Device functions for error analysis and troubleshooting, for example by resetting to default values (→ 🖺65)
system parameters (08)	→	Device functions for the advanced adaptation of the measuring device to the measuring point, for example by entering the tag name (→ 🖺52)

9.4.1 Basic setup

In most cases, the basic setup is sufficient for successful commissioning. More complex measurement tasks may, however, require further settings (→ 🖹39).
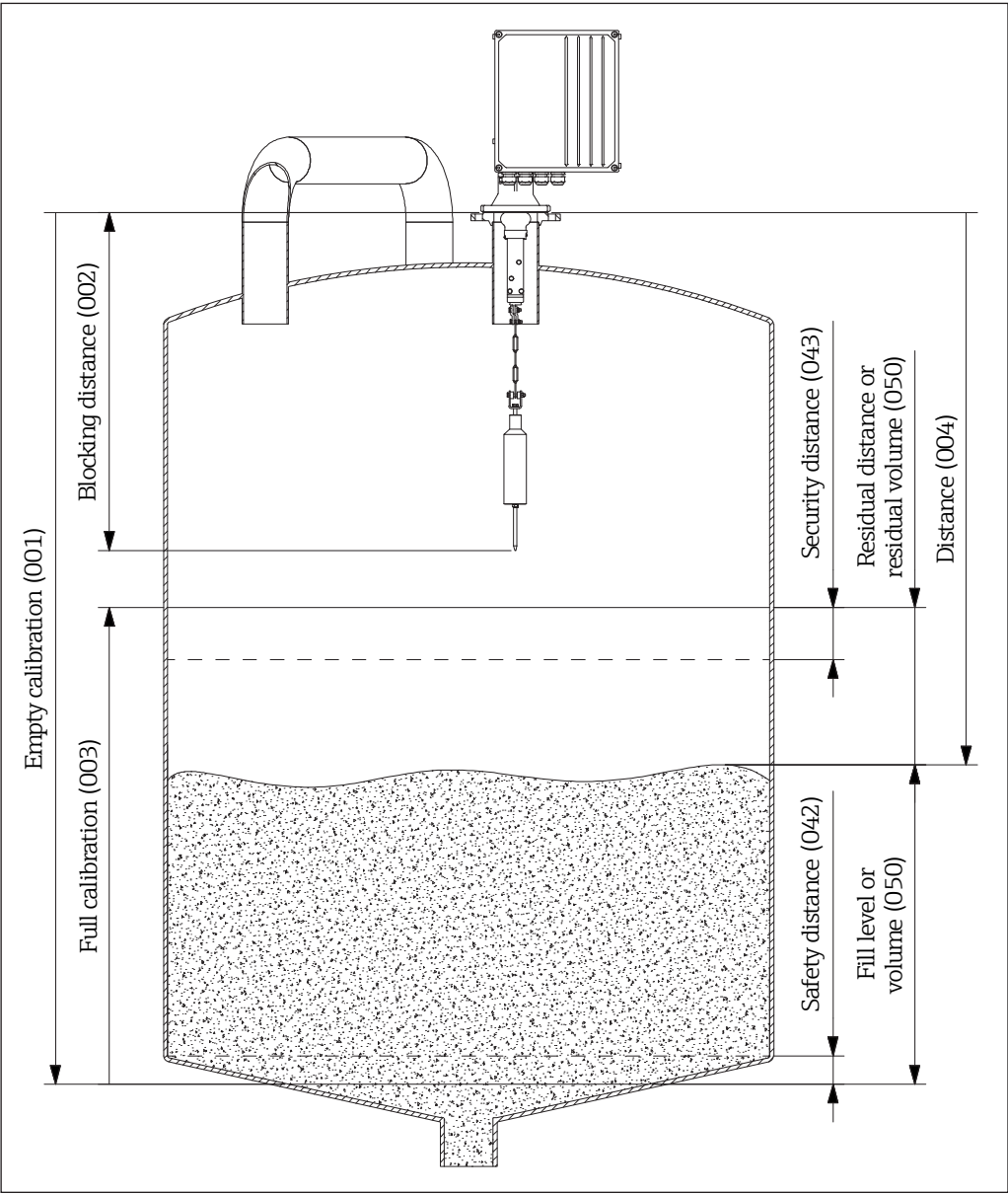
🔲 *22   Parameters of the basic setup*

9.4.1.1   Performing empty calibration

```
empty calibr.    001
        35 m
distance flange to
min. filling
```

With the **empty calibration 001** function, you enter the distance between the mounting flange (reference point for measurement) and the minimum fill level (= zero point) (→ 🔲22).

Range of values: 1 m to length of measuring tape (or converted value in feet/inches)

Default value: length of measuring tape

9.4.1.2   Setting the blocking distance

```
block distance    002
        0.80 m
distance flange to
bottom weight
```

With the **block distance 002** function, you enter the distance between the flange of the measuring device and the end of the sensing weight (in upper limit position) (→ ⊡22).

Range of values:0.23...5 m (or converted value in feet/inches)

Default value: 0.8 m

ℹ️ You will find a table in the Appendix (→ 🕮99) detailing all the default values depending on the wiper length and the sensing weight.

9.4.1.3   Performing full calibration

```
full calibration 003
        34 m
measuring range
max.=empty-bd
```

With the **full calibration 003** function, you enter the distance between the minimum fill level (=zero point) and the maximum fill level (= span) (→ ⊡22).

Range of values:1 m to empty calibration - block distance (or converted value in feet/inches)

Default value: Length of measuring tape - 0.8 m

9.4.1.4   Selecting the type of measurement

```
measurement type 020
✓single cycle
 periodical
 manual
```

With the **measurement type 020** function, you select the type of measurement for the measuring device:

- **single cycle**
  A single cycle can be activated manually using buttons on the device or using a corresponding input signal in function 010 and 012 (→ 🕮51).
- **periodical**
  The measuring device can take time-controlled measurements. The time interval can be defined in functions 021 and 022 (→ 🕮42) .
- **manual**
  The measuring device can only be operated using the buttons on the device. This type of measurement allows the user to move the sensing weight slowly, e.g. when changing the cage sensing weight (→ ⊡25).

Default value: single cycle

⚠️ **WARNING**

- In the manual mode, the upper limit switch and the tape switch have no function!
- Users must themselves check in which position the sensing weight is currently located. With this type of measurement, the sensing weight can (depending on the maximum tape length) be lowered into unauthorized areas of the container (or into an outlet worm for example).

NOTICE

A measurement can only be taken when the device is in the "measured value (000)" mode. This also applies to the device version with an external start button.

9.4.1.5 Checking the measured value and distance

```
dist./meas.value 004
distance 0.90 m
meas.val 3.75 %
```

With the **dist./meas. value 004** function, you can display the distance measured between the measuring device and product and the current measured value. The display depends on the number of decimal places (function 062), the distance unit (function 083) and also linearization where applicable.

9.4.1.6 Setting the time interval

```
time interval    021
         1 h
```

With the **time interval 021** function, you enter a value for the time interval for the "periodical" type of measurement (see function 020). You enter the unit of this value (minutes or hours) in function 022.

Range of values: 1...60 (minutes or hours)

Default value: 1

> **⚠ CAUTION**
>
> When operating the measuring device, please observe the minimum time (T_M) for a measurement cycle depending on the ambient temperature (T_A) and the measuring range (MR).
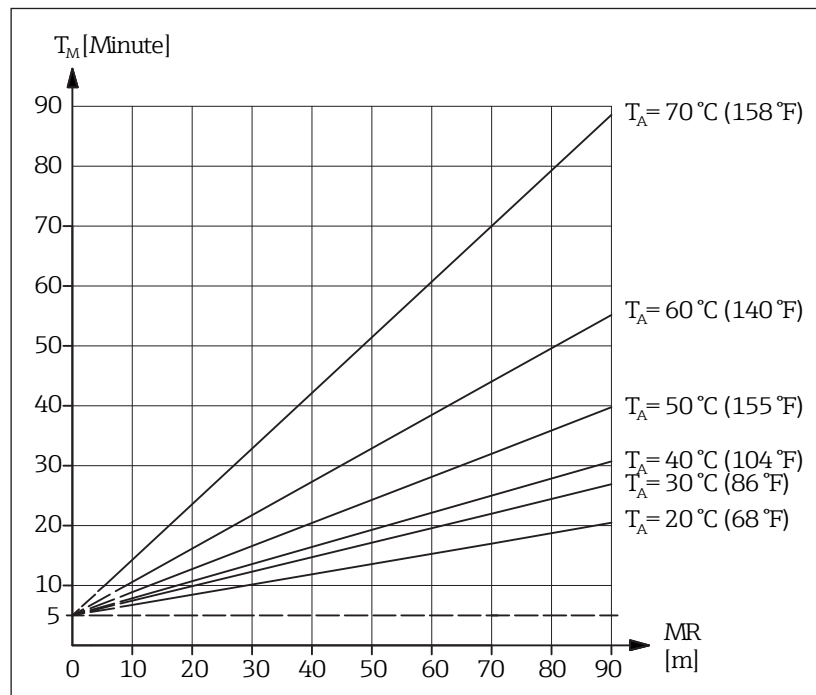
 23   Dependency on the duration of the measurement cycle

> **⚠ WARNING**
>
> - The minimum time for a measurement cycle must be taken into account for all types of measurement (function 020).
> - Failure to observe this may result in unauthorized heating and therefore malfunctions!

> **NOTICE**
>
> We recommend you do not drop below the minimum measurement cycle duration of 5 minutes even for smaller measuring ranges.

9.4.1.7   Selecting the time unit

```
time unit        022
✓h
 min.
```

With the **time unit 022** function, you enter the unit of the time interval from function 021.

- **min.**
  Minute(s)
- **h**
  Hour(s)

Default value: h

9.4.1.8   Selecting the operating mode

```
normal or short  023
✓normal
 short
```

With the **normal or short 023** function, you select the operating mode for the measurement (in the case of "single cycle" and "periodical" types of measurement):

- **normal**
  At the start of a measurement, the measuring device lowers the sensing weight as far as the product and the sensing weight is then pulled back into the upper end position.
- **short**
  At the start of a measurement, the measuring device lowers the sensing weight as far as the product and the sensing weight is then only raised by the length specified in function 028 "run-up length". An input should be used for locking since the sensing weight is not protected against burying in this operating mode. The weight moves back into the upper end position every 20 measuring cycles.

Default value: Normal

NOTICE

Depending on silo height and fill level, the "short" operating mode can considerably shorten the length of a measurement cycle. Disadvantages of this operating mode:
- By selecting appropriate settings, the user must ensure that the sensing weight is not buried.
- There is little point in using a relay output for the counter pulses since the measuring device does not move to a defined point at the end of a measurement (and therefore there is no defined path).
- Before removing the measuring device, e.g. for maintenance work (tape changes), the sensing weight must be moved into the upper end position. The "manual" type of measurement should be used for this purpose.

9.4.1.9   Setting the run-up length

```
run up length      028
           1.0 m
run up length
for short measure
```

With the **run up length 028** function, you determine the distance the sensing weight travels upwards in the "short" operating mode (function 023).

Range of values: 1 m to empty calibration - 1 m (or converted value in feet/inches)

Default value:1 m
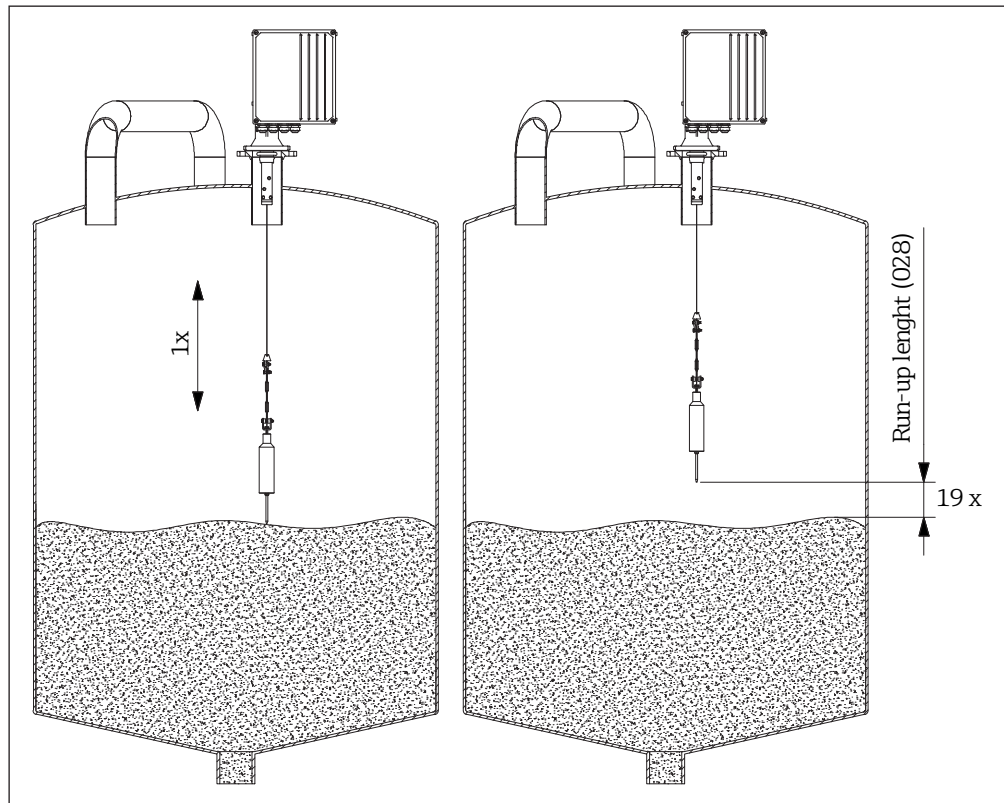
🖸*24   Run-up length*

| **NOTICE** |

Make sure that the sensing weight is not buried by a filling process (e.g. by using the "upper limit position" relay locking function → 🖹47).

9.4.2   Configuring the current output

9.4.2.1   Selecting the current output mode

```
current mode     030
✓standard
 magnify
```

With the **current mode 030** function, you determine the behaviour of the current output:
- **standard**
  The current output of the measuring device delivers a current of 0/4...20 mA (can be configured in function 033) in relation to 0...100% of the set measuring range (function 002 "full calibration").
- **magnify**
  If this option is selected, only part of the measurement range is mapped to the output current range of 0/4...20 mA. This range is defined by function 031 "0/4mA value" and function 042 "20mA value".

Default value: standard
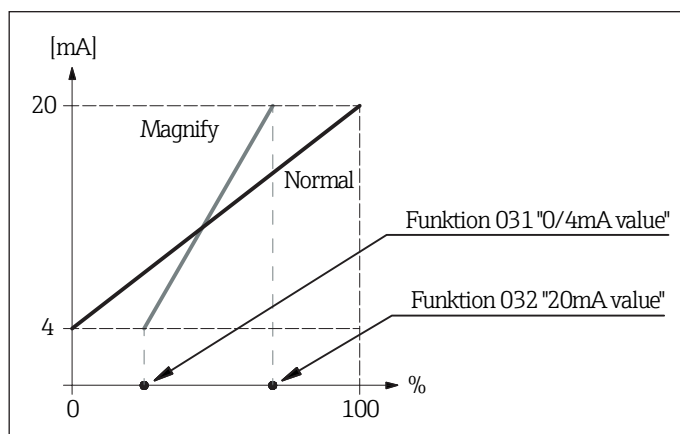
⊠*25 Current output mode*

9.4.2.2   Setting the lower current output limit

```
0/4mA value      031
     30.00 %
```

With the **0/4mA value 031** function, you determine the value for the lower limit of the current output (see function 030).

Range of values: depends on distance unit and/or CU

9.4.2.3   Setting the upper current output limit

```
20mA value       032
     70.00 %
```

With the **20mA value 032** function, you determine the value for the upper limit of the current output (see function 030).

Range of values: depends on distance unit and/or CU

NOTICE

When changing the maximum scale value (in function 057), the 0/4 mA value or the 20 mA value must also be changed or adapted!

9.4.2.4   Selecting the current range

```
current range    033
✓4-20mA
 0-20mA
```

With the **current range 033** function, you determine the range of the current output (function 030).

- **0 - 20 mA**
- **4 - 20 mA**

Default value: 4 - 20 mA

> **NOTICE**

The behaviour of the current output can be influenced by the **level/volume 050** function as follows:
- If you select "level CU" or "level DU", this causes the current output value to increase if the fill level increases.
- In contrast, if you select "ullage CU" or "ullage TU", this causes the current output value to decrease if the fill level (H) increases.
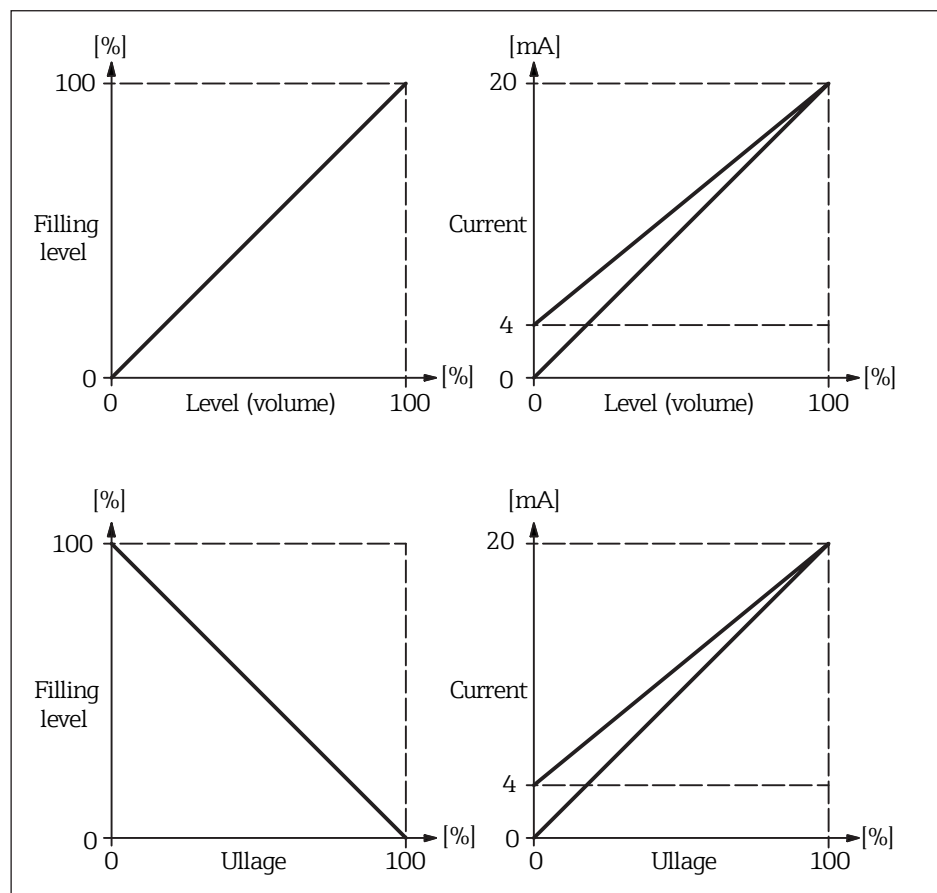
🖼 *26   Behaviour of the current output*

9.4.3   Configuring the local display

9.4.3.1   Setting back-to-home time

```
back to home     061
        100 s
time until jump back
home automatically
```

With the **back to home 061** function, you specify the time after which the display returns to the measured value display (000).

Range of values: 3...9999 seconds

Default value: 100

9.4.3.2 Selecting the number of decimal places

```
no. of decimals  062
✓x
 x.x
 x.xx
```

With the **no. of decimals 062** function, you select the number of decimal places for the measured value display (000) and for entering some parameter values (e.g. limit value):

- **x**
  No decimal place(s)
- **x.x**
  One decimal place
- **x.xx**
  Two decimal places
- **x.xxx**
  Three decimal places

Default value: x.xx

9.4.3.3 Testing the display

```
format display   063
✓on
 off
```

▼

```
███████████████████████
███████████████████████
███████████████████████
███████████████████████
```

With the **format display 063** function, you activate a test for the LC display. All points on the display are activated for around 2 seconds.

- **off**
  No display test
- **on**
  Display test

Default value: off

9.4.4 Configuring the output behaviour

9.4.4.1 Selecting the output function for relay 1

```
relay output 1   014
✓alarm
 threshold
 service interval
```

With the **relay output 1 014** function, you determine the behaviour of relay for output 1:

- **alarm**
  Relay switches as soon as an error is detected (for example tape breakage or burying).
- **threshold**
  Relay switches as soon as a set limit value (see function 017 and 018) is exceeded or not reached.
- **service interval:**
  Relay switches when the value set in the service interval (024) function is reached.
- **counter pulses**
  Relay switches at the pulse value set in function 015 and at the counter pulse length set in function 016.
- **reset pulse**
  Relay switches at the reset pulse length set in function 019 before a new measurement. This output can be used to reset an external counter.
- **band return**
  Relay switches during reversal in direction of tape from tape run-down to tape run-up.
- **running up**
  Relay switches when the sensing weight runs up.
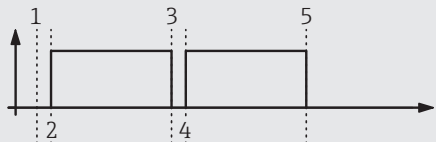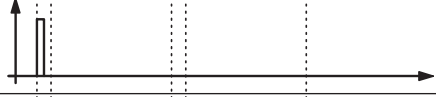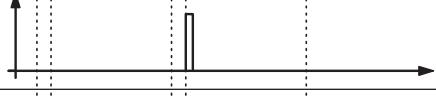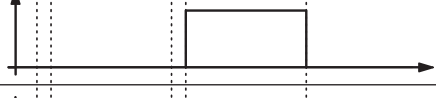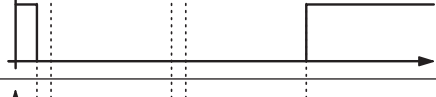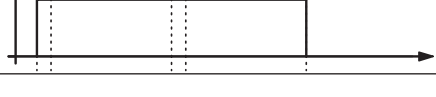
- **top position**
  Relay switches as soon as the upper end position of the
  sensing weight (end of measurement) is reached.

- **measuring**
  Relay switches during the entire measuring cycle

Default value: alarm

Measurement cycle		1 A measurement starts (time-controlled or event-controlled) 2 The sensing weight is lowered 3 The surface of the medium is detected (measured value generation) 4 The sensing weight is raised 5 The measurement ends
Counter pulse		Output pulses that correspond to the length of unwound tape
Reset pulse		Pulse before every new measurement, for example to reset the counter
Band return		Displays the lower reversal in direction of the tape (from tape run-down to tape run-up)
The sensing weight runs up		Displayed when the tape runs back up
Upper end position of the sensing weight		Indicated when the upper end position is reached (end of measurement)
Measuring		Indicates an active measuring cycle, for example to lock a filling system to protect the sensing weight from being buried
Alarm	Relay switches in a fault condition	
Service interval	Relay switches when the set number of measuring cycles is reached	
Threshold	Relay switches when a set threshold is exceeded or not reached (note: if a threshold and associated hysteresis are selected, they applies for all the relays. It is not possible to set an individual threshold and hysteresis for every relay.)	

🖻 27 *Programmable relay output functions*

NOTICE
- The rest position (→ 🖻 28) corresponds to the state of the relays with the power supply switched off. This corresponds to an active alarm if the "alarm" function is selected.
- A selected limit value (function 017) with an associated hysteresis (function 018) applies for all relays where the "threshold" function has been selected. It is not possible to set individual values for the threshold and hysteresis for each relay.

9.4.4.2   Selecting the output function for relay 2 to relay 6

The functionalities of the outputs correspond to those of the relay for output 1 (see function 014). Outputs 3 (01C) to output 6 (01E) are only optionally available (see order code).

Default values:

Relay for output 2 (01A)	Service interval
Relay for output 3 (01B)	Measuring
Relay for output 4 (01C)	Threshold
Relay for output 5 (01D)	Reset pulse
Relay for output 6 (01E)	Band return

9.4.4.3   Setting the pulse weight

```
Pulse weight      015
         10
length per pulse
output = value * 5cm
```

With the **pulse weight 015** function, you enter the run-down distance per pulse at the counting output. The distance is calculated from the set value × 5 cm.

Range of values: 1...20 (= 5...100 cm or the value converted into feet/inches)

Default value: 1

Example:
The preset counting pulse output, for example relay 1, issues one counting pulse for every 0.2 m of run-down distance travelled (pulse weight = 4). You can enter the length of this pulse in the "pulse length (016)" function.
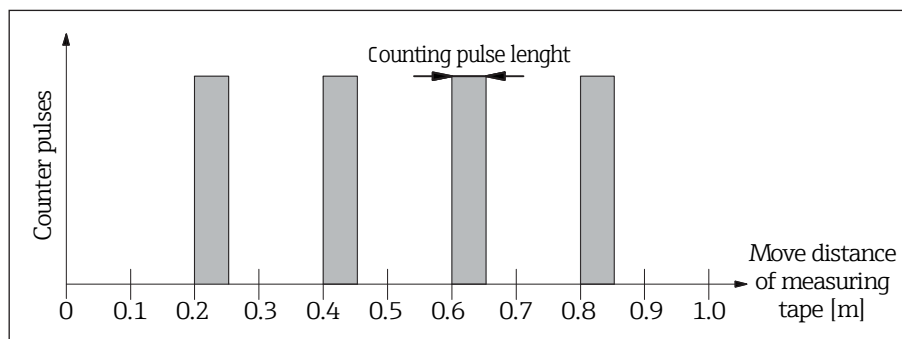
28   Example of pulse weight

9.4.4.4   Setting the pulse length

```
Pulse length      016
         50 ms
length of the
counter pulse
```

With the **pulse length 016** function, you enter the length of the counter pulse in milliseconds. Here, the range of values depends on the pulse weight in function 015 (→ 49).

Range of values:
30...100 ms [pulse weight = 1]
30...250 ms [pulse weight = 2]
30...400 ms [pulse weight = 3]
30...550 ms [pulse weight = 4 to 20]

Default value: 50 ms

9.4.4.5   Setting the limit value

```
limit value      017
      60.00 %
relative to the
full scale (003)
```

With the **limit value 017** function, you determine the limit value of the relay outputs, if "threshold" has been selected in function 014 for example, as a percentage of the measurement range (fill level).

Range of values: 0...100 %

Default value: 60 %
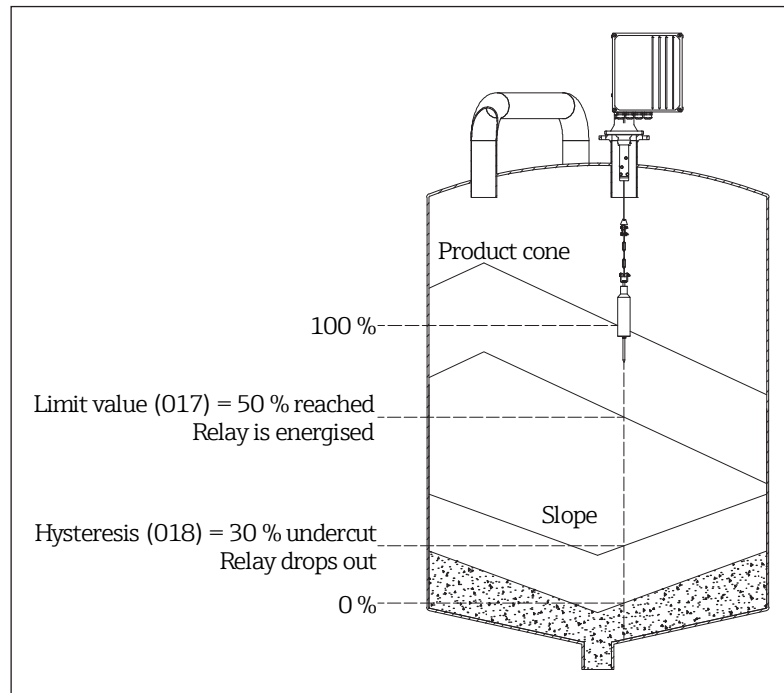
29 Limit value and hysteresis behaviour

9.4.4.6   Setting the hysteresis

```
hysteresis       018
      10.00 %
relative to the
full scale (003)
```

With this function, you determine the hysteresis of the relay outputs, if "Threshold" has been selected in function 014 for example, as a percentage of the measurement range (fill level).
Here, the value entered relates to the limit value specified in function 017 not being reached.(→ 50).

Range of values: 0...100 %

Default value: 3 %

9.4.4.7 Setting the reset pulse

```
reset pulse        019
          300 ms
length of the
reset pulse
```

With the **reset pulse 019** function, you determine the length of the reset pulse of the relay outputs in milliseconds if, for example, "reset pulse" has been selected in function 014.

Range of values: 30...1000 ms

Default value: 300 ms

9.4.5 Configuring the inputs

9.4.5.1 Selecting the function of input 1

```
input 1            010
✓not used
 bolting
 start measurement
```

With the **input 1 010** function, you determine the behaviour of input 1:
- **not used**
- **bolting**
  If there is a signal at input 1 (see also function 011), the measuring device is blocked for further measurements. If necessary, the sensing weight is moved into the upper end position, and the measurement is cancelled immediately.
- **start measurement**
  If there is a signal at input 1, the measuring device starts a new measurement.

Default value: not used

> **NOTICE**
> In the device version with an external start button, this button is connected to input 1. The function is then set to "start measurement" at the factory.

9.4.5.2 Selecting the polarity of input 1

```
Polarity input 1 011
✓NO contact
 NC contact
```

With the **polarity input 1 011** function, you determine the polarity of input 1 if "bolting" or "start measurement" has been selected in function 010:
- **NC contact**
  The input function becomes active if the input contact is opened (passive input) or the voltage level drops (active input).
- **NO contact**
  The input function becomes active if the input contact is closed (passive input) or voltage is applied (active input).

Default value: Normally open (NO) contact

9.4.5.3   Selecting the function of input 2

```
input 2           012
✓not used
 bolting
 start measurement
```

With the **input 2 012** function, you determine the behaviour of input 2. The range of options is identical to those for input 1 (see function 010).

Default value: not used

9.4.5.4   Selecting the polarity of input 2

```
polarity input 2 013
✓NO contact
 NC contact
```

With the **polarity input 2 013** function, you determine the polarity of input 2. The range of options is identical to those for input 1 (see function 011).

Default value: Normally open (NO) contact

9.5   Advanced settings

9.5.1   Defining the device tag

```
tag no.           080
  Ratingen Silo 1
```

With the tag **no. 080** function, you can give the measuring point of the device a name of no more than 16 alphanumeric characters.

Default value: ----------------

9.5.2   Setting the distance unit

```
distance unit     083
✓m
 ft
 in
```

With the **distance unit 083** function, you can enter the unit of length for the measuring device. This forms the basis for all display and entry values, with the exception of the customized unit (CU) if this has been selected (→ 🕮53).
- **m**
  Meter
- **ft**
  Feet
- **in**
  Inch

Default value: m

9.5.3 Performing linearization

9.5.3.1 Selecting the display value for the measured value display

```
level/volume      050
√level CU
 level DU
 ullage CU
```

With the **level/volume 050** you determine the display value in the measured value display function (000).

- **level CU**
  Display the level in customer units. The unit can be selected in the customer unit function (056), and the full-scale value can be set in the maximum scale function (057). Measured value linearization is possible.
- **level DU**
  Display the level in the selected distance unit (function 083).
- **ullage CU**
  Display the ullage in customized units. The unit can be selected in the customer unit function (056), and the full-scale value can be set in the maximum scale function (057). Measured value linearization is possible.
- **ullage DU**
  Display the residual distance in the distance unit selected (function 083).

Default value: Level CU

NOTICE

The reference point for residual distance and/or residual volume is the "full calibration (003)".

Example of volume measurement (no linearization)
- Full calibration (003) = 20 m
- Silo volume (in selected measuring range) = 500 m³
- Current level = 4 m

Measurement of current volume
Level/ullage (050) = level CU,
Linearization (051) = linear,
Customer unit (056) = m³,
Maximum scale (057) = 500
→ **Display (000) = 100 m³**

Measurement of residual volume
Level/ullage (050) = ullage CU,
Linearization (051) = linear,
Customer unit (056) = m³,
Maximum scale (057) = 500
→ **Display (000) = 400 m³**

9.5.3.2   Performing linearization

```
linearization   051
✓linear
 manually
 table on
```

The **linearization 051** function defines the relationship between the fill level and the container volume and/or product weight and permits a measurement in customer units (CU).

- **linear**
  The relationship between the fill level and the container volume is linear.
- **table on**
  Activates a previously entered linearization table.
- **delete table**
  Deletes an existing linearization table.
- **manually**
  Enter a linearization table.

Default value: linear

Manual linearization

If the fill level is not proportional to the volume and/or weight within the set measurement range (**full calibration (003)**), a linearization table can be entered. The following preconditions apply:
- The maximum 32 pairs of values for fill level/volume and/or fill level/weight are known (e.g. gauging capacity by liters).
- The fill level values must be entered in ascending order (curve rises monotonically).
- The fill heights for the first and last points of the linearization curve should correspond to the empty and full calibration.
- Linearization is performed in the basic setup unit (**distance unit (083)**).
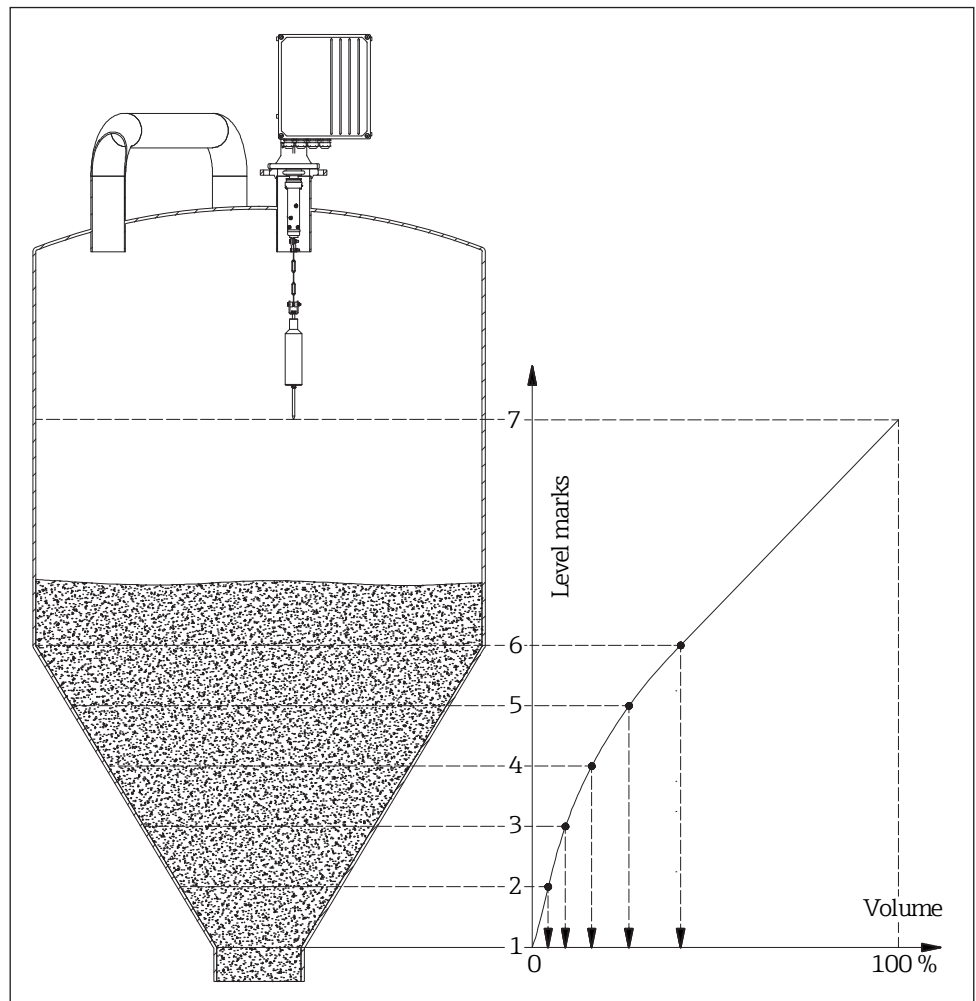
30 Manual linearization

> **NOTICE**
> - Before entering a linearization table, any tables still present from before must be deleted (linearization (051) = "delete table").
> - Once a linearization table has been entered, it must be activated (linearization (031) = "table on").
> - Once a linearization table has been entered, it can be deactivated by selecting "linear". This does not delete the table and it can be reactivated at any time by selecting "table on".

Entering a linearization table
A linearization table can be entered as follows:

1. Select manual linearization
    (= enter a linearization table)

```
linearization      051
✓linear
 manually
 table on
```

2. Select table point 1
    (start with 1, maximum 32 points)

```
linearization      052
TabNo→         1
level     0.000m
volum     0.000%
```

3. Enter the level pertaining to point 1

```
linearization      053
TabNo          1
level→    0.000m
volum     0.000%
```

4. Enter the associated volume (weight)

```
linearization      054
TabNo          1
level     0.000m
volum→    0.000%
```

5. Should another point be entered in the table?

```
next point         055
✓yes
 no
```

6. Select table point 2

```
linearization      052
TabNo→         2
level     0.000m
volum     0.000%
```

Continue either until 32 table points have been selected or until manual entry of the linearization table is completed by selecting "next point = no". Once the linearization table has been activated via "table on", linearization is activated.

> **NOTICE**
>
> If the customer unit (function 056) and/or maximum scale (function 057) is changed, the linearization table has to be re-entered and/or also adjusted!

9.5.3.3   Selecting the customer unit

```
customer unit      056
✓%
 kg
 t
```

With the **customer unit 056** function, you can select the customer unit. The following units are available for selection:
- Percentage **(%)**
- Weight: **kg**, **t**
- Volume: m^3, ft^3
- Length: **m**, **ft**, **in**

Default value: %

9.5.3.4   Setting the maximum scale

```
max. scale         057
      100 %
```

With the **max. scale 057** function, you can define the upper-range value (in the selected unit and with the selected number of decimal places).

Range of values: 1...100000

Default value: 100

9.5.5 Configuring the safety settings

9.5.5.1 Selecting the output on alarm

```
output on alarm    040
✓MIN (0/3.6mA)
 MAX (22mA)
 hold
```

With the **output on alarm 040** function, you determine how the current output behaves in the event of an error:

- **MIN (0/3.6mA)**
  If the measuring device detects an error (e.g. tape rupture), the current drops to 0 mA or 3.6 mA (depending on the function 033).
- **MAX (22mA)**
  If the measuring device detects an error, the current increases to 22 mA.
- **hold**
  If the measuring device detects an error, the last current output is retained.
- **user-specific**
  If the measuring device detects an error, the current set in function 041 is output.

Default value: MIN (0/3.6mA)
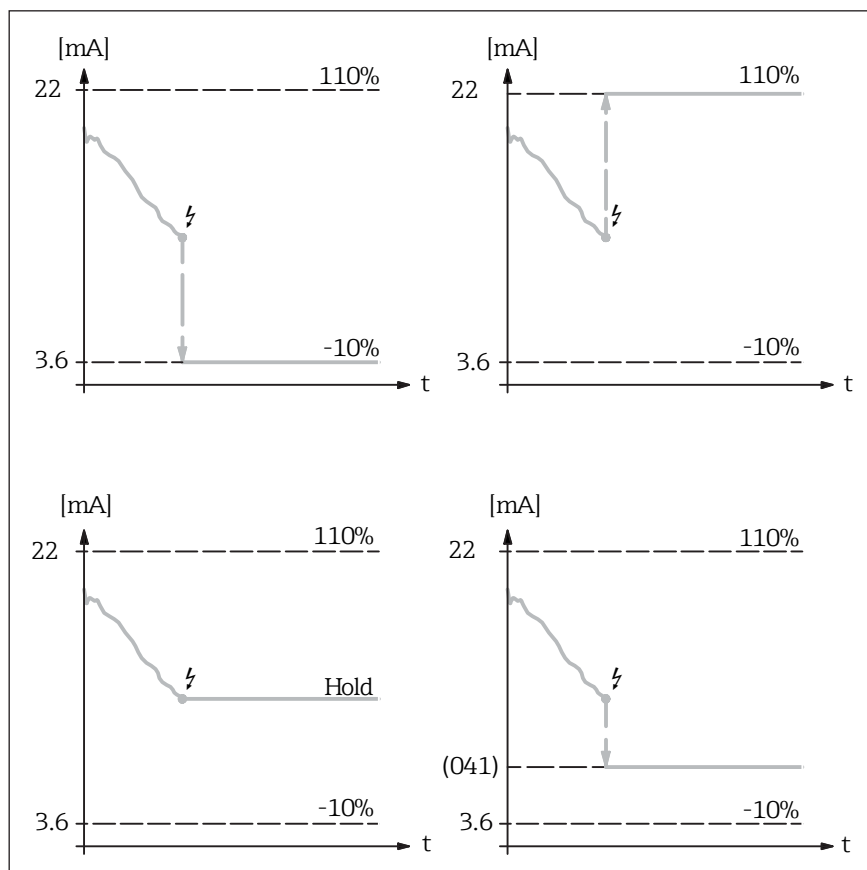
31 Behaviour of the current output in the event of an error

9.5.5.2   Setting the output on alarm

```
output on alarm   041
      3.60 mA
```

With the **output on alarm 041** function, you determine the user-specific current value in the event of an error (see function 040).

Range of values: 0...22.00 mA

Default value: 3.60 mA

9.5.5.3   Configuring the safety distance

```
safety distance  042
      1.00 m
minimum distance
to empty calibration
```

With the **safety distance 042** function, you determine the minimum distance to the configured zero point (→ ▣22). This function prevents the measuring tape from being lowered into an unauthorized area of the silo or bunker, such as an outlet worm.

Range of values:0 m to (full calibration - safety distance)
                          (or converted value in feet/inches)

Default value: 0 m

9.5.5.4   Setting the security distance

```
security dist.   043
      0.00 m
minimum distance
to empty calibration
```

With the **security dist. 043** function, a configurable safety zone is set up before the blocking distance (function (→ ▣22). This zone is used as a warning that if the fill level continues to rise, future measurements might be invalid since the blocking distance (and therefore also the minimum run-down length of the measuring device) might be undershot.

Range of values:0 m to (full calibration - safety distance)
                          (or converted value in feet/inches)

Default value: 0 m

9.5.5.5   Selecting behaviour in security distance

```
in securit.dist. 044
 warning
 alarm
```

With the **in securit. dist. 044** function, you can select how the device reacts when the security distance is reached. This function is only available if the value entered in the "security distance" 043 function is greater than zero.
- **alarm**
- **warning**

Default value: warning

9.5.5.6   Selecting behaviour in safety distance

```
in safety dist.  045
✓alarm
 warning
```

With the **in safety dist. 045** function, you can select how the device reacts if the safety distance is reached. This function is only available if the value entered in the "safety distance" 042 function is greater than zero.
- alarm
- warning

Default value: alarm

Device response when the safety distance is reached

"In safety distance" (045) = **warning**
→ The sensing weight stops when the safety distance is reached.
→ The current measurement ends with a valid measured value.
   (Measured value (level) = full calibration (002) − safety distance (042)
→ The current value that corresponds to the measured value is output at the current output.
→ Warning W661 is shown on the display (error symbol flashes).

"In safety distance" (045) = **alarm**
→ The sensing weight stops when the safety distance is reached.
→ The current measurement is rejected (the last valid measured value is displayed).
→ The current value at the current output adopts the value selected in the "output on alarm" (041).
→ Error A660 is shown on the display (error symbol is permanently lit).
→ The relay with the selected "alarm" function switches.

9.5.6   Configuring the service interval

9.5.6.1   Setting the service interval

```
service interval 024
       45000
num. of measurements
til tape change
```

With the **service interval 024** function, you specify the number of measurement cycles before the next maintenance (including tape changes) is undertaken. If the set value is reached, the measuring device issues a warning. The "service interval" relay output switches. The warning and/or switched relay output can be reset by resetting the service interval counter in function 025.

Range of values: 1...90000

Default value: 45000

> **NOTICE**
>
> The number of measurements the device performs before the next servicing depends on the process environment. The user should adjust this value depending on the level of dirt and/or measuring tape condition!

9.5.6.2   Resetting the service interval counter

```
serv.int.counter 025
       5678
```

With the **serv. int. counter 025** function, you can view and change the current reading on the counter, e.g. to reset the counter after the service interval has been reached (see function 024).

Range of values: 0...90000

9.6   Simulation

Simulation enables you to simulate various process variables in the process and the device alarm mode without real flow measurements, and to verify downstream signal chains (e.g. the switching of an outlet worm).

9.6.1   Selecting the simulation function

```
simulation        026
vsim. off
 sim. level
 sim. volume
```

The **simulation 026** function allows the user to simulate a certain measured value. The relay outputs can also be checked.

During simulation, the measured value display (function 000) shows the alarm symbol.

The following simulations can be selected:

- **sim. off**
  Simulation is switched off.
- **sim. level**
  A fill level can be specified in function 027. In such cases, the range of values is based on the maximum scale value entered in function 057. The value entered is shown on the measured value display. The functions of the relay outputs (e.g. the limit value) and the current output follow the simulation value.
- **sim. volume**
  A volume can be specified in function 027. In such cases, the range of values is based on the maximum scale value entered in function 057. The value entered is shown on the measured value display. The functions of the relay outputs (e.g. the limit value) and the current output follow the simulation value.
- **sim. current**
  A current value can be specified in function 027. The measured value display continues to show the last measured value. The functions of the relay outputs (e.g. the limit value) do not follow the simulation value.

Default value: sim. off

NOTICE

When in simulation mode, normal measuring with the measuring device is not possible.
- If the device was in manual mode before simulation was activated, the sensing weight remains in its current position.
- If the device was in measuring mode before simulation was activated, this mode remains active. The last measured value is saved internally and is shown on the measured value display when the simulation is over.
- If the device was in single cycle mode before simulation was activated, this mode is no longer active. The inputs and the "man.start" button are deactivated. A measurement which has already been started is ended as usual, the measured value is saved internally and is shown on the measured value display when the simulation is over.

9.6.2 Setting the simulation value

```
sim. value      027
     10.00 mA
```

With the **sim. value 027** function, you enter the value for the type of simulation selected in function 026.

Range of values: 0...99 m (level)
0...22.00 mA (current)
0...100.000 (volume)

Example of fill level simulation

Device settings:

Function	Function number	Input / value
Empty calibration	001	50 m
Full calibration	003	45 m
Relay 1	014	limit value
Limit value	017	50 %
Hysteresis	018	10 %
Level/ullage	050	CU (customer unit)
Linearization	051	linear
Customer unit	056	m³
Maximum scale	057	10000

Simulation (**026**) = "level"
Simulation value (**027**) = 8000
→ Display (**000**) = 8000 m³
→ Current output = 16.8 mA
→ Relay 1 is energized

Simulation (**026**) = level
Simulation value (**027**) = 2000
→ Display (**000**) = 2000 m³
→ Current output = 7.2 mA
→ Relay 1 is de-energized

9.7 Protecting settings from unauthorized access

You can choose from the following options to protect the configuration of the measuring device from unintentional modification after commissioning:
- Write protection via access code
- Write protection via keypad lock (→ 🖺37)

Setting the unlock parameter code

```
unlock parameter 074
        100
for reset code
see manual
```

With the **unlock parameter 074** function, you can lock parameter entry. No more values can then be entered in any part of the menu (exception: access code).

Range of values:
- **100**
  Unlocks parameter entry
- **<>100**
  Locks parameter entry

10 Operation

10.1 Changing the operating language

ℹ️ For information on the operating languages supported by the measuring device → 🕮38

10.2 Configuring the display

The following functions are available to configure the display:
- Basic settings for the local display → 🕮46, 47
- Local display test → 🕮47

10.3 Reading measured values

The following functions are available to read measured values:
- Display **measured value 000** → 🕮33
- Display **dist./meas. value 004** → 🕮42

10.4 Adapting the measuring device to the process conditions

All the functions from chapter 9 are available for this purpose.

10.5 Manual mode

By selecting "manual" mode in the **measurement type 020** function (→ 🕮41), the measuring device can be operated using the ⊟ and ⊞ keys on the device. Manual mode allows the user to move the sensing weight slowly (e.g. for a tape change).

ℹ️ Once "manual" mode has been selected for the type of measurement, the **measured value 000** function must first be selected and then the sensing weight can be moved manually using the keys.

⚠️ **WARNING**

- In the manual mode, the upper limit switch and the tape switch have no function!
- Users must themselves check in which position the sensing weight is currently located. With this type of measurement, the sensing weight can (depending on the maximum tape length) be lowered into unauthorized areas of the container (or into an outlet worm for example).

In the manual mode, the **measured value 000** function automatically shows the length of tape that has been lowered. The value displayed depends on the distance unit (m, ft, in) selected in function 083 (→ 🕮52) and on the number of decimal places to be displayed as selected in function 062 (→ 🕮47). On completion of the manual operation mode, the measured value display switches to the display mode originally selected (e.g. level in customer units).

ℹ️ The last valid measured value remains saved internally, it is not overwritten in manual mode. The outputs continue to follow this value (e.g. with a 50 % fill level, 12 mA is still output at the current output).

10.6   LED

The green LED positioned to the right of the LC display is used to display the pulses of the counting wheel during a measurement process. The counting wheel sends a pulse to the evaluation electronics every 5 cm of tape length. The status of the LED changes at the same time. Once the measurement process is complete, the last LED status is retained.
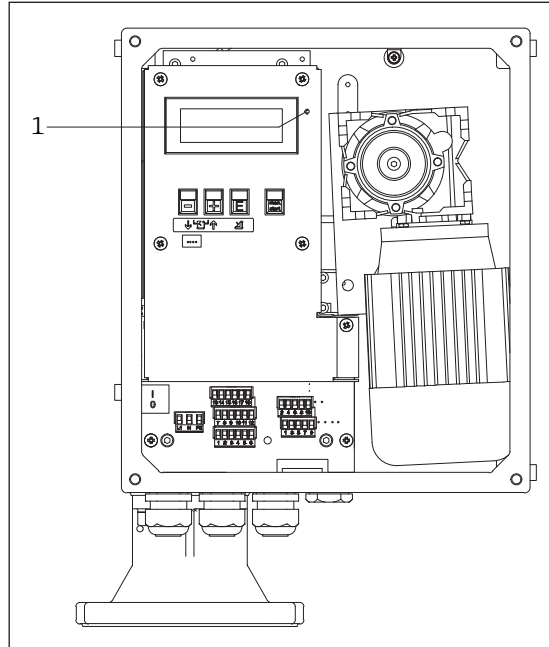
32   Position of the LED

1   LED for counting wheel pulses

11 Diagnostics and troubleshooting

11.1 General troubleshooting

Troubleshooting the local display

Error	Possible causes	Remedial action
Local display dark and no output signals	No contact between connecting cables and terminals	Check the connection of the cables and correct if necessary
Local display dark and no output signals	Electronics are defective	Order spare part → 🗎73
Local display is dark, but signal output is within the valid range	Display is set too bright or too dark	Adjust the contrast setting → 🗎36
Local display is dark, but signal output is within the valid range	Display module is defective	Order spare part → 🗎73
Text on local display appears in a foreign language and cannot be understood.	Incorrect operating language is configured	Change the operating language → 🗎38

Troubleshooting the output signals

Error	Possible causes	Remedial action
Signal output outside the valid range	Electronics are defective	Order spare part → 🗎73
Device shows correct value on local display, but signal output is incorrect, though in the valid range	Parametrization errors	Check and correct parameterization → 🗎45
Device measures incorrectly	Parametrization errors	Check and correct parameterization → 🗎39
Device measures incorrectly	Device is being operated outside the range of application	Observe limit values specified in the "Technical data" → 🗎99

Troubleshooting access problems

Error	Possible causes	Remedial action
Not possible to write to parameters, access code = 100	Hardware locking enabled	Disable locking → 🗎37
Not possible to write to parameters, access code <> 100	Software locking enabled	Disable locking → 🗎37

11.2   Diagnostic functions on the local display

11.2.1 Diagnostic messages

Faults detected by the self-monitoring system of the measuring device are displayed as a diagnostic message in alternation with the **measured value 000** function.

```
1 ──── measured value    000
2 ──┐
        ␗
             63.42 %
     ████████████─────────


3 ──── present error
4 ──── simulation
       activated
                    W621 ──── 5
```
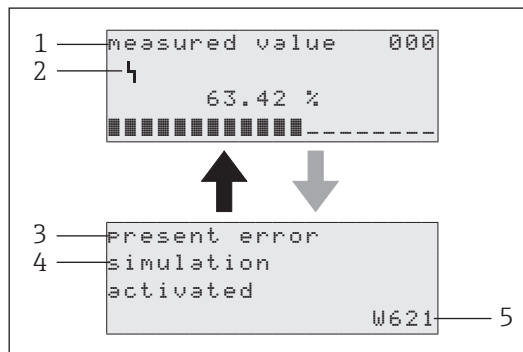
1   measured value 000 function
2   Alarm symbol
3   Present error
4   Help text pertaining to the current error
5   Error code

If two or more diagnostic events (alarm or warning) are pending simultaneously, only the diagnostic message of the diagnostic event with the highest priority (= lowest number) is shown.

11.2.2 Present error

```
present error    070
simulation
activated
                 W621
```

The **present error 070** with the error code (→ 🖹66) and the letter "W" for warning or "A" for alarm is shown on the display.
If the error is a warning, only this is displayed.
In the case of an alarm, this is also output via the "alarm" relay output, provided that this has been selected.

11.2.3 Previous error

```
previous error   071
minimum move
distance
not reached      A440
```

The **previous error 071** with the error code (→ 🖹66) and the letter "W" for warning or "A" for alarm is shown on the display.

11.2.4 Resetting errors

```
clear errors      072
√erase last
 erase current
 erase all
```

With the **clear errors 072** function, you can delete the errors displayed:
- **keep**
  Errors are not deleted.
- **erase last**
  The last error is deleted.
- **erase current**
  The current error is deleted.
- **erase all**
  The current (070) and previous (071) errors are deleted.

Default value: keep

11.3 Overview of the diagnostic functions

Code	Diagnostics information	Corrective measure
A100	Checksum error in internal program memory	1. Reset hardware 2. Avoid EMC problems 3. If the alarm is still present after a reset, contact service and/or replace the electronics
A101	Check sum error in EEPROM 1	
A102	Check sum error in EEPROM 2	
A103	Initialization failed	

Code	Diagnostics information	Corrective measure
A106	Program download error (only for service technicians)	Repeat download and/or restart

Code	Diagnostics information	Corrective measure
W110	Default service parameters loaded	1. Warning that a reset has been performed 2. Disappears automatically the next time an entry is made
W111	Default user parameters loaded	
W112	Default input/output configuration loaded	
W113	Default table for linearization loaded	

Code	Diagnostics information	Corrective measure
A120	Error when loading the service parameters	1. Reset hardware 2. Avoid EMC problems 3. If the alarm is still present after a reset, contact service and/or replace the electronics
A121	Error when loading the user parameters	
A122	Error when loading the input / output configuration	
A123	Error when loading the last measured values	

Code	Diagnostics information	Corrective measure
A124	Error when loading the linearization table	1. Check linearization table 2. Enter the linearization table again if necessary

Code	Diagnostics information	Corrective measure
A125	Error when loading the lineariza-tion table",	1. Reset hardware 2. Avoid EMC problems 3. If the alarm is still present after a reset, contact service and/or re-place the electronics
A130	Process of saving the service para-meters has failed	
A131	Process of saving the user parame-ters has failed	
A132	Process of saving the input / out-put configuration has failed	
A133	Process of saving the measured values has failed	
A134	Process of saving the linearization has failed	

Code	Diagnostics information	Corrective measure
A200	Interface to motor controller defective	1. Reset hardware 2. Avoid EMC problems 3. If the alarm is still present after a reset, contact service and/or re-place the electronics
A201	Initialization of the motor control-ler failed	
A202	Fatal motor error	

ℹ The **Fatal motor error A202** comprises multiple errors in the motor drive system and indicates critical damage to the electronics and/or motor.

Code	Diagnostics information	Corrective measure
A203	Temperature switch inside motor is triggered	1. Reset hardware 2. Avoid excessive heating of the measuring device: - Observe the minimum time for a measuring cycle (→ 🖺100) - Observe the maximum ambient temperature (→ 🖺101) - Observe the maximum weight of the sensing weight 3. If the alarm is still present after a reset, contact service and/or re-place the motor
A205	Motor current consumption is too high	

Code	Diagnostics information	Corrective measure
A204	Line voltage is too low	1. Reset hardware 2. Check the supply voltage (→ 🖺100) 3. After replacing the electronics: use the right spare part (→ 🖺73) 4. If the alarm is still present after a reset, contact service
A207	Line voltage is too high	

ℹ • The limits of the permitted supply voltage are dictated by the order code.
 • This error message appears when using an electronics system for the 180 – 253 VAC voltage range and a local supply voltage in the 90 – 127 VAC range.
 • Please use suitable spare parts only.

Code	Diagnostics information	Corrective measure
A206	Motor driver defective	1. Reset hardware 2. If the alarm is still present after a reset, contact service and/or re-place the motor

Code	Diagnostics information	Corrective measure
A220	Temperature in the device is too high	1. Check the ambient temperature (→ 🕮101) 2. Check the measurement cycle time (→ 🕮100)

Code	Diagnostics information	Corrective measure
A330	Maximum time for a measurement exceeded	1. Check the wiper (→ 🕮23, 79): The wiper must move to the upper end position for a measurement to finish. 2. If the alarm persists after several measurements, contact service

🛈 ▪ When a measurement starts, an internal counter is started. If the measurement is not completed within approximately 10 minutes, this error message appears .
▪ If the wiper does not reach the top position, no pulses are received from the counting wheel. A450 is then the last error code in function 071 .

Code	Diagnostics information	Corrective measure

A340	Sensing weight/tape is torn	1. Check the sensing weight and measuring tape:
		    Replace sensing weight and/or measuring tape if necessary
		2. Motor is in contact with the tape switch for an extended period when the tape is run up (→ 🕮13):
		    Check installation (angle of inclination greater than 2°)

🛈 The error message appears if the motor is in contact with the tape switch for approx. 100 ms.

Code	Diagnostics information	Corrective measure
A350	Sensing weight is buried	1. Free the sensing weight by hand 2. If the sensing weight is not buried: Check the current consumption of the motor (→ 🕮100)

Code	Diagnostics information	Corrective measure
A430	Tape switch expected	Contact service and/or replace tape switch

Code	Diagnostics information	Corrective measure
A431	Limit switch expected	Contact service

Code	Diagnostics information	Corrective measure
A440	Minimum run-down distance not reached	1. Check the installation position (→ 🕮18) 2. Observe minimum sensing weight run-down distance of 20 cm. 3. Sensing weight present?

Code	Diagnostics information	Corrective measure
A450	Time for counting wheel pulses exceeded	1. Check the counting wheel 2. Reset hardware 3. If the alarm persists after several measurements, contact service

🛈 This error message mostly appears in conjunction with error A330 if the upper end position is not reached.

Code	Diagnostics information	Corrective measure
A460	Slip on counting wheel	1. Check counting wheel 2. Reset hardware 3. If the sensing weight is located near the level: Check the wiper to see whether it has left the measuring device 4. If the alarm still persists after several measurements, contact service

> • The error message appears if the difference between the counting wheel pulses during run-up and run-down is too large.
> • If the wiper does not fully leave the measuring device, the sensing weight is understood to have arrived at the upper end position when the weight is raised and therefore this is interpreted as the end of the measurement procedure. This is what causes a maximum difference between the counting wheel pulses.

Code	Diagnostics information	Corrective measure
A470	The measurement could not be started	Check the device for damage or blocking parts

Code	Diagnostics information	Corrective measure
W611	Less than 2 points entered in linearization table	1. Check linearization table (→ 🕮53) 2. Add missing linearization points if needed

Code	Diagnostics information	Corrective measure
W621	Simulation activated	Switch off simulation (→ 🕮60)

Code	Diagnostics information	Corrective measure
A650 W651	Security distance not reached	1. Check the installation situation 2. Check the programming (→ 🕮40)
A660 W661	Safety distance not reached	
W681	Measurement range exceeded	

> • The error message appears if the measuring device detects a measured value above the full calibration (tape switch is triggered).
> • If this error message occurs regularly, the installation position should be inspected to ensure that no struts or internal fixtures are obstructing the lowering (run-down) of the sensing weight.

Code	Diagnostics information	Corrective measure
W690	Linearization incomplete or unusable	1. Check linearization table 2. Add missing points if needed

Code	Diagnostics information	Corrective measure
W700	Tape must be changed	1. Check measuring tape, replace if necessary 2. Reset service interval counter

> If this error message appears regularly without there being a need to replace the tape, the **service interval 024** can be increased (→ 🕮59).

11.4   Resetting the measuring device

```
Rücksetzen        073
          0
Zur Code Eingabe
siehe Betriebsanl.
```

The device configuration can be reset to a defined state (default values) using the **Reset 073** function.

Range of values:
- **333**
  A reset is performed
- **<>333**
  A reset is not performed

> **NOTICE**
> - At least one basic setup must have been performed before the measuring device can be reset.
> - If possible, note down the configured parameters so that the desired device functions can be re-established after the reset. A table is provided for this purpose in the appendix (→ 📖 102).

11.5   Device information

The following functions contain information about the identification of the device.

11.5.1 Displaying the protocol and software version

```
Protokoll+SW-Nr. 081
V01.01.00
```

With the **Protocol+SW No. 081** function, you can display the protocol and software version of the measuring device.

> **NOTICE**
> Please contact Endress+Hauser Service for information about repairing or ordering spare parts for firmware versions for technical special products (TSP).

11.5.2 Displaying the serial number

```
Seriennummer      082
        1001
```

With the **Serial number 082** function, you can display the serial number of the measuring device. You will also find the serial number on the nameplate.

11.6   Firmware history

Release date	Firmware version	Firmware changes	Documentation
03.2017	01.06.11	Software revised: - Minor corrections to help text	BA00286F/97/en/14.17
01.2015	01.06.10	Software revised: - Mapping error A460 in the "Short" operating mode - "Run-up length" function (028) added for the "Short" operating mode	BA00286F/97/en/14.17
05.2012	01.06.08	Software revised: - Modification of moving sensing weight into upper end position	BA00286F/97/en/14.17
04.2011	01.06.07	Software revised: - Minor changes to manual mode	BA286F/97/en/04.10

Release date	Firmware version	Firmware changes	Documentation
09.2009	01.06.06	Software revised: - Minor changes to Japanese language version	BA286F/97/en/12.07
06.2009	01.06.05	Software revised: - Minor changes to Japanese language version	BA286F/97/en/12.07
09.2007	01.06.04	Software revised: - New serial numbers according to E+H Standard 223	BA286F/97/en/11.06
08.2007	01.06.03	Software upgrade: - Extended functionality at the Service level	BA286F/97/en/11.06
03.2007	01.06.02	Software revised: - Minor changes to "Unlock parameter" function (074)	BA286F/97/en/11.06
02.2007	01.06.01	Software revised: - Japanese help text in function 061 and 061 corrected	BA286F/97/en/01.07
12.2006	01.06.00	Software upgrade: - "In safety distance" (045) function added	BA286F/97/en/11.06
03.2006	01.05.01	Software extension: - Japanese language version with Japanese help	BA286F/97/en/07.05
12.2005	01.05.00	Software extension: - French language version	BA286F/14/fr/07.05
11.2005	01.04.00	Software extension: - Enhanced functionality	BA286F/97/en/07.05
10.2005	01.03.00	Software extension: - Japanese language version with English help	BA286F/97/en/07.05
09.2005	01.02.02	Software extension: - Enhanced functionality	BA286F/97/en/07.05
07.2005	01.02.01	Software extension: - Enhanced functionality	BA286F/97/en/07.05
06.2005	01.02.00	Software extension: - Output current range extended to 0 - 20 mA (033)	BA286F/97/en/04.05
12.2004	01.01.00	Original software	BA286F/97/en/12.04

12   Repair

12.1   General notes

Repair and modification concept

The Endress+Hauser repair and modification concept provides for the following:

• The measuring devices have a modular design.
• Spare parts are grouped into logical kits and are accompanied by Installation Instructions.
• Repairs are carried out by Endress+Hauser Service or by appropriately trained customers.
• Certified devices can only be converted to a variant with different certification by the Endress+Hauser Service team or at the factory.

Notes concerning repair and modification

Observe the following when repairing or modifying a measuring device::

• Use original Endress+Hauser spare parts only.
• Carry out the repair according to the Installation Instructions.
• Observe the applicable standards, national regulations, Ex documentation (XA) and certificates.
• Document every repair and modification and enter the details in the W@M life cycle management database.

12.2   Spare parts

NOTICE

• Please refer to the instruction leaflet supplied or these Operating Instructions for installation instructions.
• Each spare part is identified by an order number. When changing parts, please make sure that only a suitable spare part is installed.
• Other spare part numbers apply for special versions (TSP) of devices. Please contact Endress+Hauser if you want to order a spare part for your special version!

⚠ WARNING

• **If incorrect spare parts are installed in Ex-certified devices, the device is no longer compliant with Ex specifications and can no longer be operated in the hazardous area.**
• **If the wrong supply voltage is selected, this can destroy spare parts immediately.**

12.2.1 Electronics side
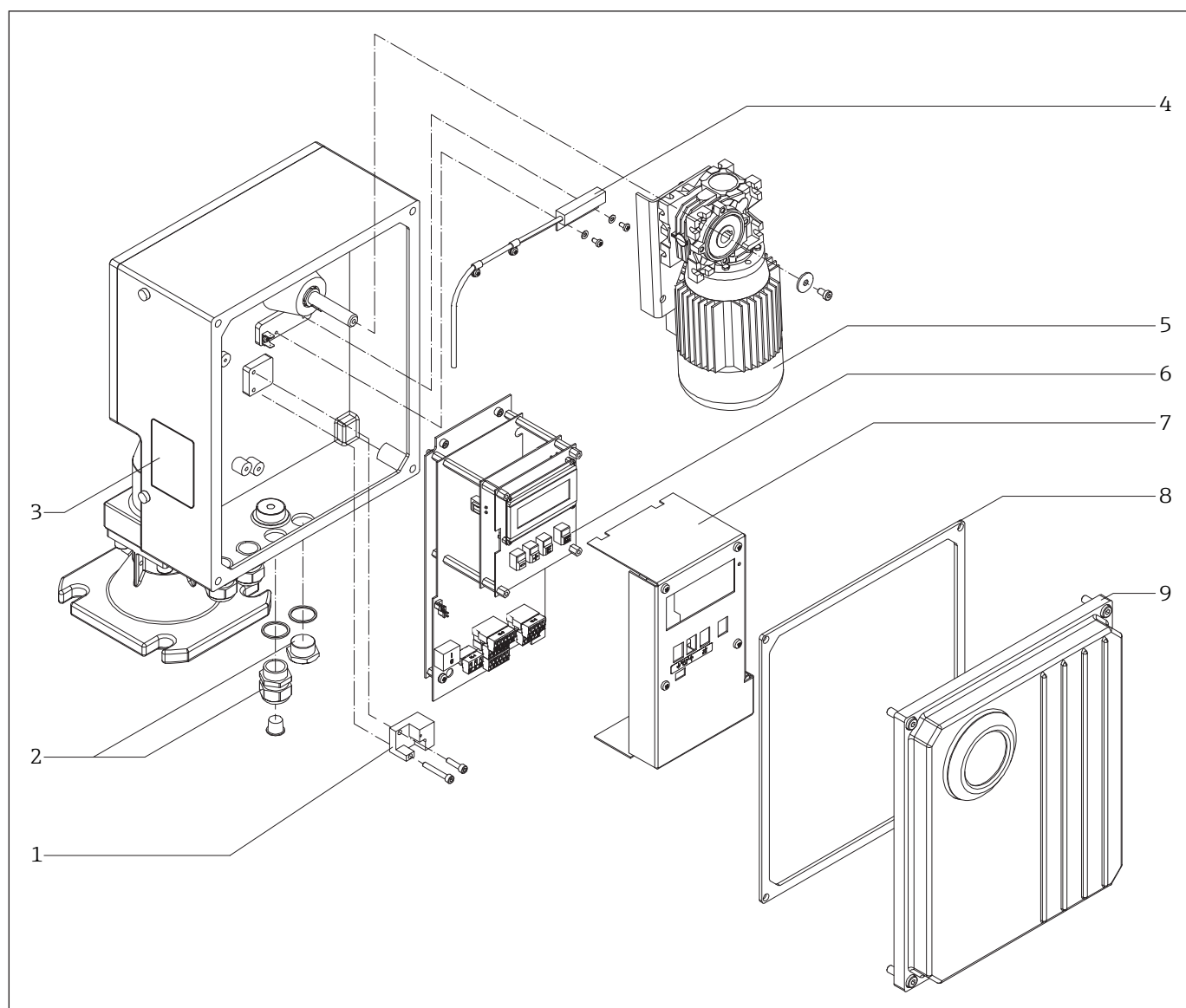
33 Spare parts on the electronics side

1 Tape switch unit
52028117 Tape switch, mounting material

2 Cable glands and/or external start button
52028118 Cable gland, 4 parts, with Ex certification
52028119 Cable gland, 4 parts, without Ex certification
52028178 Start-button, external, stainless steel version

3 Nameplate
71296636 Replacement nameplate

NOTICE
When ordering, please specify the order code of the device which is to receive the replacement nameplate.

4 Device heater
52028177 Device heater, 115/230 VAC

5   Motor/gearbox unit

71113428	Incl. connection and potential matching line, 230 VAC, 500 N
71113432	Like 71113428 (230 VAC, 500 N) + extended climate resistance
71113429	Incl. connection and potential matching line, 230 VAC, 250 N
71113433	Like 71113429 (230 VAC, 250 N) + extended climate resistance
71113430	Incl. connection and potential matching line, 115 VAC, 500 N
71113434	Like 71113430 (115 VAC, 500 N) + extended climate resistance
71113431	Incl. connection and potential matching line, 115 VAC, 250 N
71113436	Like 71113431 (115 VAC, 250 N) + extended climate resistance

6   Electronic unit, preassembled on mounting plate

52028120	230 VAC, 2 relay, not an Ex version, without heating connection
71001310	Like 52028120 + extended climate resistance
52028121	230 VAC, 6 relay, not an Ex version, no heating connection
71001311	Like 52028121 + extended climate resistance
52028122	230 VAC, 2 relay, Ex version, without heating connection
71001312	Like 52028122 + extended climate resistance
52028123	230 VAC, 6 relay, Ex version, without heating connection
71001313	Like 52028123 + extended climate resistance
52028124	115 VAC, 2 relay, not an Ex version, without heating connection
71001314	Like 52028124 + extended climate resistance
52028125	115 VAC, 6 relay, not an Ex version, without heating connection
71001315	Like 52028125 + extended climate resistance
52028126	115 VAC, 2 relay, Ex version, without heating connection
71001316	Like 52028126 + extended climate resistance
52028127	115 VAC, 6 relay, Ex version, without heating connection
71001317	Like 52028127 + extended climate resistance
52028128	230 VAC, 2 relay, not an Ex version, with heating connection
71301716	Like 52028128 + extended climate resistance
52028129	230 VAC, 6 relay, not an Ex version, with heating connection
71301719	Like 52028129 + extended climate resistance
52028130	230 VAC, 2 relay, Ex version, with heating connection
71301720	Like 52028130 + extended climate resistance
52028131	230 VAC, 6 relay, Ex version, with heating connection
71301721	Like 52028131 + extended climate resistance
52028132	115 VAC, 2 relay, not an Ex version, with heating connection
71301722	Like 52028132 + extended climate resistance
52028133	115 VAC, 6 relay, not an Ex version, with heating connection
71301725	Like 52028133 + extended climate resistance
52028134	115 VAC, 2 relay, Ex version, with heating connection
71301727	Like 52028134 + extended climate resistance
52028135	115 VAC, 6 relay, Ex version, with heating connection
71301729	Like 52028135 + extended climate resistance

7   Electronic cover

|	
52028155	Cover, steel plate with inscription
71001329	Cover, steel plate with inscription + extended climate resistance

8   Cover seal for electronics compartment

52028104	Seal, non-Ex version
52028105	Seal, Ex version or climate version

9   Housing cover (incl. cover seal item 1)

52028136	Housing cover, not coated, non-Ex version, no window
52028137	Housing cover, coated, non-Ex version, no window
52028138	Housing cover, not coated, Ex version, no window
71026889	Like 52028138 + extended climate resistance
52028139	Housing cover, coated, Ex version, no window
52028140	Housing cover, not coated, non-Ex version, with window
52028141	Housing cover, coated, non-Ex version, with window
71026891	Like 52028141 + extended climate resistance

12.2.2 Process side
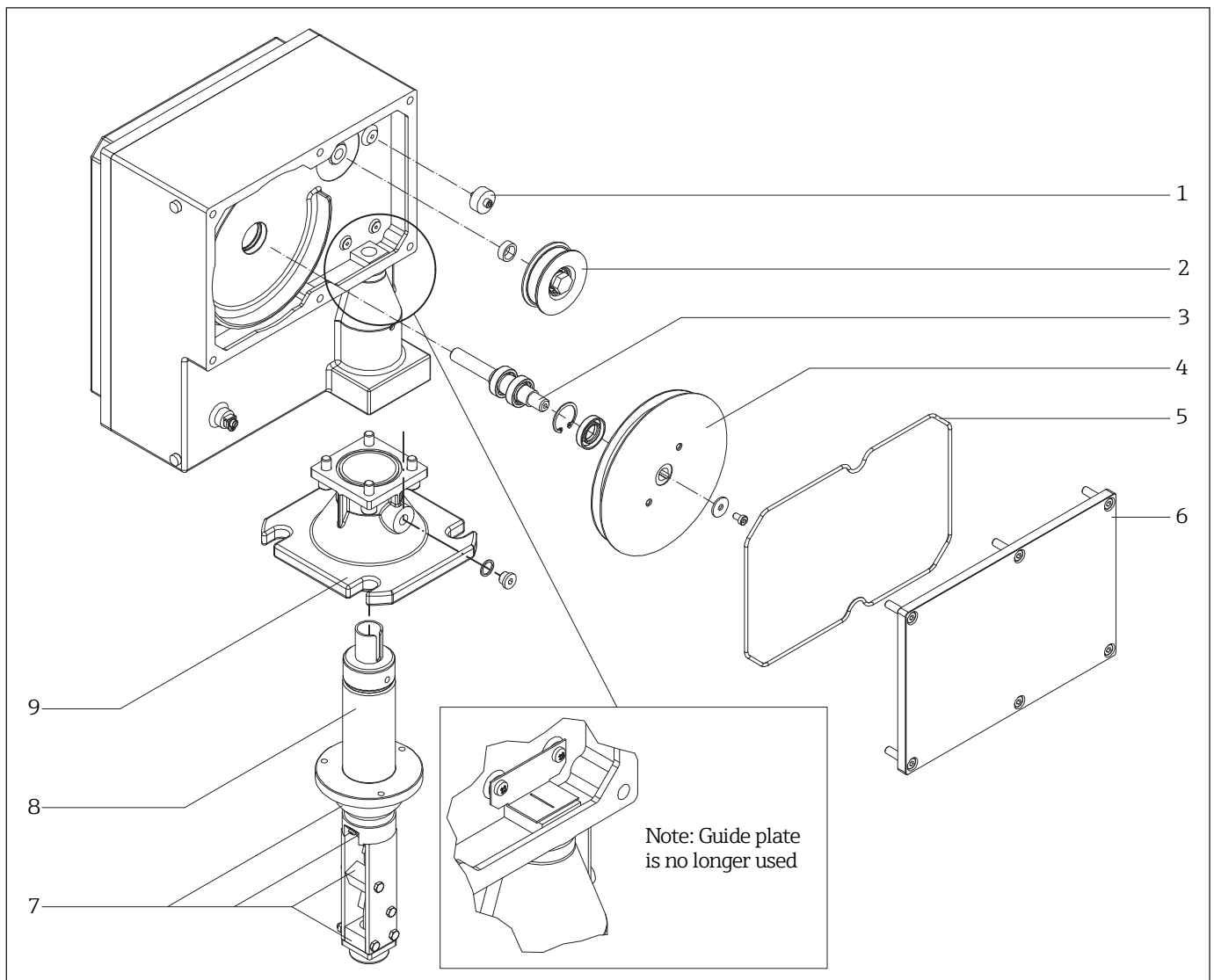
🖼 *34   Spare parts for the process side*

1   Tape guide kit
52028115   Tape guide, guide plate, mounting material
71026887   Like 52028115 + extended climate resistance

NOTICE
- For devices from year of construction 2016, the guide plate is no longer mounted.
- During repair, it can still be mounted on customer request.

2   Counting wheel, complete
52028103   Counting wheel, fully mounted

3   Drive shaft, complete
52028102   Drive shaft incl. ball bearings, shaft seal and mounting material

4	**Tape spool**	
	52028111	Steel spool, stainless steel measuring tape, 25 m
	71026882	316Ti spool, stainless steel measuring tape, 25 m (extended climate resistance)
	52028112	Steel spool, stainless steel measuring tape, 35 m
	71026884	316Ti spool, stainless steel measuring tape, 35 m (extended climate resistance)
	52028113	Steel spool, stainless steel measuring tape, 50 m
	71026885	316Ti spool, stainless steel measuring tape, 50 m (extended climate resistance)
	52028114	Steel spool, stainless steel measuring tape, 70 m
	71026886	316Ti spool, stainless steel measuring tape, 70 m (extended climate resistance)
	71301749	Steel spool, stainless steel measuring tape, 90 m
	71301750	316Ti spool, stainless steel measuring tape, 90 m (extended climate resistance)
	71301745	Steel spool, plastic measuring tape, 15 m
	71301748	316Ti spool, plastic measuring tape, 15 m (extended climate resistance)

5	**Cover seal for spool compartment**	
	52028116	Seal

6	**Housing cover (incl. cover seal item 5)**	
	52028142	Housing cover, not coated
	52028143	Housing cover, coated
	71026894	Like 52028143 + extended climate resistance
	52028144	Housing cover, not coated, process pressure up to 3 bar
	52028145	Housing cover, coated, process pressure up to 3 bar
	71026897	Like 52028145 + extended climate resistance

| 7	**Wiper spare parts kit**	
	52028080	End guide, tape-wipe scrapers, wiper parts, bellows, mounting material, process temperature of up to +70 ℃ (+158 ℉)
	52028081	End guide, tape-wipe scrapers, wiper parts, bellows, mounting material, process temperature of up to +150 ℃ /+230 ℃ (+302 ℉ / +446 ℉)

8	**Wiper, complete**	
	52028068	Wiper, 230 mm, aluminum/steel, process temperature of up to +70 ℃ (+158 ℉)
	52028069	Wiper, 230 mm, stainless steel, process temperature of up to +70 ℃ (+158 ℉)
	52028070	Wiper, 230 mm, aluminum/steel, process temperature of up to +150 ℃ (+302 ℉)
	52028071	Wiper, 230 mm, stainless steel, process temperature of up to +150 ℃ (+302 ℉)
	52028072	Wiper, 500 mm, aluminum/steel, process temperature of up to +70 ℃ (+158 ℉)
	52028073	Wiper, 500 mm, stainless steel, process temperature of up to +70℃ (+302 ℉)
	52028074	Wiper, 500 mm, aluminum/steel, process temperature of up to +150 ℃ (+302 ℉)
	52028075	Wiper, 500 mm, stainless steel, process temperature of up to +150 ℃ (+302 ℉)
	52028076	Wiper, 1000 mm, aluminum/steel, process temperature of up to +70 ℃ (+158 ℉)
	52028077	Wiper, 1000 mm, stainless steel, process temperature of up to +70 ℃ (+158 ℉)
	52028078	Wiper, 1000 mm, aluminum/steel, process temperature of up to +150 ℃ (+302 ℉)
	52028079	Wiper, 1000 mm, stainless steel, process temperature of up to +150 ℃ / +230 ℃ (+302 ℉ / +446 ℉)

9   Process adapter
52028146   Process adapter, not coated, incl. seal and mounting material
52028147   Process adapter, coated, incl. seal and mounting material

12.2.3 Sensing weights
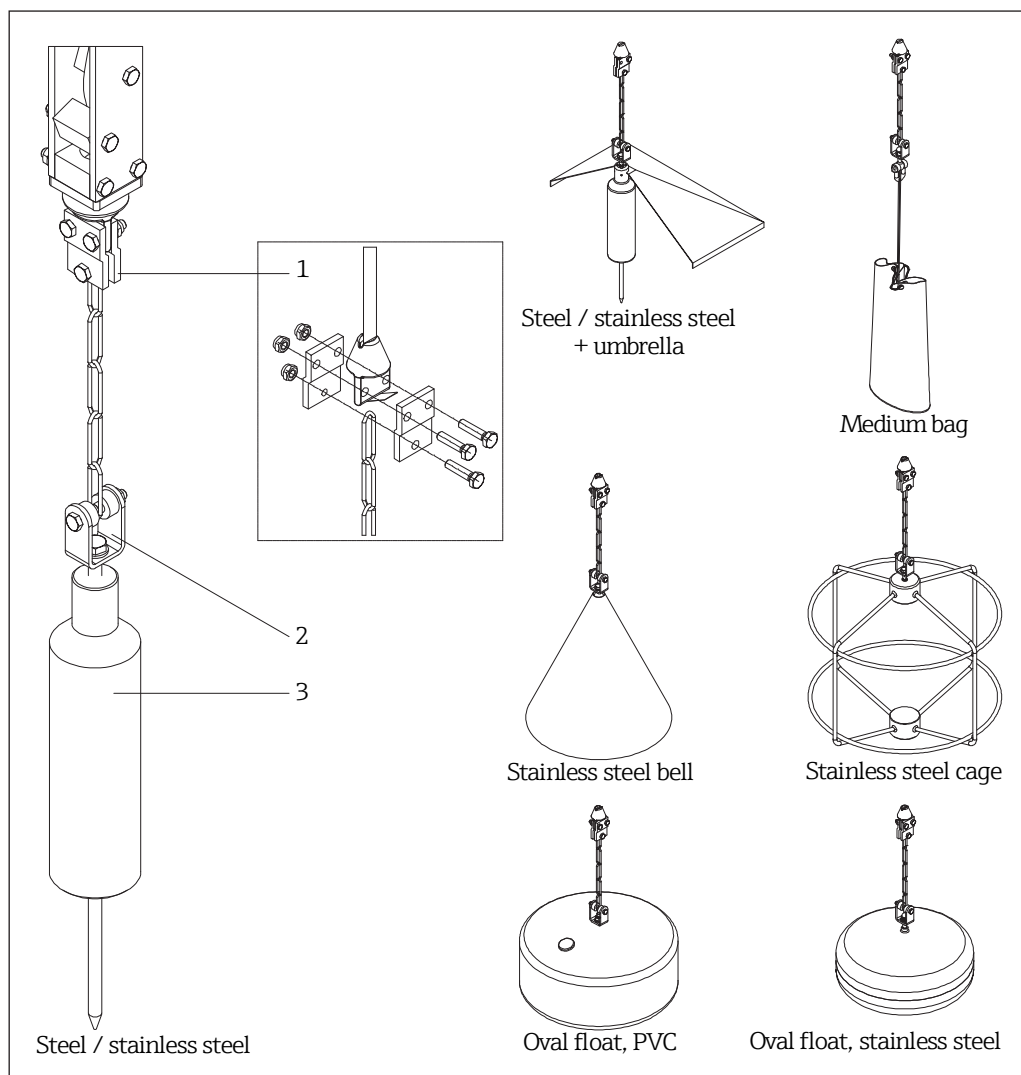
🖻 *35   Spare parts for the sensing weight*

1   Sensing weight mounting, complete
52028088   Tape border, rotating bush, chain, mounting material, steel
52028089   Tape border, rotating bush, chain, mounting material, stainless steel

2   Rotating bush, complete
52028100   Rotating bush, mounting material, steel
52028101   Rotating bush, mounting material, stainless steel

3   Sensing weight, incl. rotating bush item 2
52028090   Steel
52028091   Stainless steel
52028092   Steel + umbrella
52028093   Stainless steel + umbrella
52028094   Medium bag
52028096   Stainless steel cage
52028098   Stainless steel bell
52028099   Float, PVC
71301751   Float, 316Ti

12.3   Replacing components

12.3.1 Replacing the tape spool
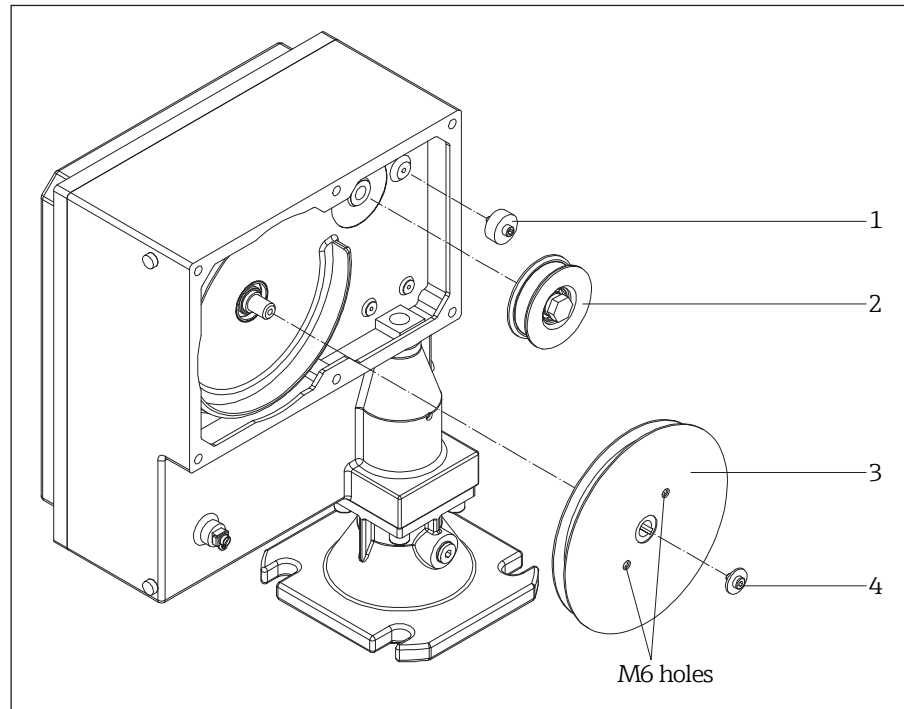
 36   Replacing the tape spool

1   Tape guide
2   Counting wheel
3   Tape spool
4   Securing screw

Proceed as follows to replace the tape spool:

1. Move the sensing weight down a little (at least 5 cm) in the "Manual mode (020)" type of measurement to relieve the tension on the measuring tape.

NOTICE

When using larger sensing weights (for example cage weight), the weight must be lowered to an appropriate hatch (→ 25).
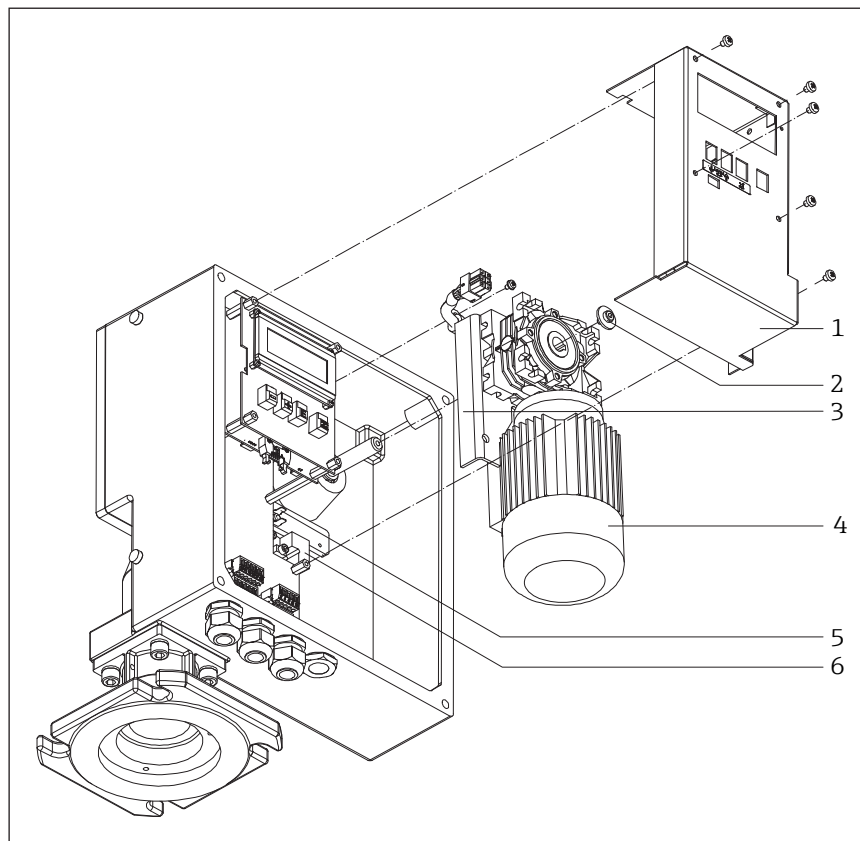
2. Switch off the supply voltage:
    • Move mains switch to "O" (Off) if the sensing weight is easily accessible.
    • Disconnect the mains cable if the measuring device needs to be removed.

3. Remove and/or expose the measuring device until the wiper and sensing weight are accessible.

4. Remove the tape border from the measuring tape (→ 26).

5. Unfasten the tape spool's locking screw.

To simplify the process of changing the tape, we recommend removing the counting wheel and tape guide.

6. Screw the M6 screws (at least 50 mm, DIN EN ISO 4017) evenly into the relevant reel holes. This pulls the reel off the drive shaft.

Alternatively, a removal tool is also available (→ 98).

7. Carefully remove the tape spool and unwound part of the measuring tapes from the device.

8. A new tape spool is then installed in reverse order.

12.3.2 Replacing the wiper

Guide screw

Guide groove
of wiper

1

2
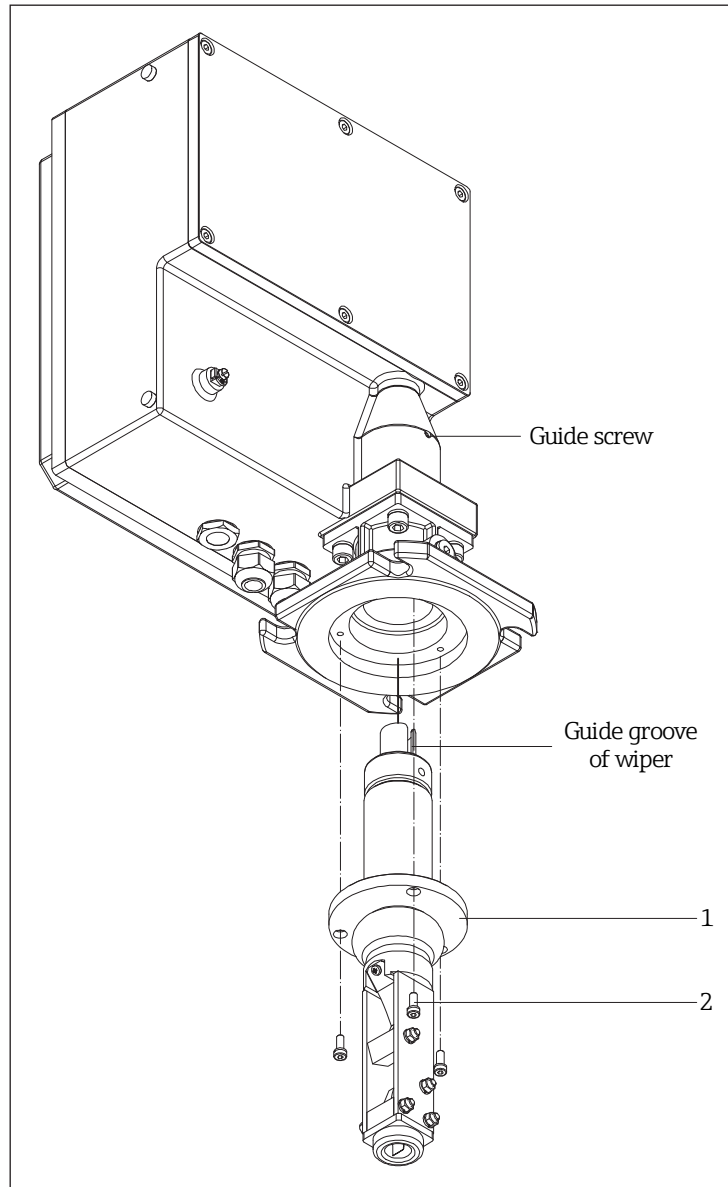
🖻 *37   Replacing the wiper*

1   Wiper
2   Mounting screws M6x16

Proceed as follows to replace the wiper:

1.   Move the sensing weight down a little (at least 5 cm) in the "Manual mode (020)" type of measurement to relieve the tension on the measuring tape.

NOTICE

When using larger sensing weights (for example cage weight), the weight must be lowered to an appropriate hatch (→ 🖻25).

2. Disconnect the mains cable.
3. Remove and/or expose the measuring device until the wiper and sensing weight are accessible.
4. Release the tape border and remove it (and therefore also the sensing weight) from the measuring tape.
5. Release the three M6 screws on the wiper. The wiper can now be removed.

NOTICE

When dismantling and/or installing, ensure that the measuring tape is positioned correctly in the wiper. The measuring tape must not be turned in the spool compartment. The spool compartment cover should be opened during installation for this purpose.

6. A new wiper is then installed in reverse order. While assembling, you must ensure that the guide groove on the wiper is positioned correctly in relation to the guide screw on the housing.

12.3.3 Replacing the motor/gearbox unit

 38   Replacing the motor/gearbox unit

1   Cover plate
2   Securing screw
3   Switch plate
4   Motor/gearbox unit
5   Ground terminal
6   Switch socket

Proceed as follows to replace the drive unit:
1. Move the sensing weight down a little in the "Manual mode" (020) type of measurement to relieve the tension on the measuring tape and therefore the drive shaft, and then fix the sensing weight or the measuring tape in place. A tape stopper (→ 🗎98) is available for this purpose.

2. Switch off the supply voltage:
   ▪ Move mains switch to "O" (Off) if the sensing weight is easily accessible.
   ▪ Disconnect the mains cable if the measuring device needs to be removed.

⚠ WARNING

Once the supply voltage has been disconnected, the interim circuit of the measuring device retains a dangerous voltage for around 20 minutes. Therefore, after disconnecting the supply voltage always wait 20 minutes before you remove the cover!

3. Loosen the cross-head screws (x 5) of the cover plate and take off the cover.

4. Disconnect the plug of the motor connection cable (top right).

5. Loosen the locking screw on the drive shaft and carefully pull out the motor/gearbox unit, along with the switch plate connected to it, by around 10 cm. A removal tool is also available for this purpose (→ 🕮98).

6. Disconnect the earthing line from the earthing terminal and you can now fully remove the drive unit.

7. A new drive unit is then installed in reverse order.

NOTICE

▪ Do not forget to reconnect the earthing cable.
▪ Use a suitable tool to force the spring in the switch socket back so that you can insert the switch plate.
▪ Carefully guide in the switch plate ensuring that the switch is not damaged.

12.3.4 Replacing the electronic unit

NOTICE

▪ The electronic unit should only be replaced by a specialist.
▪ When working with electronic components, ensure that you have sufficient ESD protection (protection against electrostatic discharge).
▪ Only use the electronics permitted for the device type when replacing parts. The use of incorrect electronics may result in the destruction of the device or the loss of Ex-certification.

⚠ WARNING

Once the supply voltage has been disconnected, the interim circuit of the measuring device retains a dangerous voltage for around 20 minutes. Therefore, after disconnecting the supply voltage always wait 20 minutes before you remove the cover!

Once an electronic unit has been replaced, a basic setup must be performed again and all the parameters must be re-entered. Therefore the following procedure is recommended:
▪ Make a note of all the settings, including the values in a linearization table if one has been entered (→ 🕮102).
▪ After replacement, transfer all the settings noted and if necessary the values from a linearization table.

NOTICE

There are two types of housing:
▪ In the older version up to around Device No. 1100, all the PC boards must be removed individually to remove the electronics. Therefore, the electronics unit should only be replaced by Endress+Hauser Service.
▪ In the latest version, the entire electronics along with the carrier plate can be removed. This housing version is recognizable from the four (of a total of five) securing screws that are visible when the cover plate is mounted.
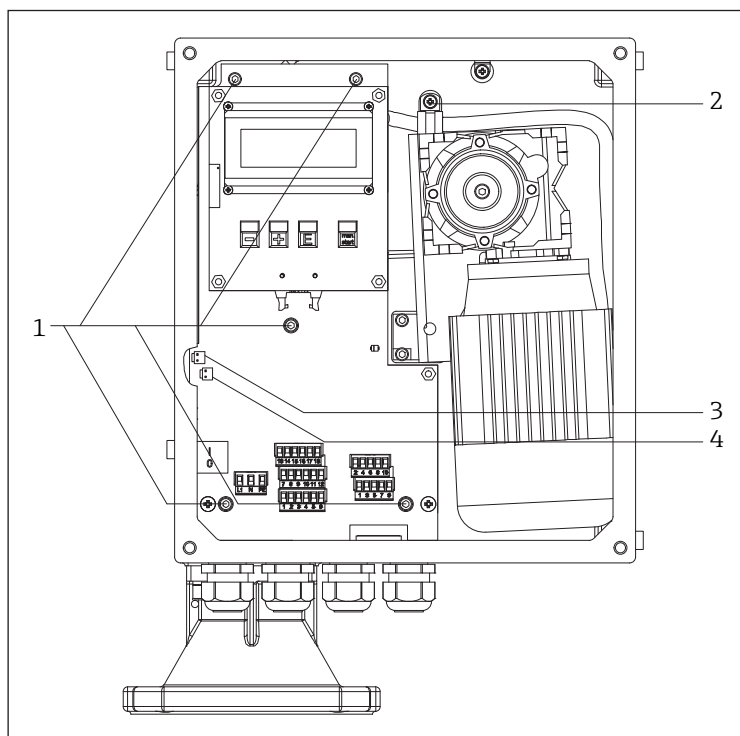
🖾 *39   Replacing the electronic unit*

1   Screws M5x8
2   Screw to fix the motor connecting cable
3   Socket for temperature fuse (only certified device versions)
4   Socket for optional device heater

Proceed as follows to remove the electronics:

1. Disconnect the supply voltage then wait for around 20 minutes (dangerous interim circuit voltage!).
2. Remove the cover plate (5 screws).
3. Disconnect the motor plug.

> ℹ️ To make is easier to disassemble the electronics, we recommend you also release the fastener for the motor connecting cable.
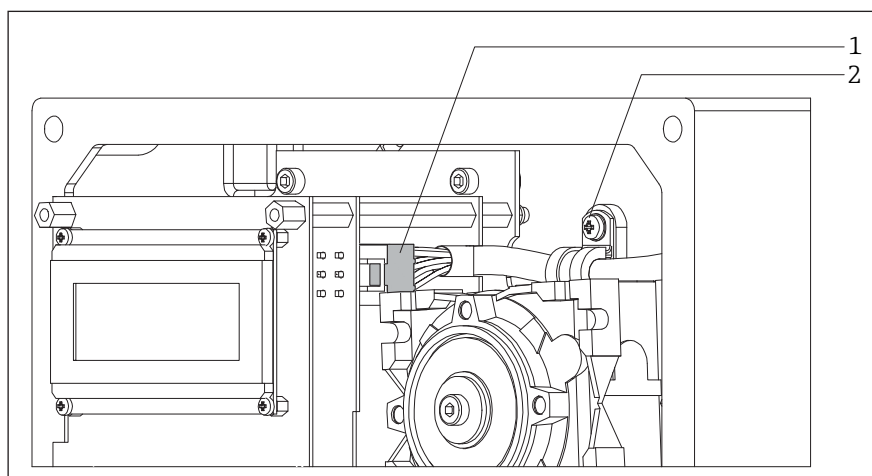
🖾 *40   Position of the motor plug*

1   Plug to connect the motor/gearbox combination
2   Fastener for the motor connecting cable

4. Release the plug of the tape switch
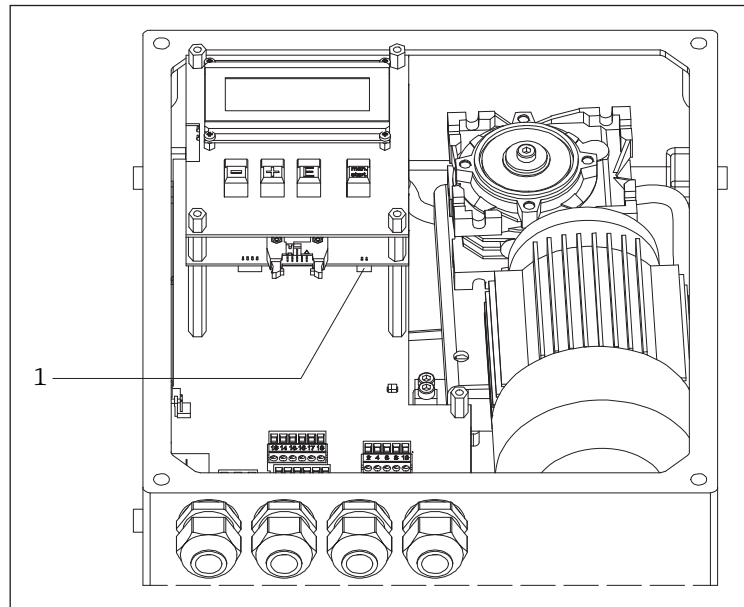
41 Position of the tape switch plug

1   Loose band plug

5. Depending on the device version, also release the plug for the temperature fuse (ATEX) and the device heater plug (→ 82).

6. The electronics module can only be removed carefully by releasing the 5 Allen screws (4 mm AF).

7. Once the defective electronics module has been replaced, the new module is installed in the reverse order.

NOTICE

Please do forget to plug in all the plugs.

12.4 Endress+Hauser services

Contact your Endress+Hauser Sales Center for information on services and spare parts.

13   Maintenance

13.1   Maintenance work

The following maintenance work may be required depending on the level of fouling.

13.1.1 External cleaning

When cleaning the exterior of the measuring device, ensure that the cleaning agent used does not corrode the housing surface and seals.

13.1.2 Cleaning the spool compartment

The cleaning periods depend on the properties of the bulk solid. If a lot of dust has accumulated, we would recommend blowing in small amounts of clean compressed air via the mounting flange (→ 🖥22).

13.1.3 Wiper check

The two wiper parts in the wiper are worn to a greater or lesser extent depending on the abrasive nature of the product and then no longer sufficiently clean the measuring tape.

To check the wiper, you have to remove the measuring device (→ 🖥22). The following points should be checked:

1. Check whether the measuring tape is cutting into the cone and bore of the end guide. If there are deep gashes, there is a risk of the measuring tape jamming. Replace the end guide if necessary.
2. Check whether both tape-wipe scrapers are securely in contact with the measuring tape. Also replace the tape-wipe scrapers if worn.
3. Check whether the bellows are still in perfect condition. Replace if damaged.
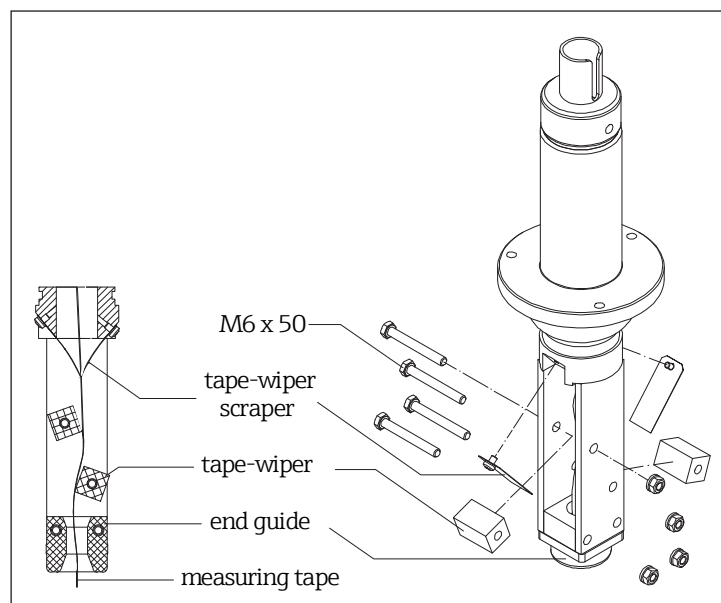
🖼42   *Wiper check*

13.1.4 Measuring tape check

The greatest mechanical load is put on the measuring tape. Therefore the tape should be checked as follows at regular intervals:
1. If the visible part (sensing weight in the upper limit position) of the measuring tape is damaged, unwind it a bit (type of measurement: "Manual" 020) until it looks flawless and in perfect condition
2. Cut off the damaged part and re-mount the sensing weight.
3. If a longer section of the measuring tape is damaged, replace the entire measuring tape. Reels of standard lengths can be supplied for this purpose (→ 🕮75).

NOTICE

Do not cut off too much. Consider the original tape length and the measurement range required (container height).

13.1.5 Spool compartment check

The spool compartment must also be inspected at regular intervals as follows:
1. If the tape spool/reel is severely corroded or damaged, replace it. Reels of coiled tape of standard lengths can be supplied for this purpose (→ 🕮75).
2. Replace the counting wheel if it is very sluggish to turn when the measuring tape is not loaded or if it is damaged.
3. If the metal parts in the spool compartment (tape guide and small parts) are severely corroded or damaged, replace them. Appropriate repair kits can be supplied for this purpose (→ 🕮72).
4. If the cover seal is severely corroded or damaged, replace it.

13.2 Endress+Hauser services

Endress+Hauser offers a wide variety of services for maintenance such as onsite inspection and maintenance or device tests.

🛈 Contact your Endress+Hauser Sales Center for information on services and spare parts.

14   Return

The measuring device must be returned if it is in need of repair or a factory calibration, or if the wrong measuring device has been delivered or ordered. Legal specifications require Endress+Hauser, as an ISO-certified company, to follow certain procedures when handling products that are in contact with the medium.

To ensure safe, swift and professional device returns, please refer to the procedure and conditions for returning devices provided on the Endress+Hauser website http://www.endress.com/support/return-material.

NOTICE

A blank "Declaration of Hazardous Material and Decontamination" is available in the appendix (→ 🖺105).

15   Disposal

15.1   Removing the measuring device

1. Switch off the measuring device.
2. Carry out the mounting and connection steps from the "Mounting the measuring device" and "Connecting the measuring device" chapters in the logically reverse sequence. Observe the safety instructions when doing so.

⚠ **WARNING**

Danger to persons from process conditions! Beware of hazardous process conditions such as pressure in the measuring device, high temperatures or aggressive fluids.

15.2   Disposing of the measuring device

⚠ **WARNING**

Danger to personnel and environment from fluids that are hazardous to health!
Ensure that the measuring device and all cavities are free of fluid residues that are hazardous to health or the environment, e.g. substances that have permeated into crevices or diffused through plastic.
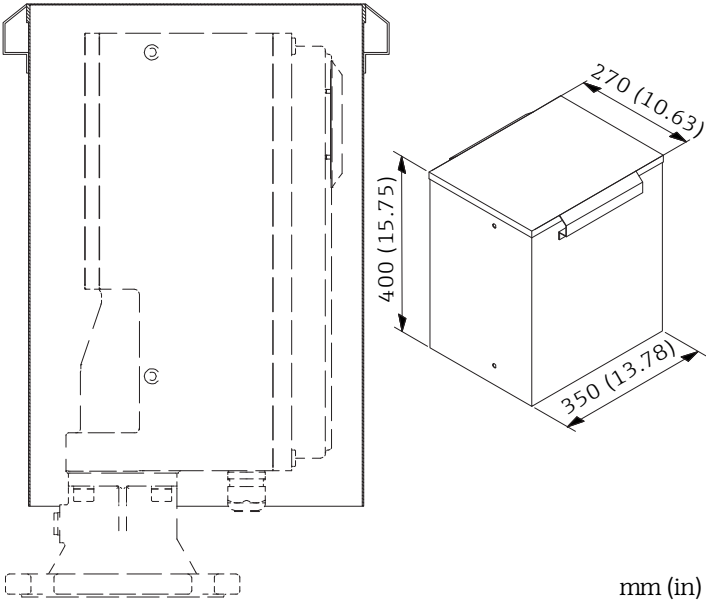
Observe the following when disposing:
- Observe valid national regulations.
- Ensure proper separation and reuse of the device components.
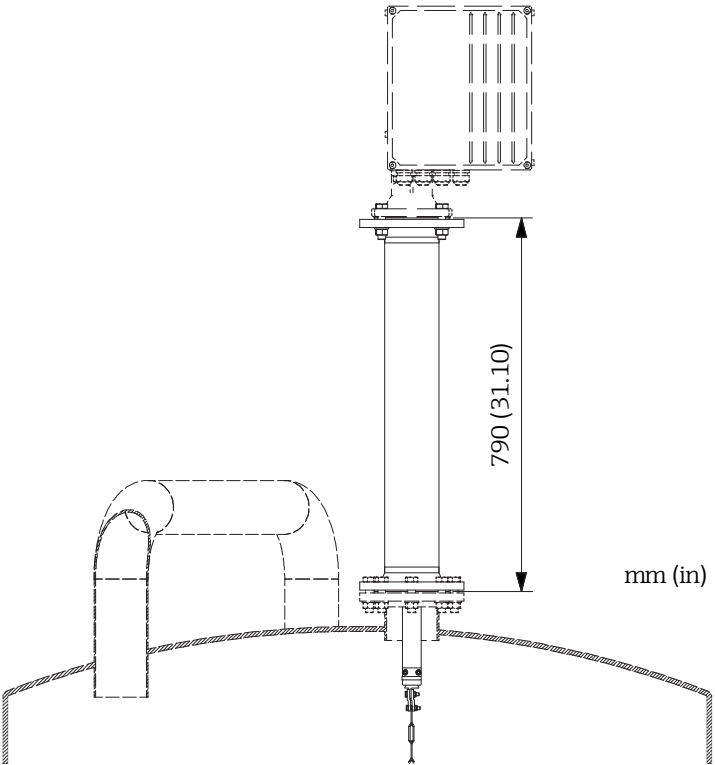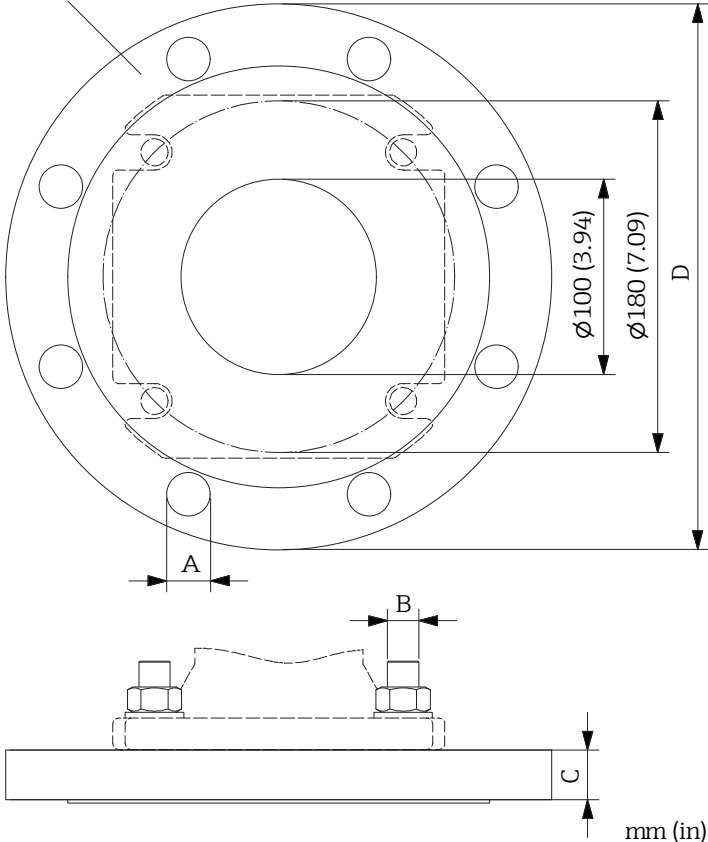
16   Accessories

Various accessories are available for the device, and can be ordered with the device or at a later stage from Endress+Hauser. Detailed information on the order code in question is available from your local Endress+Hauser Sales Center or on the product page of the Endress+Hauser website: www.endress.com.
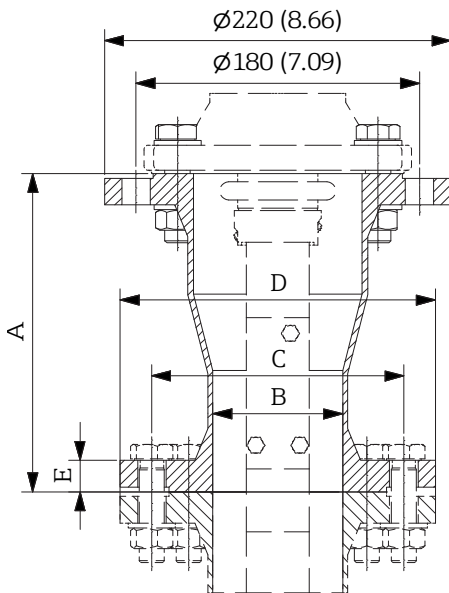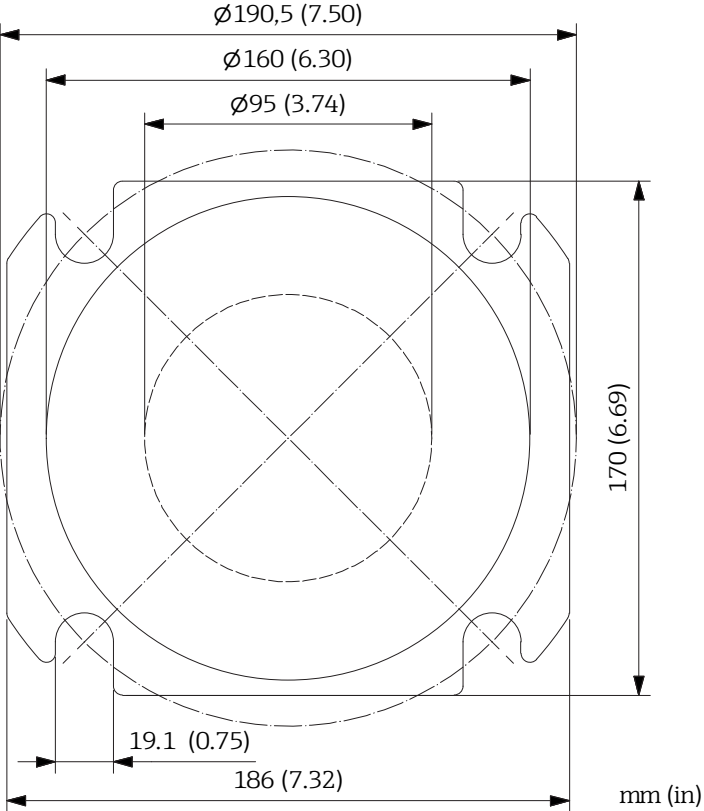
16.1   Device-specific accessories

Accessories	Description
Protective hood	A protective hood is available for mounting the measuring device outdoors: • Order No.: 52027964 • Material: stainless steel 304 • Weight: 7.5 kg • The delivery includes suitable mounting screws. mm (in) **NOTICE** You will need a free height of at least 400 mm above the measuring device for installing and/or dismantling the protective hood. ℹ The protective hood is simply fitted over the device once the device is installed and fastened on the device with four screws.

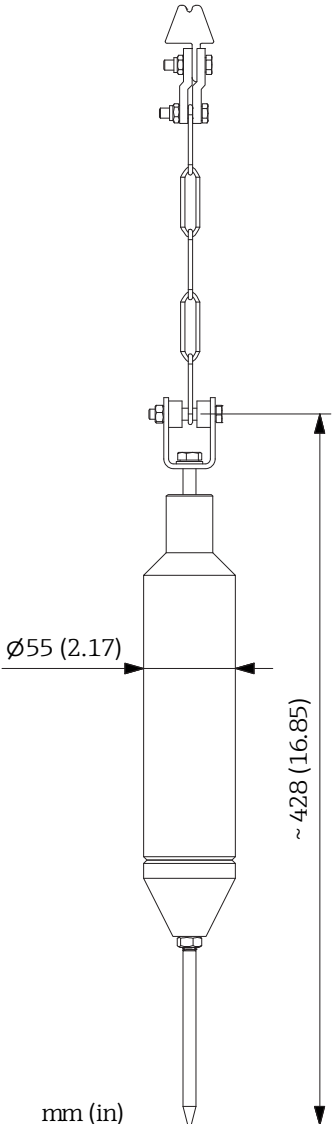| Accessories	Description
Process adapter extension	If process temperatures are between +150 ℃ (+302 ℉) and +230 ℃ (+446 ℉), the following process adapter extensions can be used to reduce the temperature when using the 1000 mm wiper extension (for installation and dimensions → 🖾21): • Order No.: 52028083 • Material: Stainless steel 316Ti • Weight: 16 kg • The delivery contains four suitable screws with nuts to secure the measuring device to the process adapter extension. 790 (31.10) mm (in)

Accessories	Description
Adapter flange	The following adapter flanges can be used to adapt to existing process connections: • Order No.: 71301820 DN150, PN16, EN1092-1, stainless steel 316Ti 71301821 DN150, PN16, EN1092-1, steel 71301822 DN200, PN16, EN1092-1, stainless steel 316Ti 71301824 DN200, PN16, EN1092-1, steel 71301811 6", 150lbs, ASME B16.5, stainless steel 316Ti 71301815 6", 150lbs, ASME B16.5, steel 71301816 8", 150lbs, ASME B16.5, stainless steel 316Ti 71301817 8", 150lbs, ASME B16.5, steel • Dimensions (mm/in) and weights:

	A	B	C	D	Weight
71301820	8x	M16	22/0.87	285/11.22	9 kg
71301821	22/0.87				
71301822	12x	M16	24/0.94	340/13.4	15 kg
71301824	22/0.87				
71301811	8x	UNC 5/8"	25.4/1	279.4/11	10 kg
71301815	22.4/0.88				
71301816	8x	UNC 5/8"	28.6/1.13	342.9/13.5	18 kg
71301817	22.4/0.88				

• The delivery contains four suitable nuts to secure the measuring device to the adapter flange.

Example: ASME B16.5 6" 150lbs

mm (in)

ℹ The adapter flange is mounted between the process connection of the device and the application. As the flange is not very high, the clearance needed for the device is only marginally increased.
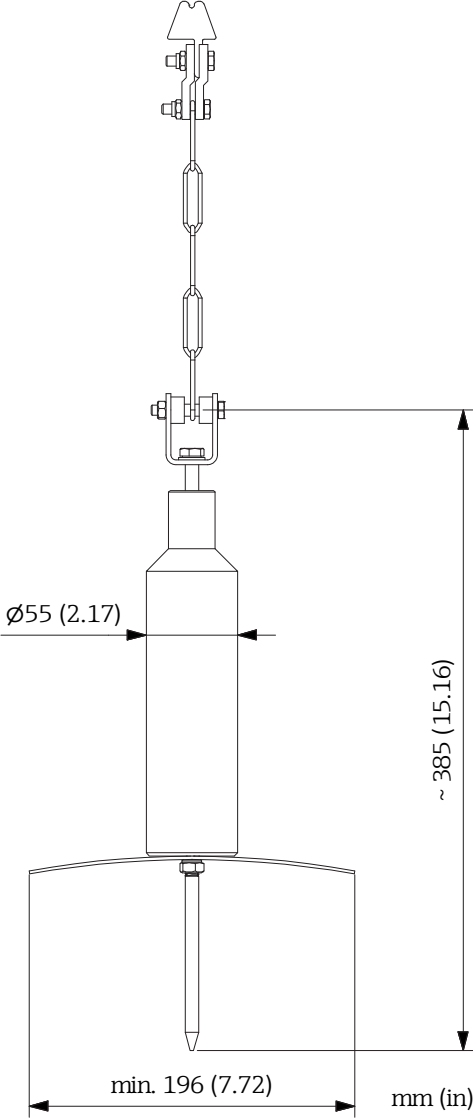
Accessories	Description
Adapter flange with studs for higher pressure ratings	The following adapter flanges can be used to adapt to existing process connections: • Order No.: 71301826 DN100, PN25/40, EN1092-1, stainless steel 316Ti 71301829 DN100, PN25/40, EN1092-1, steel 71301831 4", 300lbs, ASME B16.5, stainless steel 316Ti 71301833 4", 300lbs, ASME B16.5, steel 71301834 4", 600lbs, ASME B16.5, stainless steel 316Ti 71301835 4", 600lbs, ASME B16.5, steel • Dimensions (mm/in) and weights:

	A	B	C	D	Weight
71301826	8x M22	M16	25/0.98	235/9.25	7 kg
71301829					
71301831	8x UNC 3/4"	UNC 5/8"	31.8/1.25	254/10	11 kg
71301833					
71301834	8x UNC 3/4"	UNC 5/8"	38.1/1.5	273.1/10.75	16 kg
71301835					

• The delivery contains four suitable screws to secure the measuring device to the adapter flange.

Example: DN100 PN25/40

mm (in)

ℹ The adapter flange is mounted between the process connection of the measuring device and the application.
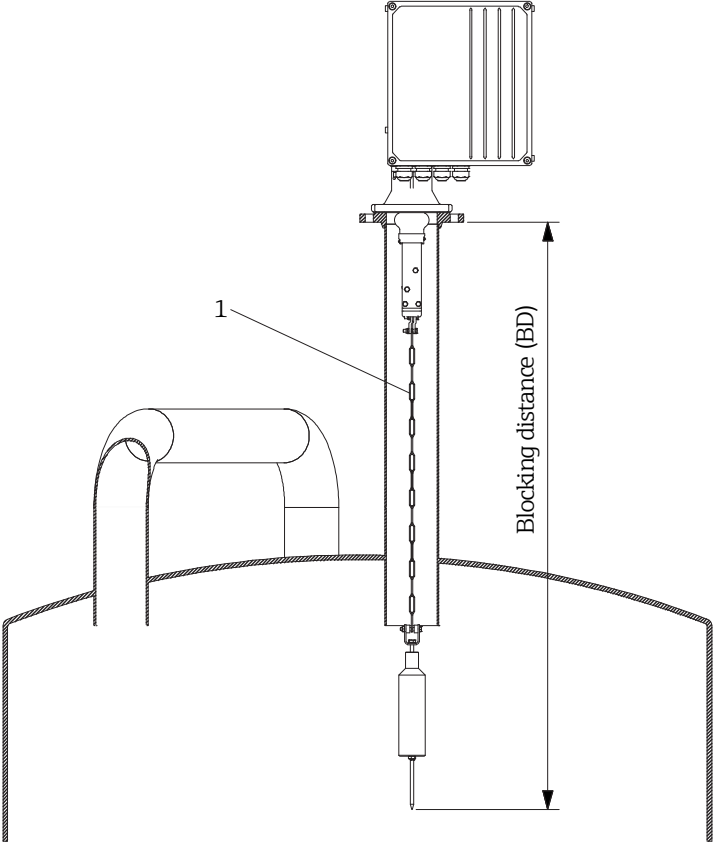
Accessories	Description
Process adapters for smaller nominal diameters	The following process adapters can be used to adapt to existing process connections with smaller nominal diameters (< DN100):

- Order No.:

71301837	DN50, PN16, EN1092-1, stainless steel 316Ti
71301839	DN50, PN16, EN1092-1, steel
71301841	DN65, PN16, EN1092-1, stainless steel 316Ti
71301843	DN65, PN16, EN1092-1, steel
71301844	DN80, PN16, EN1092-1, stainless steel 316Ti
71301857	DN80, PN16, EN1092-1, steel
71301858	2", 150lbs, ASME B16.5, stainless steel 316Ti
71301859	2", 150lbs, ASME B16.5, steel
71301861	3", 150lbs, ASME B16.5, stainless steel 316Ti
71301864	3", 150lbs, ASME B16.5, steel
71301867	4", 150lbs, ASME B16.5, stainless steel 316Ti
71301868	4", 150lbs, ASME B16.5, steel

- Dimensions (mm/in) and weights:

	A	B	C	D	E	Weight
71301837	400/	54.5/	125/	165/	18/	10.5 kg
71301839	15.75	2.15	4.92	6.50	0.71	
71301841	400/	70.3/	145/	185/	18/	11 kg
71301843	15.75	2.77	5.71	7.28	0.71	
71301844	200/	82.5/	160/	200/	20/	10 kg
71301857	7.87	3.25	6.30	7.87	0.79	
71301858	420/	52.6/	120.7/	152.4/	19.1/	11 kg
71301859	16.54	2.07	4.75	6.00	0.75	
71301861	220/	78/	152.4/	190.5/	23.9/	11.5 kg
71301864	8.66	3.07	6.00	7.50	0.94	
71301867	128/	102.4/	190.5/	228.6/	23.9/	12.5 kg
71301868	5.04	4.03	7.50	9.00	0.94	

- The delivery contains four suitable screws with nuts to secure the measuring device to the process adapter.

Example:
DN80 PN16

mm (in)

To prevent incorrect measurements if the sensing weights swings, the lower edge of the wiper should project out of the reduced area (diameter B).

Accessories	Description

Process adapter as replacement for the standard adapter	The standard process adapter can be replaced by one of the following adapters to adapt to existing process connections:
	• Order No.:
	   71301870 150lbs, RF 4", ASME, aluminum
	   71301872 150lbs, RF 4", ASME, aluminum coated
	
	ℹ The standard process adapter can be easily replaced by releasing four screws.
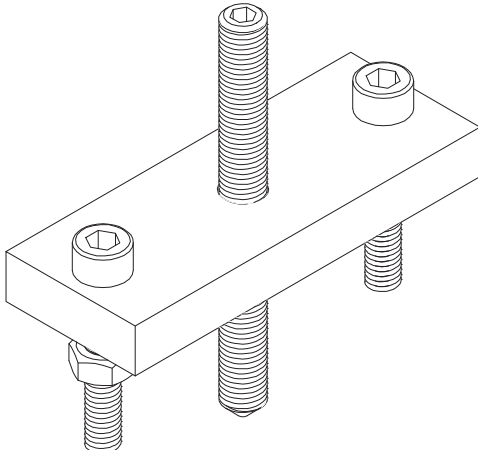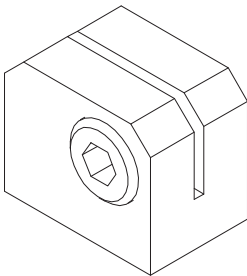
Accessories	Description
Process adapter with spray water cleaning	The following process adapter can be used with spray water cleaning to prevent any damage from chemical substances that can enter the measuring device via the measuring tape: • Order No.: 71301886 • Material: stainless steel 316Ti • Weight: 15 kg • The delivery includes suitable mounting screws. Ø220 (8.66) ~310 (12.20) G ¼ DN100 PN16 (EN 1092-1) mm (in) ℹ️ • The process adapter is mounted between the process connection of the measuring device and the application. • Filtered water should only be used for spray water cleaning as otherwise the nozzles could clog. • The amount of water needed is between 1 l/min (1 bar) and 3 l/min (6 bar).

Accessories	Description
Sensing weight for interface measurement in liquids with a significant difference in density	One of the following sensing weights can be used for interface measurement in liquids with a significant difference in density: • Order No.: 71301873 stainless steel 316Ti 71301875 stainless steel 316Ti, coated • Weight: 4 kg ⌀55 (2.17) ~ 428 (16.85) mm (in) ℹ️ The sensing weight can be easily replaced by releasing a screw (→ 🖼️ 26).

Accessories	Description

Sensing weight for interface measurement in liquids with a minor difference in density	One of the following sensing weights can be used for interface measurement in liquids with a minor difference in density:
	• Order No.:
	  71301876 stainless steel 316Ti
	  71301877 stainless steel 316Ti, coated
	• Weight: 4 kg
	
	Ø55 (2.17) ~ 385 (15.16) min. 196 (7.72) mm (in)
	
	ℹ️ The sensing weight can be easily replaced by releasing a screw (→ 🖼26).

Accessories	Description
Chain to increase the block distance	The following chain can increase the block distance by a maximum distance of 2 m in the event of longer connections which the sensing weight should not enter into: • Order No.: 71301880 • Material: stainless steel 316 • Length: 2 m • Weight: 0.3 kg • The chain can be shortened as required. 1 Blocking distance (BD) ℹ️ If the sensing weights sway significantly, we recommend the use of the extended wiper (→ 🖼21).

16.2   Device-specific tool

Accessories	Description
Removal tool	A removal tool is available for changing the tape and the gearbox motor: • Order No.: 71001353 • Material: steel An Allen key (5 mm AF) is also needed for the removal tool.
Tape stopper	A tape stopper is available to replace the gearbox motor in the application: • Order No.: 71001352 • Material: brass and steel An Allen key (6 mm AF) is also needed for the tape stopper.

17   Technical data

17.1   Application

The measuring device is designed for the level measurement of solids and liquids only. Interface measurement in liquids is also possible using appropriate sensing weights. Depending on the device version ordered, the measuring device can also be used in hazardous areas.

To ensure that the device remains in proper operating condition for its service life, use the measuring device only for media against which the process-wetted materials are adequately resistant.

17.2   Function and system design

Measuring principle	Electromechanical level system
Measuring system	Compact device with lowered sensing weight

17.3   Input

Measured variable

Direct measured variable
- Level (in selectable units)

Calculated measured variable
- Volume (in selectable units; if the linearization function is used also for a non-linear relationship between the level and volume)

Measuring range

The maximum measurement range is calculated from the type code:
- Silopilot FMM50 - ***6*: 15 m
- Silopilot FMM50 - ***1*: 25 m
- Silopilot FMM50 - ***2*: 35 m
- Silopilot FMM50 - ***3*: 50 m
- Silopilot FMM50 - ***4*: 70 m
- Silopilot FMM50 - ***5*: 90 m

Block distance

The block distance depends on the wiper used and on the sensing weight:

Sensing weight	Wiper 230 mm	Wiper 500 mm	Wiper 1000 mm
B, C, D, E, L	0.80 m	1.10 m	1.60 m
G	1.20 m	1.50 m	2.00 m
J	0.86 m	1.16 m	1.66 m
M	0.65 m	0.95 m	1.45 m
N	0.63 m	0.93 m	1.43 m

Input signal

- 2 signal inputs (start measurement, lock)
  - Active: 12...24 VDC
  - Passive: switching contact, max. 30 VDC / 300 mW
  - Start pulse length: min. 200 ms

17.4 Output

Output signal	• 0 - 20 mA / 4 - 20 mA current output
	  - Active
	  - Max. load: 600 Ω
	• Relay outputs (2 or 6)
	  - Contact load: 250 VAC, 6 A

Signal on alarm	• Error symbol, error code and description in plain text on the on-site display
	• Current output, can be configured:
	  - MIN (0/3.6 mA)
	  - MAX (22 mA)
	  - Last value is retained
	  - Selectable value (0…22 mA) is output
	• Relay outputs (alarm function)

17.5 Performance characteristics

Measured error	• ± 5 cm (independent of measurement range selected)

17.6 Minimum time for one measurement cycle

Minimum time T_M for one measurement cycle
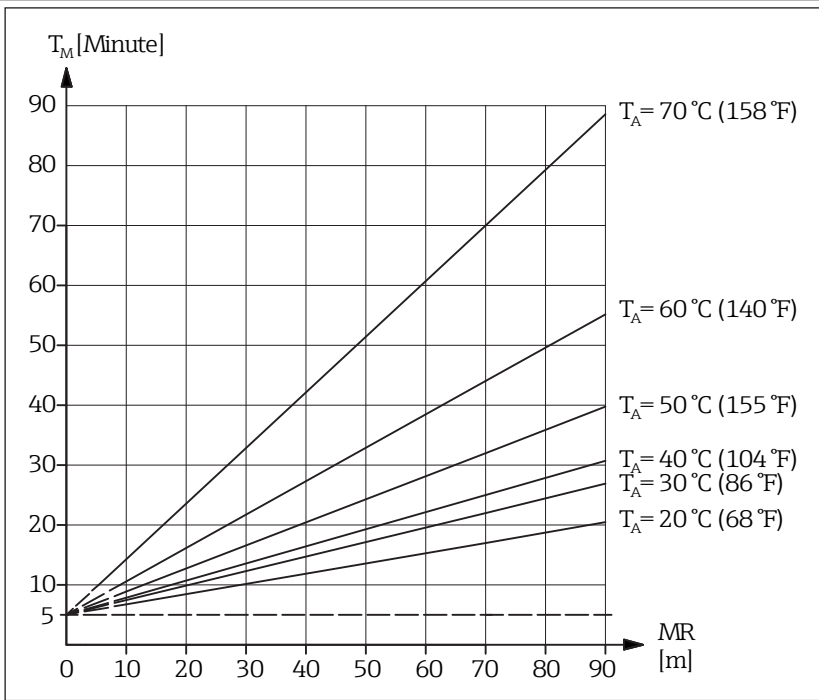
17.7 Running speed

Tape running speed	• Min. 0.21 m/s • Max. 0.35 m/s

17.8 Power supply

Terminal assignment	→ 🗏27

Supply voltage	• Silopilot FMM50 - *****1*: 180 - 253 VAC, 50/60 Hz • Silopilot FMM50 - *****2*: 90 - 127 VAC, 50/60 Hz **NOTICE** An easily accessible power switch must be installed in the proximity of the device if the device is connected to the public power supply system. The power switch must be labeled as a circuit breaker for the device (EN/IEC 61010).
Power consumption	• 230 VA (without device heating) • 250 VA (with integrated device heating)

Cable entry	• M25 x 1.5
	• Cable gland non-hazardous area:
	  - Material: plastic
	  - Color: gray
	  - Clamping area: 9...17 mm
	• Cable gland ATEX:
	  - Material: plastic
	  - Color: black
	  - Clamping area: 9...13 mm
	• Quantity:
	  - 4 units (when not additionally equipped with external start button)
	  - 3 units (when additionally equipped with external start button)

17.9   Environmental conditions

Ambient temperature range	• Silopilot FMM50 - *******A*/*******C*: -20...+70 °C (-4...+158 °F) • Silopilot FMM50 - *******B*/*******D*: -40...+70 °C (-40...+158 °F) **NOTICE** If operating outdoors in strong sunlight, the device should be fitted with the protective hood, which is available as an accessory (→ 🖹88).
Storage temperature	-40...+80 °C (-40...+176 °F)
Degree of protection	• With closed housing: IP 67 • With closed housing and with the use of the external start button: IP 65 • With open housing: IP 20
Electromagnetic compatibility (EMC)	• Interference emission in accordance with EN 61326, class B operating equipment • Interference immunity in accordance with EN 61326, Appendix A (industrial environment) • A normal installation cable is sufficient for the wiring.

17.10 Process conditions

Process temperature	• Silopilot FMM50 - ********1***: -20...+70 °C (-4...+158 °F) (Restriction for Silopilot FMM50 - ********1*M*: 0...+60 °C (+32...+140 °F)) • Silopilot FMM50 - ********2***: -20...+150 °C (-4...+302 °F) • Silopilot FMM50 - ********3***: -20...+230 °C (-4...+446 °F)
Process pressure	• Silopilot FMM50 - *********1**: 0.8...1.1 bar absolute • Silopilot FMM50 - *********2**: 0.8...3.0 bar absolute

18   Appendix

18.1   User parameters

Basic setup

Function	Default	User setting
001 Empty calibration	Length of meas. tape	
002 Block distance	→ 🕮 41	
003 Full calibration	001 – 002	

Inputs / outputs

Function	Default	User setting
010 Input 1	Not used	
011 Polarity input 1	NO contact	
012 Input 2	Not used	
013 Polarity input 2	NO contact	
014 Relay 1	Alarm	
015 Pulse weight	1	
016 Pulse length	50 ms	
017 Limit value	60 %	
018 Hysteresis	3 %	
019 Reset pulse	300 ms	
01A Relay 2	Service interval	
01B Relay 3	Measuring	
01C Relay 4	Limit value	
01D Relay 5	Reset pulse	
01E Relay 6	Band return	

Measurement parameter

Function	Default	User setting
020 Measurement type	Single cycle	
021 Time interval	1	
022 Time unit	h (hour)	
023 Normal or short	Normal	
024 Service interval	45000	
028 Run-up length	1 m	

Current output

Function	Default	User setting
030 Current mode	Normal	
031 0/4mA value	0	
032 20mA value	(full calibration)	
033 Current range	4-20mA	

Safety settings

Function	Default	User setting
040 Current on alarm	MIN(<=3.6mA)	
041 Current on alarm	3.6 mA	
042 Safety distance	0 m	
043 Security distance	0 m	
044 In security distance	Warning	
045 In safety distance	Alarm	

Linearization

Function	Default	User setting
050 Level/volume	Level CU	
051 Linearization	Linear	
056 Customer unit	%	
057 Maximum scale	100%	

Linearization table

Tab.no.	Level	Volume	Tab.no.	Level	Volume
1			17		
2			18		
3			19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		
16			32		

Display

Function	Default	User setting
060 Language	English	
061 Back to home	100 s	
062 Number of decimals	X.XX	

Diagnostics

Function	Default	User setting
074 Unlock parameter	100	

System parameters

Function	Default	User setting
080 Tag number	----------------	
083 Distance unit	m	

18.2   Declaration of Contamination

Endress+Hauser

People for Process Automation

Declaration of Hazardous Material and De–Contamination
Erklärung zur Kontamination und Reinigung

RA No. ☐☐☐☐☐☐☐☐

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.
Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De–Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.
Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor   **Serial number**
Geräte-/Sensortyp _____   *Seriennummer* _____

☐ **Used as SIL device in a Safety Instrumented System /** *Einsatz als SIL Gerät in Schutzeinrichtungen*

Process data/*Prozessdaten*   Temperature / *Temperatur* _____ [°F] _____ [°C]   Pressure / *Druck* _____ [psi] _____ [Pa]
                                    Conductivity / *Leitfähigkeit* _____[µS/cm]   Viscosity / *Viskosität* _____ [cp] _____ [mm²/s]

Medium and warnings
Warnhinweise zum Medium

	Medium /concentration *Medium /Konzentration*	Identification CAS No.	flammable *entzündlich*	toxic *giftig*	corrosive *ätzend*	harmful/ irritant *gesundheits- schädlich/ reizend*	other * *sonstiges* *	harmless *unbedenklich*
Process medium *Medium im Prozess*								
Medium for process cleaning *Medium zur Prozessreinigung*								
Returned part cleaned with *Medium zur Endreinigung*								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / *Fehlerbeschreibung* _____
_____
_____

Company data / *Angaben zum Absender*

Company / *Firma* _____   Phone number of contact person / *Telefon-Nr. Ansprechpartner:*
_____   _____

Address / *Adresse*   Fax / E-Mail _____
_____
_____   Your order No. / *Ihre Auftragsnr.* _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."
"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."
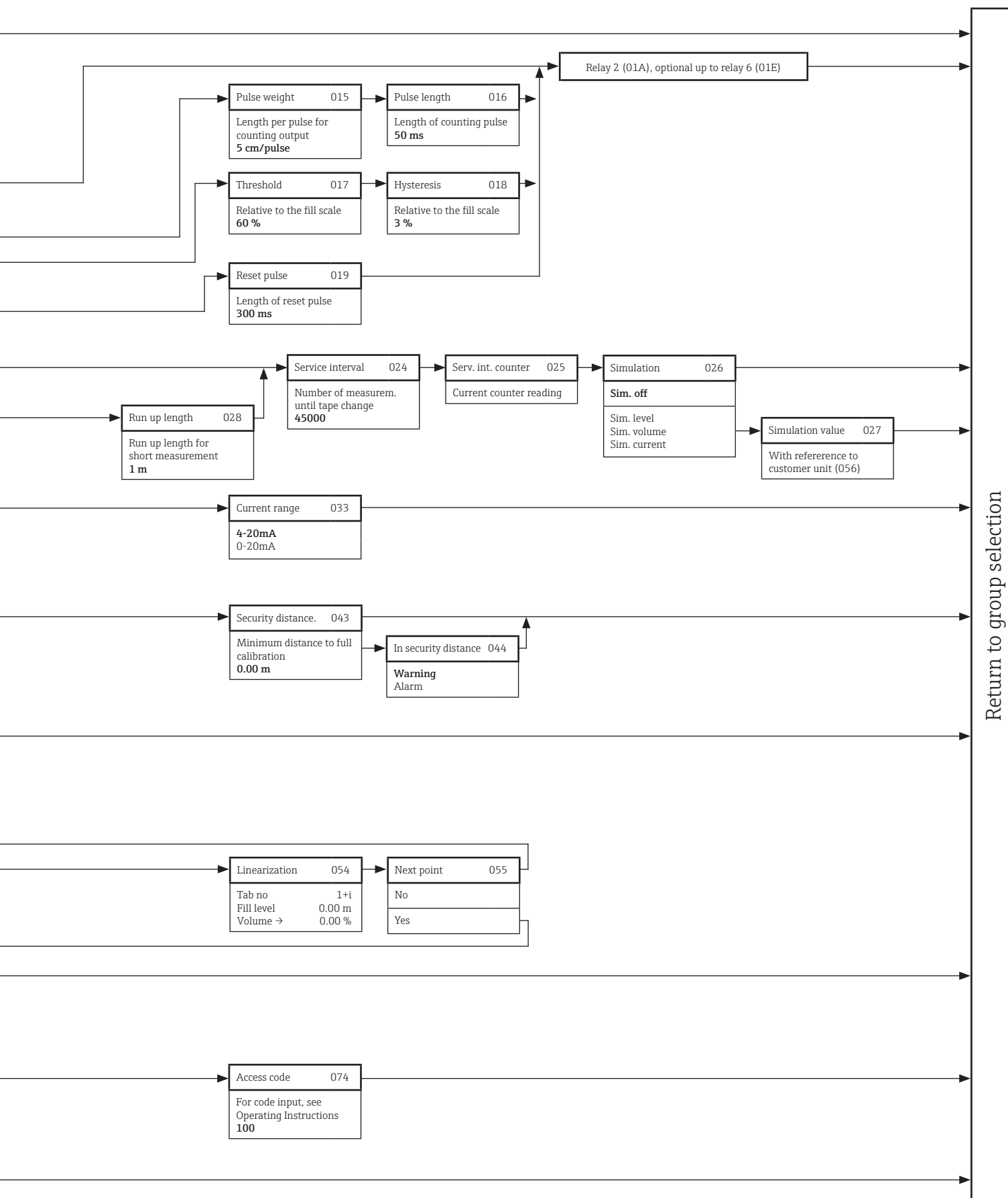
P/SF/Konta XV

_____   _____   _____
(place, date / *Ort, Datum*)   Name, dept./*Abt.* (please print / *bitte Druckschrift*)   Signature / *Unterschrift*

18.3   User menu

Basic setup 00	→	Empty calibration 001	→	Blocking distance 002	→	Full calibration 003	→	Measurement type 020	→	Dist./meas.value 004
		Distance between device flange and min. filling		Distance between device flange and bottom weight		Measuring range		**Single cycle** Manual Periodical		Display of distance between device flange and product surface + measured value

Inputs and outputs 01	→	Input 1 010		Input 2 012		Relay 1 014
		Not used		**Not used**		Service intervall Band return Running up Top position Measuring
		Start measurement Bolting		Start measurement Bolting		Counter pulses
						Threshold
		Polarity input 1 011		Polarity input 2 013		**Alarm**
		NC contact **NO contact**		NC contact **NO contact**		Reset pulse

Measurem. param. 02	→	Measuring type 020		Normal or short 023
		Single cycle Manual		**Normal**
				Short
		Periodical		
		Time intervall 021	→	Time unit 022
		1 h		**h** Min.

Current output 03	→	Current mode 030		0/4 mA value 031	→	20 mA value 032
		Normal		With reference to customer unit (056)		With reference to customer unit (056)
		Magnify				

Safety settings 04	→	Output on alarm 040		Safety distance 042		In safety distance 045
		MIN (0/3.6mA) MAX (22mA) Hold		Minimum distance to empty calibration **0.00 m**		**Alarm** Warning
		User specific				
		Output on alarm 041				
		3.60 mA				

Linearization 05	→	Level/volume 050		Linearization 051		Customer unit 056	→	Max. scale 057
		Level m/ft/in Ullage m/ft/in		Table on		**%**, kg, t, m³, ft³, m, ft, in **%**		bezogen auf Kunden-einheit **100.00 %**
		Level CU Ullage CU		**Linear** Clear table				
				Manually		Linearization 052		Linearization 053
						TabNr→ 1+i Level 0.00 m Volume 0.00 %		TabNr 1+i Level→ 0.00 m Volume 0.00 %

Display 06	→	Language 060	→	Back to home 061	→	No. of decimals 062	→	Format display 063
		English Deutsch Français **ニホンゴ**		Time until automatic return to function 000 **100 s**		X X.X **X.XX** X.XXX		**Off** On

Diagnostics 07	→	Present error 070	→	Previous error 071	→	Clear errors 072	→	Reset 073
		Display present error		Display previous error		**Keep** Erase last Erase current Erase all		For code input refer Operating Instructions **0**

System parameters 08	→	Tag number 080	→	Protocol+SW-No. 081	→	Serial number 082	→	Distance unit 083
		--------------------------		Display of current version		Serial no. of the device		**m** ft in

Relay 2 (01A), optional up to relay 6 (01E)

Pulse weight	015
Length per pulse for counting output **5 cm/pulse**	

Pulse length	016
Length of counting pulse **50 ms**	

Threshold	017
Relative to the fill scale **60 %**	

Hysteresis	018
Relative to the fill scale **3 %**	

Reset pulse	019
Length of reset pulse **300 ms**	

Service interval	024
Number of measurem. until tape change **45000**	

Serv. int. counter	025
Current counter reading	

Simulation	026
Sim. off	
Sim. level Sim. volume Sim. current	

Simulation value	027
With refererence to customer unit (056)	

Run up length	028
Run up length for short measurement **1 m**	

Current range	033
4-20mA 0-20mA	

Security distance.	043
Minimum distance to full calibration **0.00 m**	

In security distance	044
Warning Alarm	

Linearization	054
Tab no　　　　　　1+i Fill level　　　0.00 m Volume →　　　0.00 %	

Next point	055
No	
Yes	

Access code	074
For code input, see Operating Instructions **100**	

Return to group selection

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Endress+Hauser [EH]

People for Process Automation

中国E+H技术销售服务中心 www.ainstru.com
电话：18923830905
邮箱：sales@ainstru.com