Operating Instructions
Silopilot FMM50
Electromechanical level system
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1 About this document

1.1 Symbols

1.1.1 Safety symbols

⚠️ DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠️ WARNING
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

⚠️ CAUTION
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol contains information on procedures and other facts which do not result in personal injury.

1.1.2 Electrical symbols

⚡ Protective Earth (PE)
A terminal which must be connected to ground prior to establishing any other connections.

1.1.3 Symbols for certain types of information

✔️ Permitted
Procedures, processes or actions that are permitted.

✖️ Forbidden
Procedures, processes or actions that are forbidden.

💡 Tip
Indicates additional information

📖 Reference to documentation

➡️ Reference to another section

🔍 Reference to graphic

₁, ₂, ₃ Series of steps

1.1.4 Symbols in graphics

A, B, C ... View
1, 2, 3 ... Item numbers

⚠️ Hazardous area

✔️ Safe area (non-hazardous area)
2 Basic safety instructions

2.1 Requirements for the personnel

The personnel must fulfill the following requirements to carry out the necessary tasks, e. g., commissioning and maintenance:

‣ Trained, qualified specialists must have a relevant qualification for the specific function and task
‣ Are authorized by the plant owner/operator
‣ Are familiar with federal/national regulations
‣ Must have read and understood the instructions in the manual and supplementary documentation
‣ Follow instructions and comply with conditions

2.2 Designated use

Only use the meter for level measurement in bunkers or silos with dusty, fine-grain or coarse-grain bulk solids or in tanks containing liquids. Improper use can pose hazards. Ensure that the measuring device is free of defects while it is in operation.

‣ Use the device only in media to which the process-wetted materials are adequately resistant.
‣ Do not exceed or drop below the limit values for the measuring device ⬣ TI00395F

2.2.1 Incorrect use

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 necessary, ensure protection against contact to prevent burns.

2.3 Workplace safety

For work on and with the device:
‣ Wear the required protective equipment according to federal/national regulations.

2.4 Operational safety

Risk of injury!
‣ Operate the device in proper technical condition and fail-safe condition only.
‣ The operator is responsible for interference-free operation of the device.

2.4.1 Conversions 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.
2.4.2  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.

2.4.3  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.

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

Electromechanical level meter for level measurement in bunkers or silos with dusty, fine-grain or coarse-grain bulk solids or in tanks containing liquids

3.1 Product design

3.1.1 Complete device

![Diagram of the FMM50 product](image)

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

1. Counting wheel
2. Tape guide
3. Tape spool with measuring tape
4. Connecting potential matching
5. Purge air connection

3.1.3  Electronics side

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

3.1.5 Sensing weight

Observe minimum process connection diameter of 95 mm (3.74 in) for installation of wiper mechanism and sensing weights B to D (see order code).
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 it hits the medium, the freely oscillating motor tilts from its working position, in which it is held by the weight 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)

![Diagram of measuring principle](image-url)
4Incoming acceptance and product identification

4.1 Incoming acceptance

Check the following during goods acceptance:

- Are the order codes on the delivery note and the product sticker identical?
- Are the goods undamaged?
- Do the nameplate data match the ordering information on the delivery note?
- If required (see nameplate): Are the Safety Instructions, e.g. XA, provided?
- Is the device properly secured?

If one of these conditions is not met, please contact the manufacturer’s sales office.

4.2 Product identification

The measuring device can be identified in the following ways:

- Nameplate data
- Extended order code with breakdown of the device features on the delivery note
- Enter serial number from nameplates in W@M Device Viewer (www.endress.com/deviceviewer): All of the information on the measuring device is displayed along with an overview of the scope of technical documentation provided
- Enter the serial number on the nameplate into the Endress+Hauser Operations App or use the Endress+Hauser Operations App to scan the 2-D matrix code (QR Code) on the nameplate

4.2.1 Nameplate

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<td>Ser.-No.:</td>
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7 Nameplate data
1 Manufacturer address
2 Order number, external order code, serial number
3 Technical data
4 Approval-specific information
4.2.2  Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany

4.3  Storage and transport

4.3.1  Storage conditions

Use original packaging.

Storage temperature
→ 84

4.3.2  Transporting the device

Transport the device to the measuring point in the original packaging.

Do not remove the transportation lock until after mounting.

5  Mounting

5.1  Mounting conditions

5.1.1  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. Do not run the measuring path too close to fixtures and struts so that the measuring tape does not brush against them when the sensing weight swings around.

Select the length of the wiper so that the sensing weight can move freely during downward or upward running and does not, for example, come into contact with the edges of a connection pipe. The sensing weight should be located in the middle between the container wall and filling curtain when it is run up and down.

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.

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.
5.1.2 **Ambient and process requirements**

Observe the maximum process temperature of +70 °C (+158 °F) at the measuring device (from the lower edge of the process adapter) during installation.

![Diagram of ambient and process requirements](image)

In case of higher process temperatures in the area of the installation site, create a suitable structural measure for compliance with this temperature condition.

Use an extension of the process connection nozzle to keep the meter away from high process temperatures. The length of the connection nozzle is based on the specific process and ambient conditions.

When mounting outdoors, use weather protection cover or attach weather protection roof.
The following minimum lengths of the process connection nozzle are recommended:
- Minimum 500 mm for process temperatures up to +150 °C (+302 °F)
- Minimum 1000 mm for process temperatures up to +230 °C (+446 °F)
- Process adapter extensions that are 790 mm long and designed for use with the 1000 mm wipers are available as accessories.
- When using process nozzles with longer lengths than 230 mm (length of the standard wiper), longer wipers can be ordered as a device option (see ordering options). Alternatively, the chain between the tape border and the sensing weight can be extended accordingly; corresponding material is available as an accessory.
- A suitable weather protection cover for the measuring device is available as an accessory.
- Accessories → 73

5.2 Mounting the device

5.2.1 Required tool
- To open the device: Allen key 5 mm
- For the process connection: Appropriate installation tool
- For the sensing weight: Open-end wrench 10 mm
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.

5.2.2 Preparing the measuring device

1. Remove all remaining transport packaging.

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

2. Mount the wiper.

![Diagram](image_url)

1 Hexagonal-head bolt M6
2 Hexagonal nut
3 Wiper extension
3. Remove the transportation lock on the electronics side (to the right of the motor/gear-box combination).

![Diagram](image1)

**Fig. 13 Removing the transportation lock**

1. Transportation lock

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 create structural support measures and lower the tape border an appropriate distance before mounting.

![Diagram](image2)

**Fig. 14 Mounting large sensing weights**

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

   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. → 14
   • Do not crease the measuring tape when inserting it, this will result in a reduced service life.

2. Fix the measuring device with four suitable screws.

When the unit is used in bunkers or silos with heavy dust generation, a slight over-pressure can be created by connecting a pressure line to the mounting flange (air volume as required), so that the spool compartment can be kept clean. A G¼ female connection is provided for this purpose. → 9

3. Mounting the sensing weight.

   The sensing weight must be outside the connection when the measuring tape is wound up.
   • The maximum height of the process connection nozzle is dictated by the length of the wiper. This height is 230 mm if a standard wiper is used.
   • The wiper is also available in lengths of 500 mm and 1000 mm (see ordering options, other lengths as special version on request).

---

1. Measuring tape
2. Tape border
3. Hexagonal-head bolt M6
4. Chain
5. Clamping bracket
6. Hexagonal nut
5.3 Post-installation check

- Is the device undamaged (visual inspection)?
- Does the device conform to the measuring point specifications?
For example:
  - Process temperature
  - Process pressure
  - Ambient temperature
- Are the measuring point number and labeling correct (visual inspection)?
- Is the device adequately protected against precipitation and direct sunlight?
- Is the device properly secured?

6 Electrical connection

For a device for the hazardous area:
Observe the instructions in the Ex documentation (XA).

6.1 Connection requirements

6.1.1 Required tool

- To open the device: Allen key 5 mm
  - 5 mm
- For the sensing weight: Open-end wrench 30 mm
  - 30 mm
- For the terminals: Slotted screwdriver 0.6x3.5mm
  - 0.6x3.5mm
- For potential equalization: Slotted screwdriver 1.0x6.5mm
  - 1.0x6.5mm

6.1.2 Connecting cable requirements

The connecting cables provided by the customer must meet the following requirements:
- Permissible temperature range → ≥84
- Protection → ≥84
- Normal installation cable sufficient
- Ø 10 to 17 mm (0.39 to 0.67 in)

**NOTICE**
- 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. Appropriate strain relief must be ensured by the operator.
- Mount the cable gland so that it is protected against mechanical damage (*low* degree of mechanical risk – impact energy: 4 Joule).

6.2 Preparing the measuring device

Remove the dummy plug if present.

**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: Observe the cable specifications
6.3 Connecting the device

6.3.1 Connect potential equalization

The potential equalization for the device must be integrated into the existing potential equalization on site.

Requirements:
- The potential equalization must be connected to the external ground terminal on the device. → 9
- For optimum electromagnetic compatibility, keep the potential equalization line as short as possible.
- The recommended cable cross-section is 2.5 mm$^2$.
- The potential equalization of the FMM50 must be included in the local potential equalization.

6.3.2 Connecting the device

Terminal assignment

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 device.

6.3.3 Supply voltage

- Terminal assignment: 1.1 (L1) / 1.2 (N) / 1.3 (PE)
- Voltage range → 83
- $I_{eff} = 8 \, A \, (115 \, V) \, \text{for} \, 40 \, \text{ms} / 4.4 \, A \, (230 \, V) \, \text{for} \, 20 \, \text{ms}$
- In accordance with IEC/EN61010 a suitable circuit breaker must be provided for the measuring device.
- Overcurrent protection device: maximum 16 A
6.3.4 Signal input

- Contact load → 82

<table>
<thead>
<tr>
<th>Order code</th>
<th>Terminal assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without</td>
<td>Input 1 (active)</td>
</tr>
<tr>
<td></td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>3.2</td>
</tr>
<tr>
<td>Input 1 (passive)</td>
<td>Input 2 (passive)</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>3.6</td>
</tr>
</tbody>
</table>

- 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.

6.3.5 Current output

- Terminal assignment: 3.9 (+) / 3.10 (−)
- Current output: 0 - 20 mA or 4 - 20 mA
- active
- Load → 82

6.3.6 Relay output

- Contact load → 82

<table>
<thead>
<tr>
<th>Order code</th>
<th>Terminal assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output option A, B</td>
<td>Relay 1</td>
</tr>
<tr>
<td></td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>2.3</td>
</tr>
<tr>
<td>Output option B</td>
<td>Relay 3</td>
</tr>
<tr>
<td></td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>2.9</td>
</tr>
</tbody>
</table>

6.4 Ensuring the degree of protection

1. Check that the housing seals are clean and fitted correctly. Dry, clean or replace the seals if necessary.
2. Tighten all housing screws.
3. Firmly tighten the cable glands.
4. Unused cable entries must be sealed with suitable blanking plugs.
6.5 Post-connection check

☐ Is the device or cable undamaged (visual inspection)?
☐ Do the cables used comply with the requirements?
☐ Do the mounted cables have adequate strain relief?
☐ Are the cable glands mounted and firmly tightened?
☐ Does the supply voltage match the specifications on the nameplate?
☐ No reverse polarity, is terminal assignment correct?
☐ If supply voltage is supplied: does information appear on the display
☐ Are all the housing covers installed and tightened?

7 Operation options

1 Operating keys for configuration
2 Button to start a measurement manually
3 External button to start a measurement manually
7.1 Structure and function of the operating menu

Overview operating menu and parameters → 85

<table>
<thead>
<tr>
<th>00</th>
<th>Basic setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Empty calibration</td>
</tr>
<tr>
<td>002</td>
<td>Block distance</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>01</th>
<th>Inputs and outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>010</td>
<td>Input 1</td>
</tr>
<tr>
<td>011</td>
<td>Polarity input 1</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>02</th>
<th>Measurement parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>020</td>
<td>Measurement type</td>
</tr>
<tr>
<td>021</td>
<td>Time interval</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

18 Schematic structure of the operating menu

7.2 Access to the operating menu via the local display

7.2.1 Operational display

19 Operational display

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

<table>
<thead>
<tr>
<th>Key</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Switch to group selection 00, 01, ...</td>
</tr>
<tr>
<td>+ / -</td>
<td>Not used</td>
</tr>
</tbody>
</table>

- 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, function 060 "language" and function 083 "distance unit" appear once only. Afterwards, the measured value display appears.

- The default values are always shown in bold in the following chapters, unless they are explicitly mentioned.

Display symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔒</td>
<td>This lock symbol is displayed when the measuring device is locked and no entries can be made.</td>
</tr>
<tr>
<td>⚠️</td>
<td>This alarm symbol is shown when the device is in an alarm condition (error condition). A flashing symbol indicates that a fault has occurred.</td>
</tr>
<tr>
<td>🔃</td>
<td>This symbol flashes when the device is in the &quot;manual&quot; measurement mode. When the button is pressed, the symbol disappears and the direction selected (run up ↑ run down ↓) is shown.</td>
</tr>
</tbody>
</table>

7.2.2 Navigation view

![Navigation view diagram]

The active selection of the function group (here "basic setup") is indicated by a check mark in front of the menu text.

Operating options

<table>
<thead>
<tr>
<th>Key</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Moves the active function group down</td>
</tr>
<tr>
<td>+</td>
<td>Moves the active function group up</td>
</tr>
<tr>
<td>E</td>
<td>Switches to the active function group</td>
</tr>
</tbody>
</table>
7.2.3 Edit view

<table>
<thead>
<tr>
<th>Operating options</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>Entering a value&lt;br&gt;Activates the edit mode&lt;br&gt;Changes the displayed character (9, 8, 7, ... , Z, Y, X, ...)&lt;br&gt;Selecting a value&lt;br&gt;Moves the active option down</td>
</tr>
<tr>
<td>+</td>
<td>Entering a value&lt;br&gt;Activates the edit mode&lt;br&gt;Changes the displayed character (0, 1, 2, ... , A, B, C, ...)&lt;br&gt;Selecting a value&lt;br&gt;Moves the active option up</td>
</tr>
<tr>
<td>E</td>
<td>Navigation to the right within a function group&lt;br&gt;In edit mode:&lt;br&gt;- Change to the next character&lt;br&gt;- At the end, accept the entry by switching to the next function</td>
</tr>
</tbody>
</table>

Editing options
The following characters are available for selection when editing:
- Numerical values: 0 to 9 and "." (period) as the separator in the unit selected
- Tag number (function 080): additionally letters A to Z and "." (period)
- Navigation characters:
  - "←" goes one or more spaces to the left
  - "→" goes one or more spaces to the right

7.2.4 Operating elements

<table>
<thead>
<tr>
<th>Operating elements</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>Entering a value&lt;br&gt;Activates the edit mode and reduces the value&lt;br&gt;Selecting a function group or a value&lt;br&gt;Moves the active option down</td>
</tr>
<tr>
<td>+</td>
<td>Entering a value&lt;br&gt;Activates the edit mode and increases the value&lt;br&gt;Selecting a function group or a value&lt;br&gt;Moves the active option up</td>
</tr>
<tr>
<td>E</td>
<td>Navigation to the right within a function group&lt;br&gt;In edit mode: Accept the value entered</td>
</tr>
<tr>
<td>- + +</td>
<td>Navigation to the left within a function group</td>
</tr>
<tr>
<td>+ + E</td>
<td>Increases the contrast of the liquid crystal display</td>
</tr>
<tr>
<td>− + E</td>
<td>Decreases the contrast of the liquid crystal display</td>
</tr>
</tbody>
</table>
### Operation options

<table>
<thead>
<tr>
<th>Key</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>- + + E</td>
<td>Enables or disables hardware locking</td>
</tr>
<tr>
<td></td>
<td>Operating keys have no function on their own</td>
</tr>
<tr>
<td></td>
<td>&quot;man. start&quot; and external start button are not locked</td>
</tr>
<tr>
<td>or manual start button</td>
<td>The measurement procedure starts if the device is in the display mode (function 000)</td>
</tr>
</tbody>
</table>

#### 7.2.5 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.

**Example: Configuring safety distance**

1. \(\text{F} \rightarrow\) Switch to group selection

   ```
   group selection 00
   basic setup
   inputs and outputs
   measurement param.
   ```

2. \(\text{F} / \text{O} \rightarrow\) Change the function group to be selected until the function group can be selected

   ```
   group selection 04
   safety settings
   linearization
   display
   ```

3. \(\text{F} \rightarrow\) Select the safety settings function group; the first function in this group is displayed

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

4. \(\text{F} \rightarrow\) Switch to the next function(s) of the function group until the desired function is displayed

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

5. \(\text{F} / \text{O} \rightarrow\) Edit mode activated, the first character starts flashing, enter the desired character string

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

6. \(\text{F} \rightarrow\) Accept the entry and change to the next function

#### 7.2.6 Disabling write protection via the access code

If the lock 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.
The lock via access code is enabled and disabled as follows:
1. Select the **unlock parameter 074** function
2. Enter the access code
   - 100 → Write protection is disabled
   - <100 → Write protection is enabled

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

### 7.2.7 Enabling and disabling the keypad lock

If the lock symbol appears in the local display and in front of the input values of the functions, the parameterization is protected by a key 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 all operating keys while the device is in the measured value 000 mode.
   → The keypad lock is enabled
2.  + : Press all operating keys again while the device is in the measured value 000 mode.
   → The keypad lock is disabled

If write protection is enabled via the access code, the lock symbol appears on the display. However in this case the unlock parameter 074 is unequal 100.

### 8 Commissioning

#### 8.1 Function check

Before commissioning the measuring point, check whether the post-installation and post-connection checks have been performed.
- *Post-installation check* checklist \(\rightarrow\) \(\square \) 20
- *Post-connection check* checklist \(\rightarrow\) \(\square \) 23

#### 8.2 Powering up the measuring device

If nothing appears on the local display or a diagnostic message is displayed: *Diagnostics and troubleshooting* chapter \(\rightarrow\) \(\square \) 51

First time the device is switched on, the following appears on the display:

**Initialization phase**

<table>
<thead>
<tr>
<th>Jan 26 2015</th>
</tr>
</thead>
</table>

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

| FMMS0 | V01.06.12 | A1A1A1AA11A1 |
8.3 Set operating language

Selection of the language for the text on the display in function language 060:

- Deutsch
- English
- Français
- ニホソゴ (Katakana, Japanese)

Selection: Deutsch, English, Français, ニホソゴ (Katakana, Japanese)

Other operating languages can be ordered optionally (product configurator)

8.4 Configuring the device

The device is configured via the individual function groups and the associated functions in the groups.

<table>
<thead>
<tr>
<th>Function group</th>
<th>Device functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic setup (00)</td>
<td>Adapting to the application (for example full and empty calibration)</td>
</tr>
<tr>
<td>Inputs and outputs (01)</td>
<td>Device functions for changing the behaviour of the inputs and of the relay outputs, for example by specifying the relay output functions</td>
</tr>
<tr>
<td>Measurement parameter (02)</td>
<td>Adapting to the measurement requirements (for example specifying the time interval for periodic measurement)</td>
</tr>
<tr>
<td>Current output (03)</td>
<td>Adapting the current output (for example selecting the magnify function)</td>
</tr>
<tr>
<td>Safety settings (04)</td>
<td>Adapting the measuring device to the safety requirements (for example selecting the behaviour of the current output in an alarm condition)</td>
</tr>
<tr>
<td>Linearization (05)</td>
<td>Adapting the measuring device to the application with regard to measured value generation (for example selecting to display a volume in a technical unit)</td>
</tr>
<tr>
<td>Display (06)</td>
<td>Adapting the display (for example selecting the menu language)</td>
</tr>
</tbody>
</table>
## 8.4.1 Basic setup

In most cases, the basic setup is sufficient for successful commissioning, more complex measurement tasks may require further settings.

### Function group

<table>
<thead>
<tr>
<th>Diagnostics (07)</th>
<th>Error analysis and troubleshooting (for example resetting to default values)</th>
</tr>
</thead>
<tbody>
<tr>
<td>System parameters (08)</td>
<td>Advanced adaptation of the measuring device to the measuring point (for example entering a tag name)</td>
</tr>
</tbody>
</table>

### Diagram legend

- **A** Empty calibration
- **B** Block distance
- **C** Full calibration
- **D** Distance
- **E** Ullage
- **F** Level/volume
- **G** Security distance
- **H** Safety distance

![Diagram](image_url)
8.4.1.1 Empty calibration
Input distance between the mounting flange (reference point for measurement) and the minimum fill level (= zero point) in **empty calibr. 001** function:

<table>
<thead>
<tr>
<th>empty calibr. 001</th>
</tr>
</thead>
<tbody>
<tr>
<td>distance flange to</td>
</tr>
<tr>
<td>min. filling</td>
</tr>
</tbody>
</table>

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

8.4.1.2 Block distance
Enter distance between the flange of the device and the end of the sensing weight (in upper limit position) in **block distance 002** function:

<table>
<thead>
<tr>
<th>block distance 002</th>
</tr>
</thead>
<tbody>
<tr>
<td>distance flange to</td>
</tr>
<tr>
<td>bottom weight</td>
</tr>
</tbody>
</table>

Range of values: 0.23 to 5 m (or converted value in feet/inches)
Default: 0.8 m

Table detailing all the default values depending on the wiper length and the sensing weight → 82

8.4.1.3 Full calibration
Input distance between the minimum fill level (=zero point) and the maximum fill level (= span) in **full calibration 003** function:

<table>
<thead>
<tr>
<th>full calibration 003</th>
</tr>
</thead>
<tbody>
<tr>
<td>measuring range</td>
</tr>
<tr>
<td>max.=empty-bd</td>
</tr>
</tbody>
</table>

Range of values: 1 m ... empty calibr. - block distance (or converted value in feet/inches)
Default: Length of measuring tape - 0.8 m

8.4.1.4 Measurement type
Select type of measurement of the device in **measurement type 020** function:

<table>
<thead>
<tr>
<th>measurement type 020</th>
</tr>
</thead>
<tbody>
<tr>
<td>single cycle</td>
</tr>
<tr>
<td>periodical</td>
</tr>
<tr>
<td>manual</td>
</tr>
</tbody>
</table>

Selection:
- **single cycle**
  Activation of single cycle measurement (manually using buttons on the device or using a corresponding input signal in function 010 and 012)
- **periodical**
  Activation of time-controlled measurements (time interval defined in functions 021 and 022)
- **manual**
  The sensing weight can only be moved using the keys on the device. This type of measurement allows the user to move the sensing weight slowly, e.g. when changing the cage sensing weight.
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). Due to the high tensile forces of the measuring device, the measuring tape may tear or be pulled out of the sensing weight attachment in this mode of operation.

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.

### 8.4.1.5 Distance/measured value

Display of the measured distance between the device and the medium and the current measured value in **dist./meas.value 004** function:

- **distance 0.90 m**
- **meas.val 9.75 %**

The display depends on the number of decimal places (function 062), the distance unit (function 083) and also linearization where applicable.

### 8.4.1.6 Time interval

Input time interval for the measurement type "periodical" (see function 020) depending on the unit (see function 022) in **time interval 021** function:

- **Range of values:** 1 ... 60 (Function 022)

The minimum time for a measuring cycle depending on the ambient temperature and the measuring range must be observed. → 83

### 8.4.1.7 Time unit

Input unit of time interval (see function 021) in **time unit 022** function:

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

### 8.4.1.8 Normal or short

Select operating mode for the "single cycle" and "periodical" type of measurement in **normal or short 023** function:

- **Selection:**
  - 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".

**Notes on the 'short' operating mode:**
- The weight moves back into the upper end position every 20 measuring cycles.
- Use input or relay output with "upper limit position" function for locking to protect the sensing weight from spillage.
- Relay output cannot be used for counting pulses, since the device does not move to a defined point (and thus no defined distance) at the end of a measurement.
- Before dismounting the device, move the sensing weight to the upper end position ('manual' type of measurement).

### 8.4.1.9 Run-up length

Input of the length that the sensing weight moves up in the 'short' operating mode (see function 023) in **run up length 028** function:

<table>
<thead>
<tr>
<th>Run-up length 028</th>
<th>1.0 m</th>
<th>Run-up length for short measure</th>
</tr>
</thead>
</table>

Range of values: 1 m ... Empty calibration - 1 m (or converted value in feet/inches)
8.4.2 Current output

8.4.2.1 Current mode
Selection behavior of current output in current mode 030 function:

<table>
<thead>
<tr>
<th>current mode 030</th>
</tr>
</thead>
<tbody>
<tr>
<td>normal</td>
</tr>
<tr>
<td>magnify</td>
</tr>
</tbody>
</table>

Selection:
- **normal**
  The current output supplies a current of 0/4 to 20 mA (adjustable in function 033) referred to 0 to 100 % of the set measuring range (see function 002 "full calibr.").
- **magnify**
  Only a part of the measuring range is mapped to the output current range of 0/4 to 20 mA, this range is defined in 031 "0/4mA value" and 042 "20mA value" function.

8.4.2.2 0/4mA value
Input lower limit current output (see function 030) in 0/4mA value 031 function:

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

8.4.2.3 20mA value
Input upper limit current output (see function 030) in 20mA value 032 function:

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

When changing the maximum scale value (in function 057), the 0/4 mA value or the 20 mA value must also be adapted.
8.4.2.4 Current range

Selection current output range (see function 030) in current range 033 function:

<table>
<thead>
<tr>
<th>Current range 033</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20mA</td>
</tr>
<tr>
<td>0-20mA</td>
</tr>
</tbody>
</table>

Selection:
- 4-20mA
- 0-20mA

The behaviour of the current output can be influenced by the level/volume 050 function as follows:
- The settings "level DU" or "level CU" cause an increasing output current as the level increases.
- The settings "ullage DU" or "ullage CU", on the other hand, cause a decreasing output current as the filling level increases.

![Graphs showing the behaviour of the current output](image)

**8.25 Behaviour of the current output**

A  Filling level  
B  Level (volume)  
C  Current  
D  Ullage
8.4.3 Display

8.4.3.1 Back to home
Input of time until return to measured value display (000) in back to home 061 function:

```
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>back to home</td>
<td>061</td>
</tr>
<tr>
<td>time until jump back</td>
<td>home automatically</td>
</tr>
</tbody>
</table>
```

Range of values: 3 ... 9999 seconds
Default: 100

8.4.3.2 No. of decimals
Selection number of decimal places (among others for the measured value display (000)) in no. of decimals 062 function:

```
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of decimals</td>
<td>062</td>
</tr>
<tr>
<td>x</td>
<td></td>
</tr>
<tr>
<td>x.x</td>
<td></td>
</tr>
<tr>
<td>x.xx</td>
<td></td>
</tr>
<tr>
<td>x.xxx</td>
<td></td>
</tr>
</tbody>
</table>
```

Selection:
- x
- x.x
- x.xx
- x.xxx

8.4.3.3 Format display
Activation test LC display (all points are activated for approx. 2 seconds) in format display 063 function:

```
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>format display</td>
<td>063</td>
</tr>
<tr>
<td>off</td>
<td></td>
</tr>
<tr>
<td>on</td>
<td></td>
</tr>
</tbody>
</table>
```

Selection:
- off
- on

8.4.4 Output

8.4.4.1 Relay output 1
Selection behavior relay 1 in relay output 1 014 function:

```
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>relay output 1</td>
<td>014</td>
</tr>
<tr>
<td>alarm</td>
<td></td>
</tr>
<tr>
<td>threshold</td>
<td></td>
</tr>
<tr>
<td>service interval</td>
<td></td>
</tr>
</tbody>
</table>
```

Selection:
- alarm
- threshold
- service interval
- counter pulses
- reset pulse

Relay switches as soon as an error is detected.
Relay switches as soon as a set limit value (see function 017 and 018) is exceeded or not reached.
Relay switches when the value set in the service interval (024) function is reached.
Relay switches at the pulse value set in function 015 and at the counter pulse length set in function 016.
Relay switches at the reset pulse length set in function 019 before a new measurement.
(for example, 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.

---

**Measurement cycle (a)**
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

**Programmable relay output functions**

<table>
<thead>
<tr>
<th>Relay output function</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counter pulses (b)</td>
<td>Output pulses that correspond to the length of unwound tape</td>
</tr>
<tr>
<td>Reset pulse (c)</td>
<td>Pulse before every new measurement</td>
</tr>
<tr>
<td>Band return (d)</td>
<td>Displays the lower reversal in direction of the tape (from tape run-down to tape run-up)</td>
</tr>
<tr>
<td>Running up (e)</td>
<td>Displayed when the tape runs back up</td>
</tr>
<tr>
<td>Top position (f)</td>
<td>Indicated when the upper end position is reached (end of measurement)</td>
</tr>
<tr>
<td>Measuring (g)</td>
<td>Indicates an active measuring cycle, for example to lock a filling system to protect the sensing weight from being buried</td>
</tr>
<tr>
<td>Relay output function</td>
<td>Meaning</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Alarm</td>
<td>Relay switches in a fault condition</td>
</tr>
<tr>
<td>Threshold</td>
<td>Relay switches when a set threshold is exceeded or not reached</td>
</tr>
<tr>
<td>Service interval</td>
<td>Relay switches when the set number of measuring cycles is reached</td>
</tr>
</tbody>
</table>

- The rest position 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.

### 8.4.4.2 Relay output 2 to 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:
- Relay output 2 (01A): Service interval
- Relay output 3 (01B): Measuring
- Relay output 4 (01C): Threshold
- Relay output 5 (01D): Reset pulse
- Relay output 6 (01E): Band return

### 8.4.4.3 Pulse weight

Input run-down distance (set value x 5 cm) per pulse at the counter pulse output in pulse weight 015 function:

- **pulse weight**: 015
- **length per pulse**: 10
- **output = value * 5 cm**

Range of values: 1 to 20 (5 to 100 cm or converted value in feet/inches)

Default: 1

Example pulse weight = 4:

Every 0.2 m run-down distance, the preset counting pulse output, for example relay 1, outputs a counting pulse (input pulse length in "pulse length (016)" function).
8.4.4.4 Pulse length
Input counter pulse length (value range dependent on pulse weight in function 015) in pulse length 016 function:

<table>
<thead>
<tr>
<th>Pulse length 016</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 ms</td>
</tr>
<tr>
<td>Length of the counter pulse</td>
</tr>
</tbody>
</table>

Range of values:
- 30 to 100 ms (pulse weight = 1)
- 30 to 250 ms (pulse weight = 2)
- 30 to 400 ms (pulse weight = 3)
- 30 to 550 ms (pulse weight = 4 to 20)
Default: 50 ms

8.4.4.5 Threshold
Input limit value of relay outputs with selected relay output function 014 = “limit value” in percent of the measuring range (level) in limit value 017 function:

<table>
<thead>
<tr>
<th>Limit value 017</th>
</tr>
</thead>
<tbody>
<tr>
<td>60.00 %</td>
</tr>
<tr>
<td>Relative to the full scale (003)</td>
</tr>
</tbody>
</table>

Range of values: 0 to 100 %
Default: 60 %

![Diagram](image)

28 Limit value and hysteresis behaviour
A Product cone
B Slope
C Threshold (017) = 50 % reached, relay is energized
D Hysteresis (018) = 30 % undercut, relay drops out
8.4.4.6 **Hysteresis**
Input hysteresis of relay outputs with selected relay output function 014 = "limit value" (related to falling below the limit value in function 017) in percent of the measuring range in **hysteresis 018** function:

| hysteresis 018 | 60.00 % relative to the full scale (003) |

Range of values: 0 to 100 %  
Default: 3 %

8.4.4.7 **Reset pulse**
Input length reset pulse with selected relay output function 014 "reset pulse" in milliseconds in **reset pulse 019** function:

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

Range of values: 30 to 1000 ms  
Default: 300 ms

8.4.5 **Inputs**

8.4.5.1 **Input 1**
Selection behavior of input 1 in **input 1 010** function:

| input 1 010 | not used | bolting | start measurement |

Selection:
- **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.

|  

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.

8.4.5.2 **Polarity input 1**
Selection polarity input 1 for selected "bolting" or "start measurement" (function 010) in **polarity input 1 011** function:

| polarity input 1 011 | NO contact | NC contact |

Selection:
- **NO contact**  
  The input function becomes active if the input contact is closed (passive input) or voltage is applied (active input).  
- **NC contact**  
  The input function becomes active if the input contact is opened (passive input) or the voltage level drops (active input).
8.4.5.3  Input 2 (012)
For selection options see input 1 (010)
Default: not used

8.4.5.4  Polarity input 2 (013)
For selection options see contact input 1 (011)
Default: NO contact

8.5  Advanced settings

8.5.1  Device tag
Input maximum 16-digit alphanumeric measuring point designation in tag no. 080 function:

```
tag no. 080
Ratingen Silo 1
```
Default: ----------------

8.5.2  Distance unit
Length unit selection (basis for all display and input values, with the exception of the customer unit (CU), if this has been selected) in distance unit 083 function:

```
distance unit 083
m
ft
in
```
Selection:
- m (Meter)
- ft (Feet)
- in (Inch)

8.5.3  Linearization

8.5.3.1  Level/volume
Selection of measured value display (000) in level/volume 050 function:

```
level/volume 050
level CU
level DU
ullage CU
```
Selection:
- 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).
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/volume (050) = level CU  
Linearization (051) = linear  
Customer unit (056) = m³  
Maximum scale (057) = 500  
→ Measured value (000) = 100 m³

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

### 8.5.3.2 Linearization

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

```
linearization 051
  linear
  table on
  clear table
```

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

**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)).
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

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

   ![Linearization Table]

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

   ![Linearization Table Point 1]
3. Enter the level pertaining to point 1

<table>
<thead>
<tr>
<th>linearization 053</th>
</tr>
</thead>
<tbody>
<tr>
<td>TabNr 1</td>
</tr>
<tr>
<td>level 0.000 m</td>
</tr>
<tr>
<td>volum 0.000%</td>
</tr>
</tbody>
</table>

4. Enter the associated volume (weight)

<table>
<thead>
<tr>
<th>linearization 054</th>
</tr>
</thead>
<tbody>
<tr>
<td>TabNr 1</td>
</tr>
<tr>
<td>level 0.000 m</td>
</tr>
<tr>
<td>volum 0.000%</td>
</tr>
</tbody>
</table>

5. Should another point be entered in the table?

<table>
<thead>
<tr>
<th>next point 055</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
</tr>
<tr>
<td>no</td>
</tr>
</tbody>
</table>

6. Select table point 2

<table>
<thead>
<tr>
<th>linearization 052</th>
</tr>
</thead>
<tbody>
<tr>
<td>TabNr 2</td>
</tr>
<tr>
<td>level 0.000 m</td>
</tr>
<tr>
<td>volum 0.000%</td>
</tr>
</tbody>
</table>

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.

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!

### 8.5.3.3 Customer unit

Selection customer unit in function **customer unit 056**:

<table>
<thead>
<tr>
<th>customer unit 056</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
</tr>
<tr>
<td>kg</td>
</tr>
<tr>
<td>t</td>
</tr>
</tbody>
</table>

Selection:
- % (Percentage)
- Weight: kg, t
- Volume: m³, ft³
- Length: m, ft, in

### 8.5.3.4 Maximum scale

Input upper-range value (in the selected unit and the selected decimal places) in **max. scale 057** function:

<table>
<thead>
<tr>
<th>max.scale 057</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 %</td>
</tr>
</tbody>
</table>

Range of values: 1 to 100000
Default: 100
8.5.4 Safety settings

8.5.4.1 Output on alarm
Selection behavior current output in case of error in output on alarm 040 function:

<table>
<thead>
<tr>
<th>Output on alarm 040</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN (0/3.6mA)</td>
</tr>
<tr>
<td>MAX (22mA)</td>
</tr>
<tr>
<td>hold</td>
</tr>
</tbody>
</table>

Selection:
- **MIN (0/3.6mA)**
  - Current drops to 0 mA or to 3.6 mA (depending on function 033) in case of error.
- **MAX (22mA)**
  - Current increases to 22 mA in case of error.
- **hold**
  - In the event of an error, the last output current is retained.
- **user-specific**
  - In the event of an error, the current set in function 041 is output.

![Diagram showing behavior of current output in the event of an error](image)

---

30 Behaviour of the current output in the event of an error

- a 3.6 mA
- b 22 mA
- A MIN (0/3.6mA)
- B MAX (22mA)
- C Hold
- D User specific
8.5.4.2 Output on alarm
Input user-specific current value in case of error (see function 040) in output on alarm 041 function:

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

Range of values: 0 to 22.00 mA
Default: 3.60 mA

8.5.4.3 Safety distance
Input minimum distance to parameterized zero point in safety distance 042 function:

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

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

This function prevents the measuring tape from being lowered into an unauthorized area of the silo or bunker, such as an outlet worm.

8.5.4.4 Security distance
Input security distance before block distance in security distance 043 function:

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

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

This zone is used as a warning that if the fill level continues to rise, future measurements might be invalid since the block distance (and therefore also the minimum run-down length of the FMM) might be undershot.

8.5.4.5 In security distance
Selection of alarm behavior when security distance is reached (if a value greater than zero was entered in function 043 "security distance") in in security distance 044 function:

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

Selection:
• warning
• alarm

8.5.4.6 In safety distance
Selection of alarm behavior when safety distance is reached (if a value greater than zero was entered in function 042 "safety distance") in in safety distance 045 function:

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

Selection:
• warning
• alarm
Selection:
- warning
- alarm

Device response when the safety distance is reached
1. In safety distance = warning
   - The sensing weight stops when the safety distance is reached.
   - The current measurement (level = full calibration (002) – safety distance (042)) ends
     with a valid measured value.
   - 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).
2. In safety distance = 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.

8.5.5 Service interval

8.5.5.1 Service interval
Input number of measuring cycles until next service (among others tape change) in service interval 024 function:

<table>
<thead>
<tr>
<th>service interval 024</th>
<th>num. of measurements till tape change</th>
</tr>
</thead>
<tbody>
<tr>
<td>45000</td>
<td></td>
</tr>
</tbody>
</table>

Range of values: 1 to 90000
Default: 45000 (measuring tape made of stainless steel) / 10000 (measuring tape made of plastic)

- If the set value is reached, the FMM issues a warning.
- The relay output with the 'service interval' function switches.
- Resetting the warning or the switched relay output in 'service interval counter 025' function
- The number of measurements of the FMM until the next service depends on the process environment, the value must be adjusted depending on the degree of contamination and/or condition of the measuring tape.

8.5.5.2 Service interval counter
Display current service interval counter and reset counter in service interval counter 025:

<table>
<thead>
<tr>
<th>serv.int.counter 025</th>
<th>5678</th>
</tr>
</thead>
</table>

Range of values: 0 to 90000

To reset a service message, the maintenance interval counter must be set to 0. After the number of measurements entered in the 'service interval 024' function, a warning appears again.
8.6 Simulation

The simulation makes it possible to simulate different process variables in the process and the alarm behavior of the device without real level measurements, as well as to check downstream signal chains (for example, the switching of a discharge screw).

8.6.1 Simulation

Selection of measured value simulation in simulation 026 function:

- **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.

- During simulation, the measured value display (function 000) shows the alarm symbol.
- When in simulation mode, normal measuring with the FMM is not possible.
  - If the device was in manual mode before simulation was activated, the sensing weight remains in its current position.
  - If the FMM 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 FMM 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.

8.6.2 Simulation value

Input value of simulation type selected in function 026 in simulation value 027 function:

Range of values: 0 to 99 m (Level)
0 to 22.00 mA (Current)
0 to 100000 (Volume)
Example of fill level simulation

Device settings:
- Empty calibration (001) = 50 m
- Full calibration (003) = 45 m
- Relay output 1 (014) = threshold
- Threshold (017) = 50 %
- Hysteresis (018) = 10 %
- Level/volume (050) = level CU
- Linearization (051) = linear
- Customer unit (056) = m³
- Maximum scale (057) = 10000

1. Simulation (026) = sim. level
   Simulation value (027) = 8000
   - Measured value (000) = 8000 m³
   - Current output = 16.8 mA
   - Relay 1 is energized.

2. Simulation (026) = sim. level
   Simulation value (027) = 2000
   - Measured value (000) = 2000 m³
   - Current output = 7.2 mA
   - Relay 1 is de-energized.

8.6.3 Protecting settings from unauthorized access

To protect the configuration of the FMM against unintentional modifications after commissioning, the following options are available:
- Write protection via access code
- Write protection via keypad lock → 28

Input unlock parameter to lock parameter input in unlock parameter 074 function:

Range of values:
- 100
  Parameter input unlocked
- <=100
  Parameter input locked

9 Operation

9.1 Set operating language

Operating languages supported by the FMM → 29

9.2 Configure display

- Basic settings for the local display → 49
- Local display test → 36

9.3 Reading measured values

- Measured value (000) → 36
- Distance/measured value (004) → 32
9.4 Adapt measured values to process conditions

All the functions from chapter "Commissioning" are available for this purpose.

9.5 Manual

The "manual" mode (see measurement type 020 function) gives the user the possibility to move the sensing weight slowly (for example for a tape change).

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 and on the number of decimal places to be displayed as selected in function 062.

- The sensing weight can only be moved manually in measured value 000 function.
- 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).
- After the manual mode has been finished, the measured value display is automatically switched back to the originally selected display (for example level in customer units).

**NOTICE**

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). Due to the high tensile forces of the measuring device, the measuring tape may tear or be pulled out of the sensing weight attachment in this mode of operation.

9.6 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.
10 Diagnostics and troubleshooting

10.1 General troubleshooting

Troubleshooting the local display

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local display dark and no output signals</td>
<td>No contact between connecting cables and terminals</td>
<td>Check the connection of the cables and correct if necessary</td>
</tr>
<tr>
<td></td>
<td>Electronics are defective</td>
<td>Repair the FMM → 69</td>
</tr>
<tr>
<td>Local display is dark, but signal output is within the valid range</td>
<td>Display is set too bright or too dark</td>
<td>Adjust the contrast setting → 26</td>
</tr>
<tr>
<td></td>
<td>Display module is defective</td>
<td>Repair the FMM</td>
</tr>
<tr>
<td>Text on local display appears in a foreign language and cannot be understood.</td>
<td>Incorrect operating language is configured</td>
<td>Change the operating language → 29</td>
</tr>
</tbody>
</table>

Troubleshooting the output signals

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal output outside the valid range</td>
<td>Electronics are defective</td>
<td>Repair the FMM → 69</td>
</tr>
<tr>
<td>Device shows correct value on local display, but signal output is incorrect, though in the valid range</td>
<td>Parametrization errors</td>
<td>Check and correct parameterization</td>
</tr>
<tr>
<td>Device measures incorrectly</td>
<td>Parametrization errors</td>
<td>Check and correct parameterization</td>
</tr>
<tr>
<td></td>
<td>Device is being operated outside the range of application</td>
<td>Observe limit values</td>
</tr>
</tbody>
</table>

Troubleshooting access problems

<table>
<thead>
<tr>
<th>Error</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not possible to write to parameters, access code = 100</td>
<td>Hardware locking enabled</td>
<td>Disable locking</td>
</tr>
<tr>
<td>Not possible to write to parameters, access code 100</td>
<td>Software locking enabled</td>
<td></td>
</tr>
</tbody>
</table>

10.2 Diagnostic functions on the local display

10.2.1 Diagnostic messages

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

![Diagnostic messages](image)

1 Alarm symbol
2 Measured value (Function 000)
3 Help text pertaining to the current error
4 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.

10.2.2 Present error

Display present error with error code and letter "W" for warning or "A" for alarm in **present error 070** function:

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

If there is a warning, it will only be displayed. In the case of an alarm, this is also output via the 'alarm' relay output, provided that this has been selected.

10.2.3 Previous error

Display previous error with error code and letter "W" for warning or "A" for alarm in **previous error 071** function:

```
  previous error  071
    minimum run down length underflow
      A440
```

10.2.4 Resetting errors

Delete the displayed errors in **clear error 072** function:

```
  clear errors  072
    keep    erase previous    erase present
```

Selection
- **keep**
  Errors are not deleted.
- **erase previous**
  The last error is deleted.
- **erase present**
  The current error is deleted.
- **erase all**
  The current (070) and previous (071) errors are deleted.

10.3 Overview of the diagnostic functions

<table>
<thead>
<tr>
<th>Error code</th>
<th>Diagnostic messages</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| 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       | Checksum error in EEPROM 1         |                                                                        |
| A102       | Checksum error in EEPROM 2         |                                                                        |
| A103       | Initialization failed              |                                                                        |
| A106       | Program download error             | Only for service technicians: Repeat download and/or restart           |
| W110       | Default service parameters loaded  | 1. Warning that a reset has been performed  
2. Disappears automatically the next time an entry is made               |
<p>| W111       | Default user parameters loaded     |                                                                        |
| W112       | Default input/output configuration loaded |                                                                        |
| W113       | Default table for linearization loaded |                                                                        |</p>
<table>
<thead>
<tr>
<th>Error code</th>
<th>Diagnostic messages</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A120</td>
<td>Error when loading the service parameters</td>
<td>1. Reset hardware</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Avoid EMC problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. If the alarm is still present after a reset, contact service and/or replace the electronics</td>
</tr>
<tr>
<td>A121</td>
<td>Error when loading the user parameters</td>
<td>1. Reset hardware</td>
</tr>
<tr>
<td>A122</td>
<td>Error when loading the input / output configuration</td>
<td>2. Avoid EMC problems</td>
</tr>
<tr>
<td>A123</td>
<td>Error when loading the last measured values</td>
<td>3. If the alarm is still present after a reset, contact service and/or replace the electronics</td>
</tr>
<tr>
<td>A124</td>
<td>Error when loading the linearization table</td>
<td>1. Check linearization table</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Enter the linearization table again if necessary</td>
</tr>
<tr>
<td>A125</td>
<td>Error when loading the display texts</td>
<td>1. Reset hardware</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Avoid EMC problems</td>
</tr>
<tr>
<td>A130</td>
<td>Process of saving the service parameters has failed</td>
<td>3. If the alarm is still present after a reset, contact service and/or replace the electronics</td>
</tr>
<tr>
<td>A131</td>
<td>Process of saving the user parameters has failed</td>
<td></td>
</tr>
<tr>
<td>A132</td>
<td>Process of saving the input/output configuration has failed</td>
<td></td>
</tr>
<tr>
<td>A133</td>
<td>Process of saving the measured values has failed</td>
<td></td>
</tr>
<tr>
<td>A134</td>
<td>Process of saving the linearization has failed</td>
<td></td>
</tr>
<tr>
<td>A200</td>
<td>Interface to motor controller defective</td>
<td>1. Reset hardware</td>
</tr>
<tr>
<td>A201</td>
<td>Initialization of the motor controller failed</td>
<td>2. Avoid EMC problems</td>
</tr>
<tr>
<td>A202</td>
<td>Fatal motor error</td>
<td>3. If the alarm is still present after a reset, contact service and/or replace the electronics</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Error code</th>
<th>Diagnostic messages</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A203</td>
<td>Temperature switch inside motor is triggered</td>
<td>1. Reset hardware</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Avoid excessive heating of the measuring device:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Observe the minimum time for a measuring cycle ( \geq 83 )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Observe the maximum ambient temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Observe the maximum weight of the sensing weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. If the alarm is still present after a reset, contact service and/or replace the motor</td>
</tr>
<tr>
<td>A204</td>
<td>Line voltage is too low</td>
<td>1. Reset hardware</td>
</tr>
<tr>
<td>A205</td>
<td>Motor current consumption is too high</td>
<td>2. Check the supply voltage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. After replacing the electronics: Use the right spare part</td>
</tr>
<tr>
<td>A207</td>
<td>Line voltage is too high</td>
<td>4. If the alarm is still present after a reset, contact service</td>
</tr>
</tbody>
</table>

- 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 to 253 V AC voltage range and a local supply voltage in the 90 to 127 V AC range.
- Only use suitable spare parts.
## Diagnostics and troubleshooting

<table>
<thead>
<tr>
<th>Error code</th>
<th>Diagnostic messages</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| A206       | Motor driver defective               | 1. Reset hardware
2. If the alarm is still present after a reset, contact service and/or replace the electronics |
| A220       | Temperature in the device is too high | 1. Check the ambient temperature
2. Check the measurement cycle time → 83 |
| A330       | Maximum time for a measurement exceeded | 1. Check the wiper → 58
   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.

<table>
<thead>
<tr>
<th>Error code</th>
<th>Diagnostic messages</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| 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:
   Check installation (maximum angle of inclination 2°) |

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

<table>
<thead>
<tr>
<th>Error code</th>
<th>Diagnostic messages</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| 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 |
| A430       | Tape switch expected                 | Contact service and/or replace tape switch                           |
| A431       | Limit switch expected                | Contact service                                                         |
| A440       | Minimum run-down distance not reached | 1. Check the installation position
2. Observe minimum sensing weight run-down distance of 20 cm.
3. Sensing weight present? |
| 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.
## Diagnostics and troubleshooting

### Error code | Diagnostic messages | Remedy
--- | --- | ---
A460 | Slip on counting wheel | 1. Check the 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 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.

### Error code | Diagnostic messages | Remedy
--- | --- | ---
A470 | The measurement could not be started | Check the device for damage or blocking parts
W611 | Less than 2 points entered in linearization table | 1. Check linearization table 2. Add missing linearization points if needed
W621 | Simulation activated | Switch off simulation → 48
A630 | Maximum drain length exceeded | Check adjustment → 30
A650 | Security distance not reached | 1. Check the installation situation 2. Check parameterization
W651 | Security distance not reached | 1. Check the installation situation 2. Check parameterization
A660 | Safety distance not reached | 1. Check the installation situation 2. Check parameterization
W661 | Safety distance not reached | 1. Check the installation situation 2. Check parameterization
W681 | Measurement range exceeded | 1. Check the installation situation 2. Check parameterization

- 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.

### Error code | Diagnostic messages | Remedy
--- | --- | ---
W690 | Linearization incomplete or unusable | 1. Check linearization table 2. Add missing linearization points if needed
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. → 47
10.4 Resetting the device

Reset to factory settings in reset 073 function:

<table>
<thead>
<tr>
<th>reset</th>
<th>073</th>
</tr>
</thead>
</table>

Range of values:
- **333** performs reset
- **<>333** does not perform a reset

- At least one basic setup must have been performed before the measuring device can be reset.
- Table for noting the set parameters in order to be able to restore the desired functions after a reset → 85

10.5 Device information

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

10.5.1 Protocol and software version

Display of protocol and software version in protocol+sw-no. 081 function:

<table>
<thead>
<tr>
<th>protocol+sw-no. 081</th>
</tr>
</thead>
</table>

For information on repairing or ordering spare parts for firmware versions for special technical products (TSP), contact Endress+Hauser Service.

10.5.2 serial number

Display of the serial number in serial number 082 function:

<table>
<thead>
<tr>
<th>serial no. 082</th>
</tr>
</thead>
</table>

10.6 Firmware history

<table>
<thead>
<tr>
<th>Release date</th>
<th>Firmware version</th>
<th>Changes</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.2020</td>
<td>01.06.12-X2</td>
<td>Software revised: Special version with measurement range of 110 m</td>
<td>BA00286F/97/de/14.17</td>
</tr>
<tr>
<td>01.2020</td>
<td>01.06.12-X1</td>
<td>Software revised: Czech language version</td>
<td>BA00286F/97/de/14.17</td>
</tr>
<tr>
<td>01.2020</td>
<td>01.06.12</td>
<td>Software revised: Correction of the &quot;Short&quot; operating mode when empty calibration is reached</td>
<td>BA00286F/97/de/14.17</td>
</tr>
<tr>
<td>03.2017</td>
<td>01.06.11</td>
<td>Software revised: Minor corrections to help text</td>
<td>BA00286F/97/de/14.17</td>
</tr>
<tr>
<td>Release date</td>
<td>Firmware version</td>
<td>Changes</td>
<td>Documentation</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
</tbody>
</table>
| 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/de/14.17 |
| 05.2012      | 01.06.08         | Software revised:  
Modification of moving sensing weight into upper end position | BA00286F/97/de/14.17 |
| 04.2011      | 01.06.07         | Software revised:  
Minor changes to manual mode | BA286F/97/de/04.10 |
| 09.2009      | 01.06.06         | Software revised:  
Minor changes to Japanese language version | BA286F/97/de/12.07 |
| 06.2009      | 01.06.05         | Software revised:  
Minor changes to Japanese language version | BA286F/97/de/12.07 |
| 09.2007      | 01.06.04         | Software revised:  
New serial numbers according to E+H Standard 223 | BA286F/97/de/11.06 |
| 08.2007      | 01.06.03         | Software upgrade:  
Extended functionality at the Service level | BA286F/97/de/11.06 |
| 03.2007      | 01.06.02         | Software revised:  
Minor changes to "unlock parameter" function (074) | BA286F/97/de/11.06 |
| 02.2007      | 01.06.01         | Software revised:  
Japanese help text in function 061 and 061 corrected | BA286F/97/de/01.07 |
| 12.2006      | 01.06.00         | Software upgrade:  
"in safety distance" (045) function added | BA286F/97/de/11.06 |
| 03.2006      | 01.05.01         | Software upgrade:  
Japanese language version with Japanese help | BA286F/97/de/07.05 |
| 12.2005      | 01.05.00         | Software upgrade:  
French language version | BA286F/14/fr/07.05 |
| 11.2005      | 01.04.00         | Software upgrade:  
Enhanced functionality | BA286F/97/de/07.05 |
| 10.2005      | 01.03.00         | Software upgrade:  
Japanese language version with English help | BA286F/97/de/07.05 |
| 09.2005      | 01.02.02         | Software upgrade:  
Enhanced functionality | BA286F/97/de/07.05 |
| 07.2005      | 01.02.01         | Software upgrade:  
Enhanced functionality | BA286F/97/de/07.05 |
| 06.2005      | 01.02.00         | Software upgrade:  
Output current range extended to 0-20 mA (033) | BA286F/97/de/04.05 |
| 12.2004      | 01.01.00         | Original software | BA286F/97/de/12.04 |
11 Maintenance

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

11.1 External cleaning

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

11.2 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.

11.3 Wiper check

The two scraper blocks 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.

With the wiper removed, check the following points:

- 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.
- Are the two tape-wipe scrapers in good contact with the measuring tape? If worn, the tape-wipe scrapers must be replaced.
- Is the bellows still in perfect condition? If it is damaged, it must be replaced.

---

1 Screws M6x50
2 Tape-wipe scraper
3 Scraper block
4 End guide
5 Measuring tape
11.3.1 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 the measuring tape is damaged over a longer distance, the entire measuring tape must be replaced.

- Do not cut off too much, consider the original tape length and the measurement range required (container height).
- Tape spools in standard lengths are available as accessories for easy changeover. → 62

11.3.2 Spool compartment check

The spool compartment must be inspected at regular intervals:

- If the tape spool is severely attacked or damaged, it must be replaced.
- If the counting wheel is very difficult to turn when the measuring tape is unloaded or if it is damaged, it must be replaced.
- If the tape guide is badly damaged, it must be replaced.
- If the cover gasket is badly affected or damaged, it must be replaced.

11.4 Service

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.

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

General notes:
- 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

![Spare parts electronics side](image)

1  **Tape switch unit**
   52028117  Tape switch unit, 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  Operation key start measurement, external

3  **Nameplate**
   71296636  Replacement nameplate

   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 Motor/gearbox unit incl. connection and potential matching line, 230 V AC, 500 N
- 71113432 Motor/gearbox unit like 71113428 + extended climate resistance
- 71113429 Motor/gearbox unit incl. connection and potential matching line, 230 V AC, 250 N
- 71113433 Motor/gearbox unit like 71113429 + extended climate resistance
- 71113430 Motor/gearbox unit incl. connection and potential matching line, 115 V AC, 500 N
- 71113431 Motor/gearbox unit like 71113430 + extended climate resistance

6 Electronic unit, preassembled on mounting plate
- 52028120 230 V AC, 2 relay, not an Ex version, without heating connection
- 71001310 like 52028120 + extended climate resistance
- 52028121 230 V AC, 6 relay, not an Ex version, without heating connection
- 71001311 like 52028121 + extended climate resistance
- 52028122 230 V AC, 2 relay, Ex version, without heating connection
- 71001312 like 52028122 + extended climate resistance
- 52028123 230 V AC, 6 relay, Ex version, without heating connection
- 71001313 like 52028123 + extended climate resistance
- 52028124 115 V AC, 2 relay, not an Ex version, without heating connection
- 71001314 like 52028124 + extended climate resistance
- 52028125 115 V AC, 6 relay, not an Ex version, without heating connection
- 71001315 like 52028125 + extended climate resistance
- 52028126 115 V AC, 2 relay, Ex version, without heating connection
- 71001316 like 52028126 + extended climate resistance
- 52028127 115 V AC, 6 relay, Ex version, without heating connection
- 71001317 like 52028127 + extended climate resistance
- 52028128 230 V AC, 2 relay, not an Ex version, with heating connection
- 71301716 like 52028128 + extended climate resistance
- 52028129 230 V AC, 6 relay, not an Ex version, with heating connection
- 71301719 like 52028129 + extended climate resistance
- 52028130 230 V AC, 2 relay, Ex version, with heating connection
- 71301720 like 52028130 + extended climate resistance
- 52028131 230 V AC, 6 relay, Ex version, with heating connection
- 71301721 like 52028131 + extended climate resistance
- 52028132 115 V AC, 2 relay, not an Ex version, with heating connection
- 71301722 like 52028132 + extended climate resistance
- 52028133 115 V AC, 6 relay, not an Ex version, with heating connection
- 71301725 like 52028133 + extended climate resistance
- 52028134 115 V AC, 2 relay, Ex version, with heating connection
- 71301727 like 52028134 + extended climate resistance
- 52028135 115 V AC, 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)
- 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

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

For devices from year of construction 2016, the guide plate (A) is no longer mounted and is therefore no longer included in the tape guide kit.

2 Counting wheel
- 52028103 Counting wheel, complete

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

4 Tape spool
- 52028111 Steel, stainless steel measuring tape, 25 m
- 71026882 316Ti, stainless steel measuring tape, 25 m (extended climate resistance)
- 52028112 Steel, stainless steel measuring tape, 35 m
- 71026884 316Ti, stainless steel measuring tape, 35 m (extended climate resistance)
- 52028113 Steel, stainless steel measuring tape, 50 m
- 71026885 316Ti, stainless steel measuring tape, 50 m (extended climate resistance)
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>52028114</td>
<td>Steel, stainless steel measuring tape, 70 m</td>
</tr>
<tr>
<td>71026886</td>
<td>316Ti, stainless steel measuring tape, 70 m (extended climate resistance)</td>
</tr>
<tr>
<td>71301749</td>
<td>Steel, stainless steel measuring tape, 90 m</td>
</tr>
<tr>
<td>71301750</td>
<td>316Ti, stainless steel measuring tape, 90 m (extended climate resistance)</td>
</tr>
<tr>
<td>71301745</td>
<td>Steel, plastic measuring tape, 15 m</td>
</tr>
<tr>
<td>71301748</td>
<td>316Ti, plastic measuring tape, 15 m (extended climate resistance)</td>
</tr>
</tbody>
</table>

5 **Cover seal for spool compartment**

52028116 Seal

6 **Housing cover (incl. cover seal)**

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, scraper block, bellows, mounting material, process temperature of up to +70 °C (+158 °F)
52028081 End guide, tape-wipe scrapers, scraper block, bellows, mounting material, process temperature of up to +150/230 °C (+302/446 °F)

8 **Wiper**

52028068 230 mm, aluminum/steel, process temperature of up to +70 °C (+158 °F)
52028069 230 mm, stainless steel, process temperature of up to +70 °C (+158 °F)
52028070 230 mm, aluminum/steel, process temperature of up to +150 °C (+302 °F)
52028071 230 mm, stainless steel, process temperature of up to +150 °C (+302 °F)
52028072 500 mm, aluminum/steel, process temperature of up to +70 °C (+158 °F)
52028073 500 mm, stainless steel, process temperature of up to +70 °C (+158 °F)
52028074 500 mm, aluminum/steel, process temperature of up to +150 °C (+302 °F)
52028075 500 mm, stainless steel, process temperature of up to +150 °C (+302 °F)
52028076 1000 mm, aluminum/steel, process temperature of up to +70 °C (+158 °F)
52028077 1000 mm, stainless steel, process temperature of up to +70 °C (+158 °F)
52028078 1000 mm, aluminum/steel, process temperature of up to +150 °C (+302 °F)
52028079 1000 mm, stainless steel, process temperature of up to +150/230 °C (+302/446 °F)

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 weight

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

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

3 Sensing weight (incl. rotating bush)
   52028090  Steel (A)
   52028091  Stainless steel (A)
   52028092  Steel + umbrella (B)
   52028093  Stainless steel + umbrella (B)
   52028094  Medium bag (C)
   52028096  Stainless steel cage (E)
   52028098  Stainless steel bell (D)
   52028099  Float, PVC (F)
   71301751  Float, 316Ti (G)
12.3 Replacing components

12.3.1 Replacing the tape spool

Replacing 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.

2. Switch off the power supply if the sensing weight is easily accessible (move mains switch to 'O' (off)). 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.

5. Unfasten the tape spool's locking screw.

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 as accessory.
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

Replacing 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.

2. Switch off the power supply if the sensing weight is easily accessible (move mains switch to "O" (off)). 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. 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.
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. Reassemble in reverse order, making sure that the guide groove on the wiper is correctly positioned in relation to the guide screw on the housing.

12.3.3 Replacing the motor/gearbox unit

Replacing the motor/gearbox 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 is available as accessory for this purpose.

→ 81
2. Switch off the power supply if the sensing weight is easily accessible (move mains switch to 'O' (off)). Disconnect the mains cable if the measuring device needs to be removed.

**WARNING**
The DC link of the meter retains a dangerous voltage for approx. 20 minutes after the supply voltage has been disconnected. Therefore, wait 20 minutes after disconnecting the supply voltage before removing 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 as accessory for this purpose. → 81

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.

- 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

- 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**

The DC link of the meter retains a dangerous voltage for approx. 20 minutes after the supply voltage has been disconnected. Therefore, wait 20 minutes after disconnecting the supply voltage before removing 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.
- After replacement, transfer all the settings noted and if necessary the values from a linearization table.

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.

Replacing the electronic unit

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.

To make it easier to disassemble the electronics, we recommend you also release the fastener for the motor connecting cable.

---

**Diagram:**

- 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
4. Release the plug of the tape switch.

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

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.
12.4 Return

The measuring device must be returned if the wrong device has been ordered or delivered. As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with 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 at http://www.endress.com/support/return-material

12.5 Disposal

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), our products are marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste.

Such products may not be disposed of as unsorted municipal waste and can be returned to Endress+Hauser for disposal at conditions stipulated in our General Terms and Conditions or as individually agreed.

12.5.1 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.

12.5.2 Disposing of the measuring device

Observe the following when disposing:
- Observe valid national regulations.
- Ensure proper separation and reuse of the device components.

⚠️ 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.
13 Accessories

13.1 Device specific accessories

13.1.1 Weather protection cover

The weather protection cover is simply fitted over the device once the device is installed and fastened on the device with four screws. You will need a free height of at least 400 mm (15.75 in) above the measuring device for installing and/or dismantling.

- Material: Stainless steel 304 (1.4301)
- Weight: 7.5 kg (16.5 lb)
- Mounting screws enclosed
- Order number: 52027964
13.1.2 Process adapter extension

If process temperatures are between +150 ... +230 °C (+302 ... +446 °F), the following process adapter extensions can be used to reduce the temperature when using the 1000 mm wiper extension:

- **Material:** Stainless steel 316Ti (1.4571)
- **Weight:** 16 kg (35.3 lb)
- The delivery contains suitable screws and nuts to secure the measuring device to the process adapter extension.
- **Order number:** 52028083

13.1.3 Adapter flange

The following adapter flanges can be used to adapt to existing process connections.

13.1.3.1 Adapter flange for lower pressure ratings

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.
Order number:
71301820 (DN150, PN16, EN1092-1, stainless steel 316Ti, 9 kg (19.8 lb))
71301821 (DN150, PN16, EN1092-1, steel, 9 kg (19.8 lb))
71301822 (DN200, PN16, EN1092-1, stainless steel 316Ti, 15 kg (33.1 lb))
71301824 (DN200, PN16, EN1092-1, steel, 15 kg (33.1 lb))
71301811 (6", 150lbs, ASME B16.5, stainless steel 316Ti, 10 kg (22 lb))
71301815 (6", 150lbs, ASME B16.5, steel, 10 kg (22 lb))
71301816 (8", 150lbs, ASME B16.5, stainless steel 316Ti, 18 kg (39.7 lb))
71301817 (8", 150lbs, ASME B16.5, steel, 18 kg (39.7 lb))

Dimension (mm (in)):

<table>
<thead>
<tr>
<th>Order number</th>
<th>Holes</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>71301820</td>
<td>8</td>
<td>22 (0.87)</td>
<td>M16</td>
<td>22 (0.87)</td>
<td>285 (11.22)</td>
</tr>
<tr>
<td>71301821</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71301822</td>
<td>12</td>
<td>22 (0.87)</td>
<td></td>
<td>24 (0.94)</td>
<td>340 (13.39)</td>
</tr>
<tr>
<td>71301824</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71301811</td>
<td>8</td>
<td>22.4 (0.88)</td>
<td>UNC 5/8&quot;</td>
<td>25.4 (1)</td>
<td>279.4 (11)</td>
</tr>
<tr>
<td>71301815</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71301816</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71301817</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The delivery contains suitable nuts to secure the measuring device to the adapter flange.
13.1.3.2 Adapter flange with studs for higher pressure ratings

- Order number:
  71301826 (DN100, PN25/40, EN1092-1, stainless steel 316Ti, 7 kg (15.4 lb))
  71301829 (DN100, PN25/40, EN1092-1, steel, 7 kg (15.4 lb))
  71301831 (4”, 300lbs, ASME B16.5, stainless steel 316Ti, 11 kg (24.3 lb))
  71301833 (4", 300lbs, ASME B16.5, steel, 11 kg (24.3 lb))
  71301834 (4", 600lbs, ASME B16.5, stainless steel 316Ti, 16 kg (35.3 lb))
  71301835 (4", 600lbs, ASME B16.5, steel, 16 kg (35.3 lb))

- Dimension (mm (in)):

<table>
<thead>
<tr>
<th>Order number</th>
<th>Stud bolts</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>71301826</td>
<td>8</td>
<td>M22</td>
<td>M16</td>
<td>25 (0.98)</td>
<td>235 (9.25)</td>
</tr>
<tr>
<td>71301829</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71301831</td>
<td></td>
<td></td>
<td></td>
<td>31.8 (1.25)</td>
<td>254 (10)</td>
</tr>
<tr>
<td>71301833</td>
<td></td>
<td></td>
<td></td>
<td>38.1 (1.5)</td>
<td>273.1 (10.75)</td>
</tr>
<tr>
<td>71301834</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71301835</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- The delivery suitable screws to secure the measuring device to the adapter flange.
## 13.1.4 Process adapter

### 13.1.4.1 Process adapters for smaller nominal diameters

The following process adapters can be used to adapt to existing process connections with smaller nominal diameters (< DN100).

![Process adapter (example DN80 PN16). Unit of measurement mm (in)](image)

- **Order number:**
  71301837 (DN50, PN16, EN1092-1, stainless steel 316Ti, 10.5 kg (23.1 lb))
  71301839 (DN50, PN16, EN1092-1, steel, 10.5 kg (23.1 lb))
  71301841 (DN65, PN16, EN1092-1, stainless steel 316Ti, 11 kg (24.3 lb))
  71301843 (DN65, PN16, EN1092-1, steel, 11 kg (24.3 lb))
  71301844 (DN80, PN16, EN1092-1, stainless steel 316Ti, 10 kg (22 lb))
  71301857 (DN80, PN16, EN1092-1, steel, 10 kg (22 lb))
  71301858 (2", 150lbs, ASME B16.5, stainless steel 316Ti, 11 kg (24.3 lb))
  71301859 (2", 150lbs, ASME B16.5, steel, 11 kg (24.3 lb))
  71301861 (3", 150lbs, ASME B16.5, stainless steel 316Ti, 11.5 kg (25.3 lb))
  71301864 (3", 150lbs, ASME B16.5, steel, 11.5 kg (25.3 lb))
  71301867 (4", 150lbs, ASME B16.5, stainless steel 316Ti, 12.5 kg (27.6 lb))
  71301868 (4", 150lbs, ASME B16.5, steel, 12.5 kg (27.6 lb))

- **Dimension (mm (in)):**

<table>
<thead>
<tr>
<th>Order number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>71301837</td>
<td>400 (15.75)</td>
<td>54.5 (2.15)</td>
<td>125 (4.92)</td>
<td>165 (6.50)</td>
<td>18 (0.71)</td>
</tr>
<tr>
<td>71301839</td>
<td>70.3 (2.77)</td>
<td>145 (5.71)</td>
<td>185 (7.28)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>71301841</td>
<td>200 (7.87)</td>
<td>82.5 (3.25)</td>
<td>160 (6.30)</td>
<td>200 (7.87)</td>
<td>200 (7.87)</td>
</tr>
<tr>
<td>71301843</td>
<td>420 (16.54)</td>
<td>52.6 (2.07)</td>
<td>120.7 (4.75)</td>
<td>152.4 (6.00)</td>
<td>19.1 (0.75)</td>
</tr>
<tr>
<td>71301857</td>
<td>220 (8.66)</td>
<td>78 (3.07)</td>
<td>152.4 (6.00)</td>
<td>190.5 (7.50)</td>
<td>23.9 (0.94)</td>
</tr>
<tr>
<td>71301861</td>
<td>128 (5.04)</td>
<td>102.4 (4.03)</td>
<td>190.5 (7.50)</td>
<td>228.6 (9.00)</td>
<td></td>
</tr>
</tbody>
</table>
The delivery contains suitable screws and nuts to secure the measuring device to the process adapter extension.

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

13.1.4.2 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 number:
71301870 (150 lbs, ASME, RF 4", aluminum)
71301872 (150 lbs, ASME, RF 4", aluminum, coated)

13.1.4.3 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.

- 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).
- Use the adapter only for pressureless processes.
Process adapter with spray water cleaning. Unit of measurement mm (in)

- DN100 PN16 (Connection dimensions according to DIN EN 1092-1)
- Material: 316Ti (1.4571)
- Weight: 15 kg (33.1 lb)
- Order number: 71301886
- Mounting screws enclosed
- For pressureless processes only!
13.1.5 Sensing weights for interface measurement

A

B

\[ \varnothing 55 \text{ (2.17)} \]

\[ \sim 428 \text{ (16.85)} \]

\[ \sim 385 \text{ (15.16)} \]

\[ \text{min. 196 (7.72)} \]

13.1.5.1 Sensing weight for interface measurement in liquids with a significant difference in density

- Order number:
  71301873 (316Ti (1.4571))
  71301875 (316Ti (1.4571), coated)
- Weight: 4 kg (8.82 lb)

The deviating block distance must be observed!

\( \rightarrow \) 31

13.1.5.2 Sensing weight for interface measurement in liquids with a minor difference in density

- Order number:
  71301876 (316Ti (1.4571))
  71301877 (316Ti (1.4571), coated)
- Weight: 4 kg (8.82 lb)

13.1.6 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:

\( \rightarrow \) 16

If the sensing weights sway significantly, we recommend the use of the extended wiper.
13.2  Device-specific tool

For a change of the measuring tape and the gear motor, the following removal tool is available, the operation is carried out with an Allen key 5 mm AF.

- Order number: 71001353
- Material: Steel

13.2.1  Removal tool

For a change of the measuring tape and the gear motor, the following removal tool is available, the operation is carried out with an Allen key 5 mm AF.

- Order number: 71001353
- Material: Steel

13.2.2  Tape stopper

The following measuring tape stopper is available for a change of the gear motor in the application, the operation is done with an Allen key 6 mm AF.

- Order number: 71001352
- Material: Steel and brass

14  Technical data

14.1  Input

14.1.1  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)
14.1.2 Measuring range
- FMM50-***6*********: 15 m (590.6 in)
- FMM50-***1*********: 25 m (984.3 in)
- FMM50-***2*********: 35 m (1378.0 in)
- FMM50-***3*********: 50 m (1968.5 in)
- FMM50-***4*********: 70 m (2755.9 in)
- FMM50-***5*********: 90 m (3543.3 in)

14.1.3 Block distance

<table>
<thead>
<tr>
<th>Sensing weight</th>
<th>Wiper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>230 mm</td>
</tr>
<tr>
<td>B, C, D, E, L</td>
<td>0.80 m (31.50 in)</td>
</tr>
<tr>
<td>G</td>
<td>1.20 m (47.24 in)</td>
</tr>
<tr>
<td>J</td>
<td>0.86 m (33.86 in)</td>
</tr>
<tr>
<td>M</td>
<td>0.65 m (25.59 in)</td>
</tr>
<tr>
<td>N</td>
<td>0.63 m (24.80 in)</td>
</tr>
<tr>
<td>71301873 / 71301875</td>
<td>0.85 m (33.46 in)</td>
</tr>
</tbody>
</table>

14.1.4 Input signal
2 signal inputs (start measurement, bolting)
- active: 12 to 24 V
- passive: switching contact max. 30 V DC / 300 mW
- Start pulse length: min. 200 ms

14.2 Output

14.2.1 Output signal
- Current output 0 - 20 mA / 4 - 20 mA
  - active
  - max. load: 600 Ω
- 2/6 Relay outputs
  - Contact load: max. 250 V AC / 6 A

14.2.2 Signal on alarm
- Error symbol, error code and description in plain text on the on-site display
- Current output, configurable → 34
- Relay outputs (alarm)

14.3 Performance characteristics
Measured error: ±5 cm
14.4 Minimum time for one measurement cycle

![Graph showing minimum time for one measurement cycle]

Minimum time for one measurement cycle

- **A**: Ambient temperature 70 °C (158 °F)
- **B**: Ambient temperature 60 °C (140 °F)
- **C**: Ambient temperature 50 °C (122 °F)
- **D**: Ambient temperature 40 °C (104 °F)
- **E**: Ambient temperature 30 °C (86 °F)
- **F**: Ambient temperature 20 °C (68 °F)

**Tm** Minimum time for one measurement cycle
**Mr** Measuring range

14.5 Running speed

Tape running speed: 0.21 to 0.35 m/s

14.6 Power supply

14.6.1 Supply voltage
- FMM50-*****1******: 180 to 253 V AC, 50/60 Hz
- FMM50-*****2******: 90 to 127 V AC, 50/60 Hz
- $I_{eff} = 8$ A (115 V) for 40 ms / 4.4 A (230 V) for 20 ms
- $I_{max} = 16$ A
- In accordance with IEC/EN61010 a suitable circuit breaker must be provided for the measuring device.

14.6.2 Power consumption
- 230 VA (without device heating)
- 250 VA (with integrated device heating)
14.6.3  **Cable entries**
- M25x1.5
- ø 10 to 17 mm (0.39 to 0.67 in)
- Material:
  - Plastic, Grey (Ex-free area)
  - Plastic, black (Ex approval)
- Quantity:
  - 4 piece (not additionally equipped with external start button)
  - 3 piece (additionally equipped with external start button)

14.7  **Environment**

14.7.1  **Ambient temperature**
- FMM50-******A/C****: -20 to +70 °C (-4 to +158 °F)
- FMM50-******B/D****: -40 to +70 °C (-40 to +158 °F)
- For outdoor operation in strong sunlight: Use weather protection cover

14.7.2  **Storage temperature**
-40 to +80 °C (-40 to +176 °F)

14.7.3  **Degree of protection**
- With closed housing: IP67
- With closed housing and with the use of the external start button: IP65
- With open housing: IP20

14.7.4  **Electromagnetic compatibility**
- Interference emission to EN 61326, Electrical Equipment Class B
- Interference immunity to EN 61326, Appendix A (Industrial)
- A normal installation cable is sufficient for the wiring.

14.8  **Process**

14.8.1  **Process temperature**
- FMM50-******1****: -20 to +70 °C (-4 to +158 °F)
  (Restriction for FMM50-******1*M*: 0 to +60 °C (+32 to +140 °F))
- FMM50-******2****: -20 to +150 °C (-4 to +302 °F)
- FMM50-******1***: -20 to +230 °C (-4 to +446 °F)

14.8.2  **Process pressure**
- FMM50-******1**: 0.8 to 1.1 bar (12 to 16 psi) absolute
- FMM50-******2**: 0.8 to 3.0 bar (12 to 43 psi) absolute

14.9  **Additional technical data**

Latest technical information: Endress+Hauser website:
www.endress.com → Downloads
# Appendix

The following tables provide an aid to documentation (for example, in the event of replacement of the electronics).

## 15.1 User parameters

<table>
<thead>
<tr>
<th>Basic setup</th>
<th>Default</th>
<th>User setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>001 Empty calibration</td>
<td>Length of measuring tape</td>
<td></td>
</tr>
<tr>
<td>002 Block distance</td>
<td></td>
<td>→ 82</td>
</tr>
<tr>
<td>003 Full calibration</td>
<td></td>
<td>001 - 002</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inputs and outputs</th>
<th>Default</th>
<th>User setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>010 Input 1</td>
<td>not used</td>
<td></td>
</tr>
<tr>
<td>011 Polarity input 1</td>
<td>NO contact</td>
<td></td>
</tr>
<tr>
<td>012 Input 2</td>
<td>not used</td>
<td></td>
</tr>
<tr>
<td>013 Polarity input 2</td>
<td>NO contact</td>
<td></td>
</tr>
<tr>
<td>014 Relay output 1</td>
<td>alarm</td>
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<tr>
<td>015 Pulse weight</td>
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<tr>
<td>016 Pulse length</td>
<td>50 ms</td>
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<tr>
<td>017 Threshold</td>
<td>60 %</td>
<td></td>
</tr>
<tr>
<td>018 Hysteresis</td>
<td>3 %</td>
<td></td>
</tr>
<tr>
<td>019 Reset pulse</td>
<td>300 ms</td>
<td></td>
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<tr>
<td>01A Relay output 2</td>
<td>service interval</td>
<td></td>
</tr>
<tr>
<td>01B Relay output 3</td>
<td>measuring</td>
<td></td>
</tr>
<tr>
<td>01C Relay output 4</td>
<td>threshold</td>
<td></td>
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<tr>
<td>01D Relay output 5</td>
<td>reset pulse</td>
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<tr>
<td>01E Relay output 6</td>
<td>band return</td>
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<tr>
<th>Measurement parameter</th>
<th>Default</th>
<th>User setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>020 Measurement type</td>
<td>single cycle</td>
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</tr>
<tr>
<td>021 Time interval</td>
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<td></td>
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<tr>
<td>022 Time unit</td>
<td>Hour(s)</td>
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<tr>
<td>023 Normal or short</td>
<td>normal</td>
<td></td>
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<tr>
<td>024 Service interval</td>
<td>45000</td>
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<tr>
<td>028 Run-up length</td>
<td>1 m</td>
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<tr>
<th>Current output</th>
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<tr>
<td>030 Current mode</td>
<td>normal</td>
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<tr>
<td>031 0/4mA value</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>032 20mA value</td>
<td>(Full calibration)</td>
<td></td>
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<tr>
<td>033 Current range</td>
<td>4-20mA</td>
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<thead>
<tr>
<th>Safety settings</th>
<th>Default</th>
<th>User setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>040 Output on alarm</td>
<td>MIN (0/3.6mA)</td>
<td></td>
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<tr>
<td>041 Output on alarm</td>
<td>3.60 mA</td>
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</tr>
<tr>
<td>042 Safety distance</td>
<td>0 m</td>
<td></td>
</tr>
<tr>
<td>043 Security distance</td>
<td>0 m</td>
<td></td>
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<tr>
<td>044 In security distance</td>
<td>warning</td>
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<td>045 In safety distance</td>
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### Linearization Default User setting

<table>
<thead>
<tr>
<th>TabNr</th>
<th>Level</th>
<th>Volume</th>
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<tbody>
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<td>050</td>
<td>Level CU</td>
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</tr>
<tr>
<td>051</td>
<td>linear</td>
<td></td>
</tr>
<tr>
<td>056</td>
<td>%</td>
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<tr>
<td>057</td>
<td>100 %</td>
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### Display Default User setting

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<thead>
<tr>
<th>TabNr</th>
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<th>No. of decimals</th>
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<td>060</td>
<td>English</td>
<td>100 s</td>
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### Diagnostics Default User setting

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### System parameters Default User setting

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### 15.2 Linearization table

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