Operating Instructions
Cubemass DCI

HART

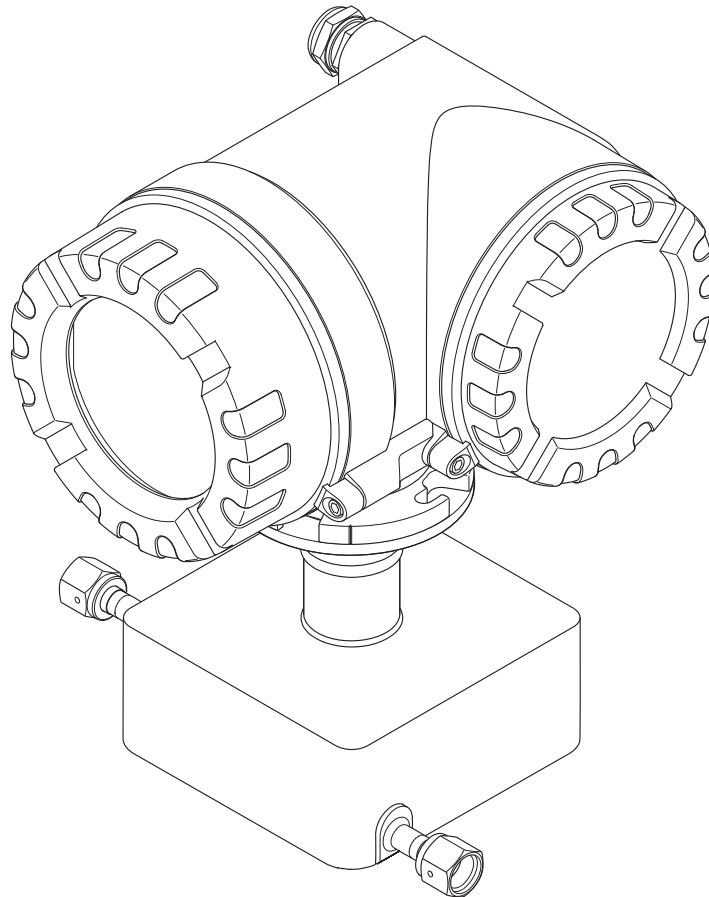Coriolis flowmeter

HART®
FIELD COMMUNICATION PROTOCOL

Endress+Hauser

People for Process Automation

Endress+Hauser [EH]

People for Process Automation

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1   Safety instructions

1.1   Designated use

The measuring device described in these operating instructions may only be used for measuring the mass flow of liquids and gases. At the same time, the system also measures fluid density and fluid temperature. These parameters are then used to calculate other variables such as volume flow. Fluids with widely differing properties can be measured. Resulting from incorrect use or from use other than that designated the operational safety of the measuring devices can be suspended. The manufacturer accepts no liability for damages being produced from this.

1.2   Installation, commissioning and operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the measuring device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions they contain.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Instructions is mandatory.
- Endress+Hauser will be happy to assist in clarifying the corrosion resistance properties of materials wetted by special fluids, including fluids used for cleaning. However, small changes of temperature, concentration or degree of contamination in the process can result in differences in corrosion resistance. Therefore, Endress+Hauser provides no warranty and assumes no liability with regard to corrosion resistance of fluid wetted materials in an application. The user is responsible for choosing suitable fluid wetted materials in the process.
- If welding work is performed on the piping system, do not ground the welding appliance via the measuring device.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded, except in cases where special protective measures have been taken, e.g. galvanically isolated power supply SELV or PELV. (SELV = Safety Extra Low Voltage; PELV = Protective Extra Low Voltage).
- Invariably, local regulations governing the maintenance and repair of electrical devices apply.

1.3   Operational safety

Note the following points:
- Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of these Operating Instructions. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this supplementary Ex documentation indicates the approval and the inspection body (⟨Ex⟩ Europe, NEC/CEC[1], NEPSI).
- The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of IEC/EN 61326, and NAMUR recommendations NE 21, 43 and 53.
- Depending on the version, the housing of the sensor can be equipped with a rupture disk to prevent the pressure in the sensor housing from increasing in the event of an error. As long as the adhesive label (→ 🖻 7) is intact, the rupture disk is also intact.

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1)   NEC (National Electrical Code) / CEC (Canadian Electrical Code)

- For measuring systems used in SIL 2 applications, the separate manual on functional safety (SD077D/06) must be observed.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser representative will supply you with current information and any updates to these Operating Instructions.
- Danger - hot surfaces. Hot fluids passing through the measuring tube increase the surface temperature of the sensor housing. Temperatures close to the fluid temperature must be expected. If fluid temperatures are high, take suitable measures to protect against scalding from the hot surfaces.

1.4   Return

- Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
- Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.
- Please note the measures on → 🗎 75

1.5   Notes on safety conventions and icons

The devices are designed to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010 "Safety requirements for electrical equipment for measurement, control and laboratory use". However, they can be a source of danger if used incorrectly or for other than the designated use. Consequently, always pay particular attention to the safety instructions indicated in these Operating Instructions by the following icons:

⚠ Warning!
"Warning" indicates an action or procedure, which, if not performed correctly, can result in injury or a safety hazard. Comply strictly with the instructions and proceed with care.

☝ Caution!
"Caution" indicates an action or procedure, which, if not performed correctly, can result in incorrect operation or destruction of the measuring device. Comply strictly with the instructions.

✎ Note!
"Note" indicates an action or procedure, which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.

1.6   Symbols on nameplates

The following symbol appears on nameplates (refer to the corresponding documentation):

In the case of devices for potentially explosive atmospheres, a documentation code appears, representing supplementary Ex documentation that it is mandatory to read.

2   Identification

The following options are available for identification of the measuring device:
• Nameplate specifications.
• Order code with breakdown of the device features on the delivery note.
• Enter serial numbers from nameplates in *W@M Device Viewer*
  (www.endress.com/deviceviewer): All information about the measuring device is
  displayed.

For an overview of the scope of the Technical Documentation provided, refer to the
following:
• The chapters "Documentation" → 🖹 86.
• The *W@M Device Viewer*: Enter the serial number from the nameplate
  (www.endress.com/deviceviewer).

Reorder
The measuring device is reordered using the order code.

Extended order code:
• The device type (product root) and basic specifications (mandatory features) are always
  listed.
• Of the optional specifications (optional features), only the safety and approval-related
  specifications are listed (e.g. LA). If other optional specifications are also ordered, these
  are indicated collectively using the # placeholder symbol (e.g. #LA#).
• If the ordered optional specifications do not include any safety and approval-related
  specifications, they are indicated by the + placeholder symbol
  (e.g. 8CN**-AACCCAAD2S1+).

2.1   Device designation

The "Cubemass DCI" flow measuring system consists of the following components:
• Transmitter
• Sensor

Two versions are available:
• Compact version: transmitter and sensor form a single mechanical unit.
• Remote version: transmitter and sensor are installed separately.

2.1.1   Nameplate of the transmitter
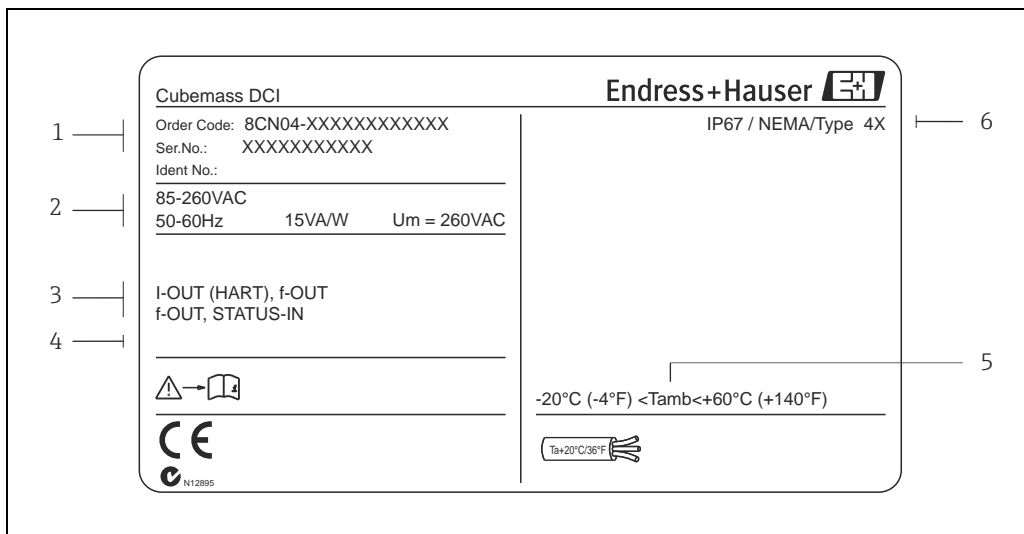
Fig. 1:   Nameplate specifications for the transmitter (example)

1   Order code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits
2   Power supply/ frequency: 85 to 260 V AC/ 50 to 60 Hz
*   Power consumption: 15 VA / 15 W*
3   Available inputs / outputs
4   Reserved for information on special products
5   Ambient temperature range
6   Degree of protection

2.1.2   Nameplate of the sensor
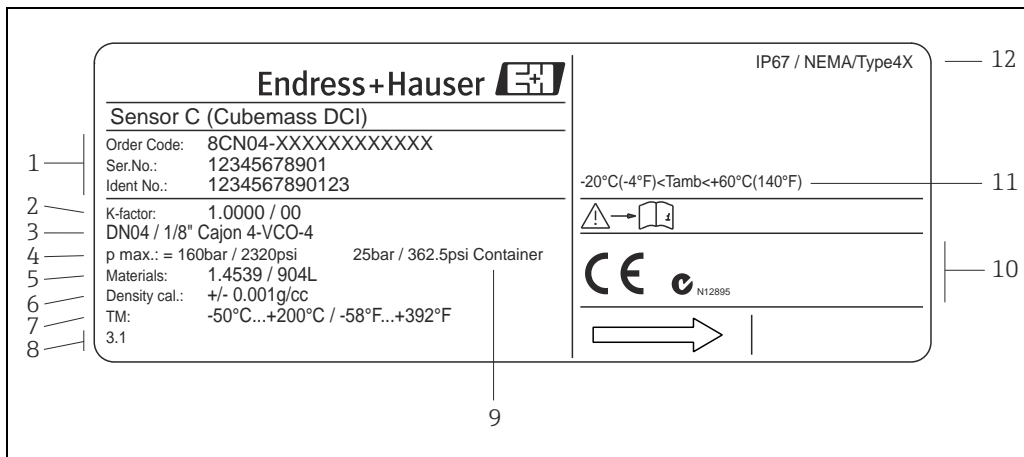
Fig. 2:   Nameplate specifications for the sensor (example)

1   Order code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits
2   Calibration factor
3   Flange nominal diameter
4   Max. pressure
5   Material
6   Density
7   Fluid temperature range
8   Reserved for information on special products
9   Secondary containment pressure range
10   Reserved for additional information on device version (approvals, certificates)
11   Ambient temperature range
12   Degree of protection

2.1.3 Nameplate for connections
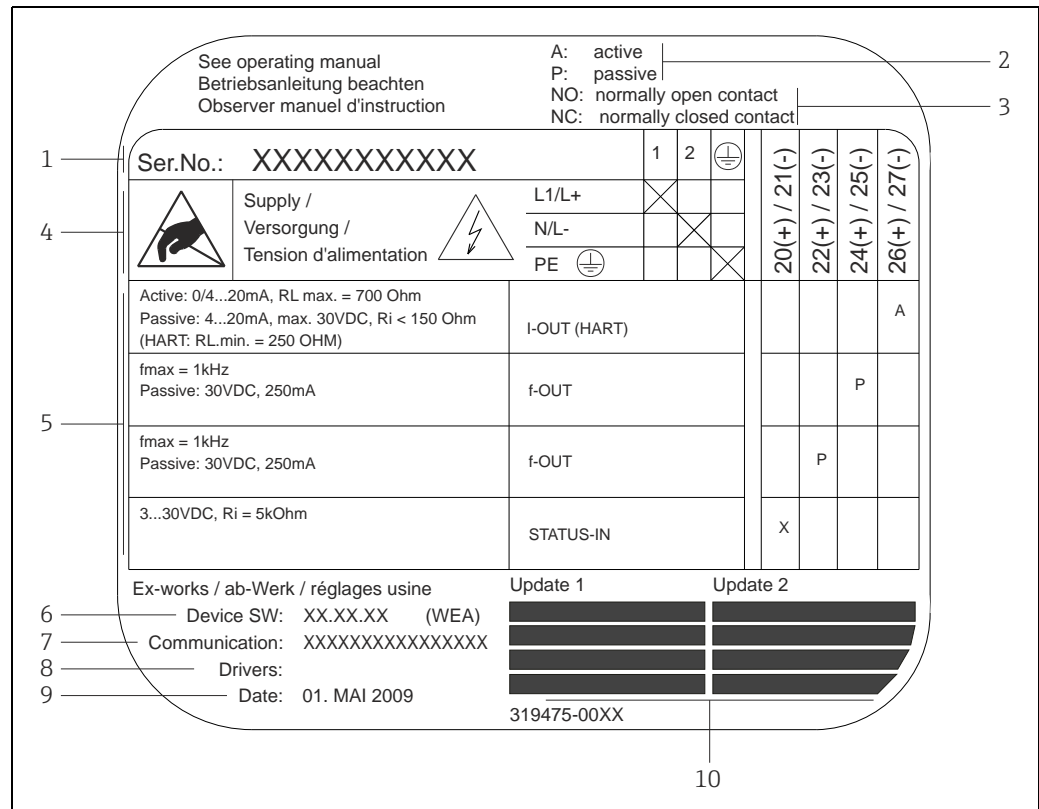
Fig. 3:   Nameplate specifications for transmitter connections (example)

1   Serial number
2   Possible configuration of current output
3   Possible configuration of relay contacts
4   Terminal assignment, cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
    *–   Terminal **No. 1**: L1 for AC, L+ for DC*
    *–   Terminal **No. 2**: N for AC, L- for DC*
5   Signals present at inputs and outputs, possible configuration and terminal assignment (20 to 27),
    → also "Electrical values of inputs/outputs" → 🕮 76
6   Version of device software currently installed (incl. language group)
7   Installed communication type
*8   Information on current communication software (Device Revision and Device Description)*
9   Date of installation
10   Current updates to data specified in points 6 to 9

2.2   Certificates and approvals

The devices are designed in accordance with good engineering practice to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate.

The measuring devices comply with the applicable standards and regulations in accordance with EN 61010 -1, "Safety requirements for electrical equipment for measurement, control and laboratory use" and with the EMC requirements of IEC/EN 61326. The measuring system described in these Operating Instructions thus complies with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

The measuring system meets the EMC requirements of the Australian Communications and Media Authority (ACMA).

2.3   Registered trademarks

KALREZ® and VITON®
Registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

HART®
Registered trademark of HART Communication Foundation, Austin, USA

Applicator®, FieldCare®, HistoROM™, S-DAT®, T-DAT®
Registered or registration-pending trademarks of the Endress+Hauser Group

3 Incoming acceptance, transport and storage

3.1 Incoming acceptance

On receipt of the goods, check the following points:
• Is the packaging or content damaged?
• Is anything missing from the shipment and does the scope of supply match your order?

3.2 Transport

Comply with the following instructions when unpacking the device and transporting it to its final location:
• Transport the devices in the containers in which they are delivered.
• The covers or caps fitted to the process connections prevent mechanical damage to the sealing faces and the ingress of foreign matter to the measuring tube during transportation and storage. Consequently, do not remove these covers or caps until immediately before installation.

3.3 Storage

Note the following points:
• Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
• The permitted storage temperature is −40 to +80 °C (−40 to 176 °F), preferably +20 °C (+68 °F).
• Do not remove the protective caps on the process connections until you are ready to install the device.
• The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.

4   Installation

4.1   Installation conditions

Note the following points:
- The measuring device is designed for mounting on tabletops, walls or pipes.
- The high oscillation frequency of the measuring tubes ensures that the correct operation of the measuring system is not influenced by pipe vibrations.
- No special precautions need to be taken for fittings which create turbulence (valves, elbows, T-pieces etc.) as long as no cavitation occurs.
- For mechanical reasons, and in order to protect the piping, it is advisable to support heavy sensors.

4.1.1   Dimensions

All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation entitled "Technical Information" → 🖺 86.

4.1.2   Mounting location

The accumulation of air and the formation of gas bubbles in the measuring tube could result in an increase in measuring errors. For this reason, **avoid** the following mounting locations in the pipe:
- The highest point of a pipeline. Risk of air accumulating.
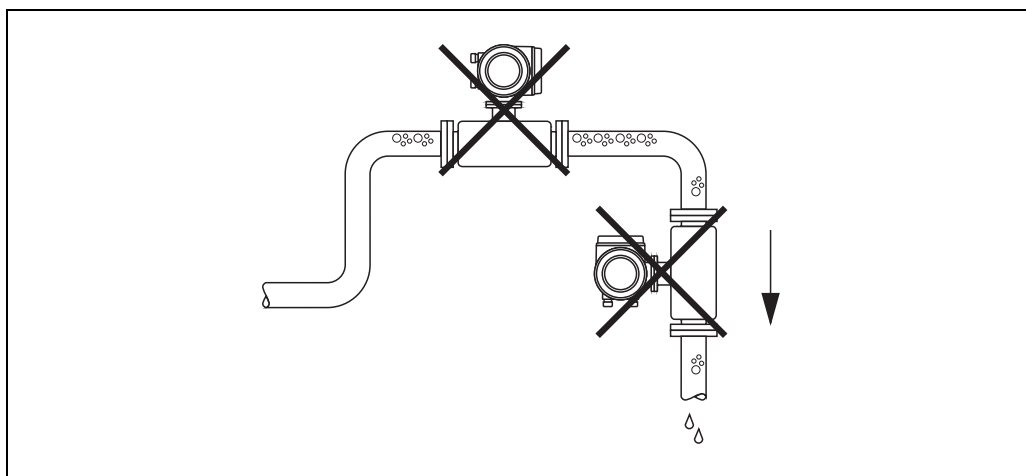- Directly upstream of a free pipe outlet in a down pipe.

Fig. 4:   Mounting location

The proposed configuration in the following diagram, however, permits installation in an open down pipe. Pipe restrictors or the use of an orifice plate with a smaller cross-section than the nominal diameter prevent the sensor from running empty during measurement.
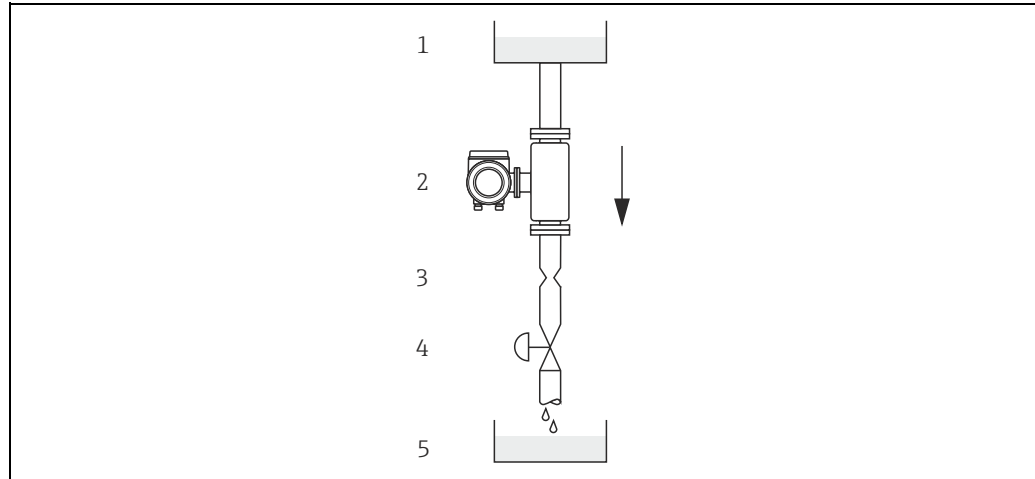
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Fig. 5:   Installation in a down pipe (e.g. for batching applications)

1   Supply tank
2   Sensor
3   Orifice plate, pipe restriction (see Table)
4   Valve
5   Batching tank

DN		Ø Orifice plate, pipe restriction	
mm	in	mm	in
1	$\frac{1}{24}$"	0.8	0.03
2	$\frac{1}{12}$"	1.5	0.06
4	$\frac{1}{8}$"	3.0	0.12
6	$\frac{1}{4}$"	5.0	0.20

System pressure

It is important to ensure that cavitation does not occur as it could influence the oscillation of the measuring tube. No special measures need to be taken for fluids which have properties similar to water under normal conditions.
In the case of liquids with a low boiling point (hydrocarbons, solvents, liquefied gases) or in suction lines, it is important to ensure that pressure does not drop below the vapor pressure and that the liquid does not start to boil. It is also important to ensure that the gases that occur naturally in many liquids do not outgas. Such effects can be prevented when system pressure is sufficiently high.

Consequently, it is generally best to install the sensor:
• On the pump pressure side (no risk of vacuum)
• At the lowest point in a riser

4.1.3   Orientation

Make sure that the direction of the arrow on the nameplate of the sensor matches the direction of flow (direction in which the fluid flows through the pipe).

Vertical/horizontal:

When installed correctly, the transmitter housing is above or below the pipe. This arrangement means that no gas bubbles or solid deposits can accumulate in the curved measuring tube (single-tube system).
Do not install the sensor in such a way that it is suspended in the pipe without support or measures to secure it. This prevents excessive material strain at the process connection. The base plate of the sensor housing is designed for mounting on a tabletop, wall or post.
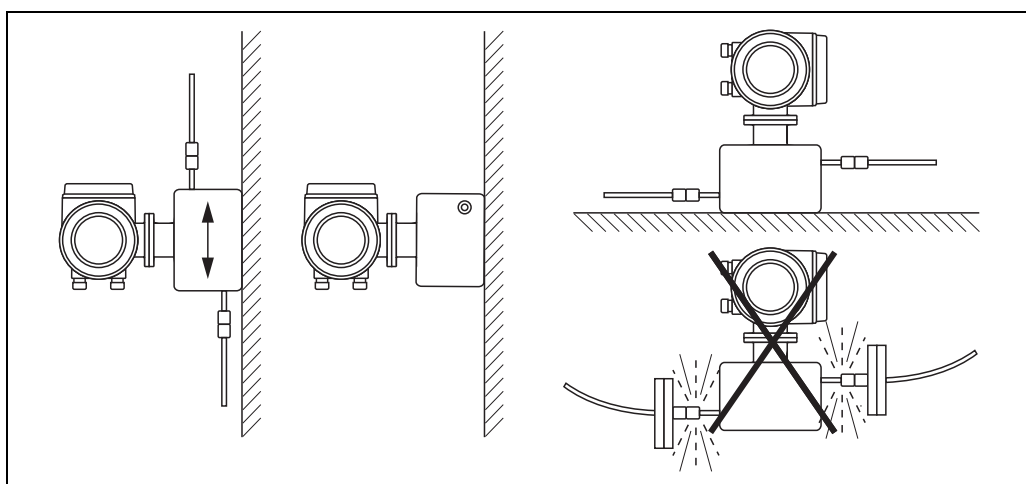

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Fig. 6:   Vertical and horizontal orientation

4.1.4   Heating

Some fluids require suitable measures to avoid loss of heat at the sensor. Heating can be electric, e.g. with heated elements, or by means of heating jackets or copper pipes conveying hot water or steam.

Caution!
- Danger of electronics overheating. Make sure that the maximum permissible ambient temperature for the transmitter is not exceeded.
  The adapter between the sensor and transmitter and the connection housing of the remote version must always remain free of insulating material.
- If using an electric trace heating system whose heating is regulated via phase control or pulse packages, there is the possibility that measured values could be influenced by magnetic fields which may occur (i.e. for values greater than those permitted by the EC standard (sine 30 A/m)). In such instances, it is necessary to magnetically shield the sensor.
  The secondary containment can be shielded with tin plate or electric sheets without privileged direction (e.g. V330-35A) with the following properties:
  – Relative magnetic permeability $\mu_r \geq 300$
  – Plate thickness $d \geq 0.35$ mm ($\geq 0.0011"$)
- For information on the permitted temperature ranges → 🗏 81. In the case of measuring devices that are used in hazardous areas, the trace heating system may not generate temperatures above the permitted fluid temperature per temperature class.

4.1.5   Inlet and outlet runs

There are no installation requirements regarding inlet and outlet runs. If possible, mount the sensor upstream of fittings such as valves, T-pieces, elbows etc.

4.1.6   Vibrations

The high oscillation frequency of the measuring tubes ensures that the correct operation of the measuring system is not influenced by pipe vibrations. Consequently, the sensors require no special measures for attachment.

4.1.7   Limiting flow

Limiting flow information can be found in the separate "Technical Information" document, → 🕮 86.

4.1.8   Special installation instructions

Rupture disk

Make sure that the function and operation of the rupture disk is not impeded through the installation of the device. The position of the rupture disk is indicated on a sticker beside it. For additional information that is relevant to the process (→ 🕮 82).

The existing connecting nozzles are not intended for the purpose of rinsing or pressure monitoring, but instead serve as the mounting location for the rupture disk.

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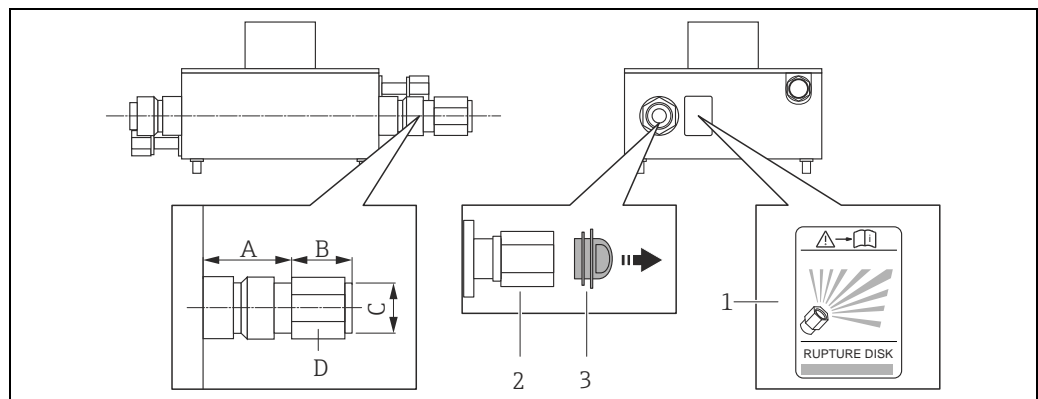
Abb. 7:   Sensor housing with rupture disk for defined medium exit

1   Rupture disk label
2   Rupture disk with ½" NPT internal thread with 1" width across flat
3   Transport protection

Dimensions in SI units

DN	A	B	C	D
1 to 6	33	Approx. 42	½" NPT	AF 1"

All dimensions in [mm]

Dimensions in US units

DN	A	B	C	D
¹⁄₂₄ to ¼"	1.3	Approx. 1.65	½" NPT	AF 1"

All dimensions in [in]

⚠ Warning!
Limited functional reliability of the rupture disk.
Danger to persons from escaping fluids.
- Do not remove the rupture disk.
- When using a rupture disk, do not use a heating jacket.
- Make sure that the function and operation of the rupture disk is not impeded through the installation of the device.
- Take precautions to prevent damage and danger to persons if the rupture disk is actuated.
- Observe information on the rupture disk sticker.

4.2 Installation instructions

4.2.1 Turning the transmitter housing

Turning the aluminum field housing

⚠ Warning!
The turning mechanism in devices with EEx d/de or NEC/CEC Cl. I Div. 1 classification is not the same as that described here. The procedure for turning these housings is described in the Ex-specific documentation.

1. Loosen the two securing screws.
2. Turn the bayonet catch as far as it will go.
3. Carefully lift the transmitter housing as far as it will go.
4. Turn the transmitter housing to the desired position (max. 2 × 90° in either direction).
5. Lower the housing into position and reengage the bayonet catch.
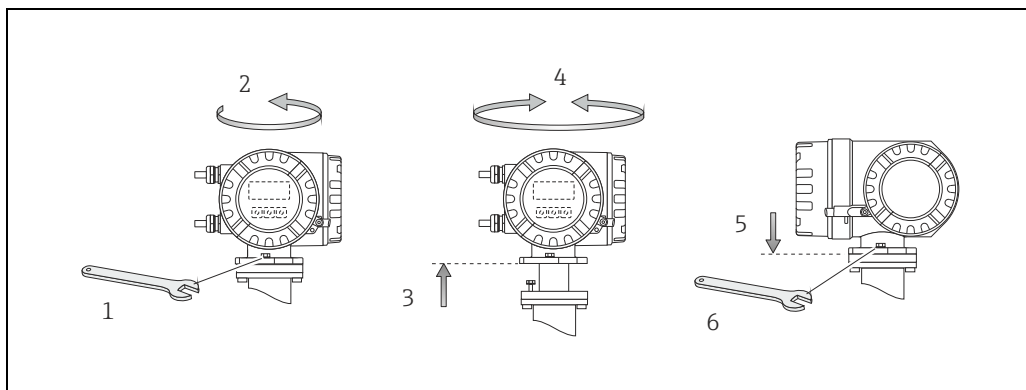6. Retighten the two securing screws.

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Fig. 8:   Turning the transmitter housing (aluminum field housing)

4.2.2   Installing the wall-mount housing

There are various ways of installing the wall-mount housing:
- Mounted directly on the wall
- Installation in control panel (separate mounting set, accessories) → 🖺 17
- Pipe mounting (separate mounting set, accessories) → 🖺 17

Caution!
- At the mounting location, ensure that the permitted ambient temperature range (−20 to +60 °C (−4 to +140 °F), optional −40 to +60 °C (−40 to +140 °F)) is not exceeded. Install the device in a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Mounted directly on the wall

1.   Drill the holes → 🖾 9.

2.   Remove the cover of the connection compartment (a).

3.   Push the two securing screws (b) through the appropriate bores (c) in the housing.
      – Securing screws (M6): max. Ø 6.5 mm (0.26")
      – Screw head: max. Ø 10.5 mm (0.41")

4.   Secure the transmitter housing to the wall as indicated.

5.   Screw the cover of the connection compartment (a) firmly onto the housing.
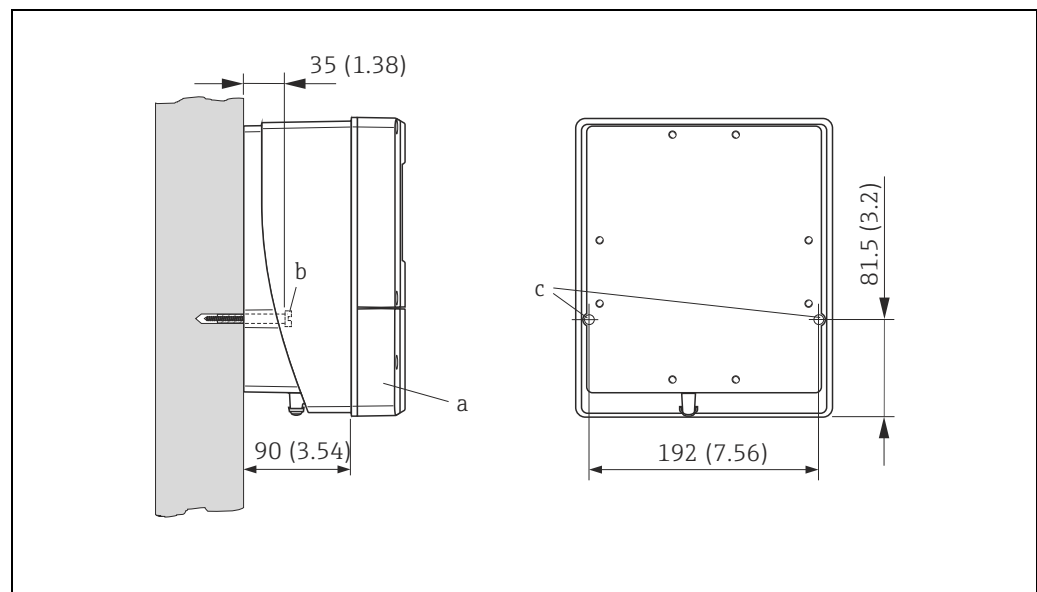
Fig. 9:   *Mounted directly on the wall*

Installation in control panel

1. Prepare the opening in the panel → ▣ 10.

2. Slide the housing into the opening in the panel from the front.

3. Screw the fasteners onto the wall-mount housing.

4. Screw the threaded rods into the holders and tighten them until the housing is secured on the panel wall. Afterwards, tighten the locking nuts. Additional support is not necessary.
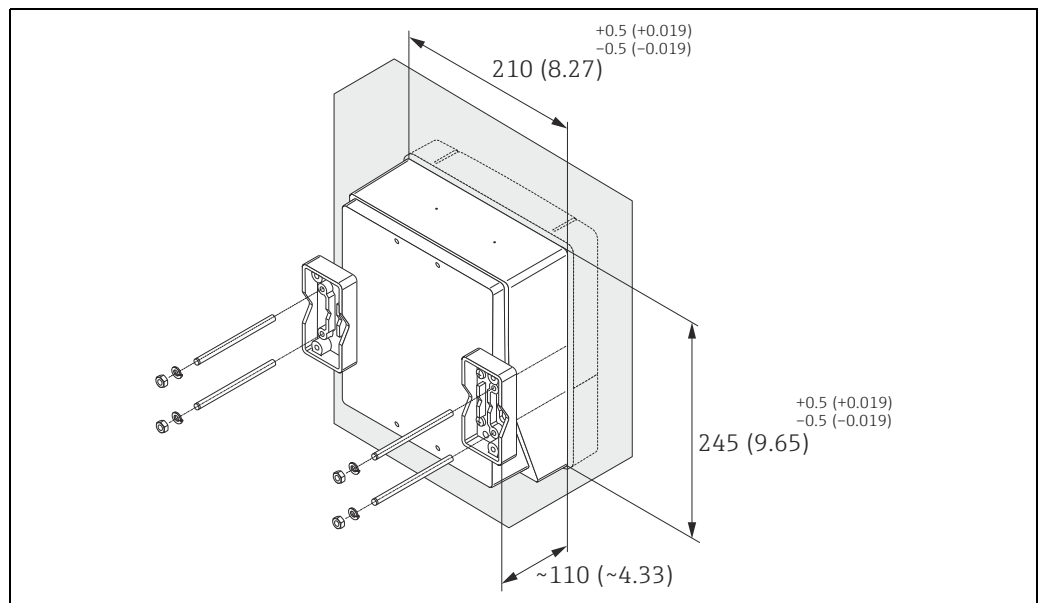
Fig. 10:   Panel installation (wall-mount housing)

Pipe mounting

The assembly should be performed by following the instructions in → ▣ 11.

☞ Caution!
If a warm pipe is used for installation, ensure that the housing temperature does not exceed the permitted value of +60 ℃ (+140 ℉).
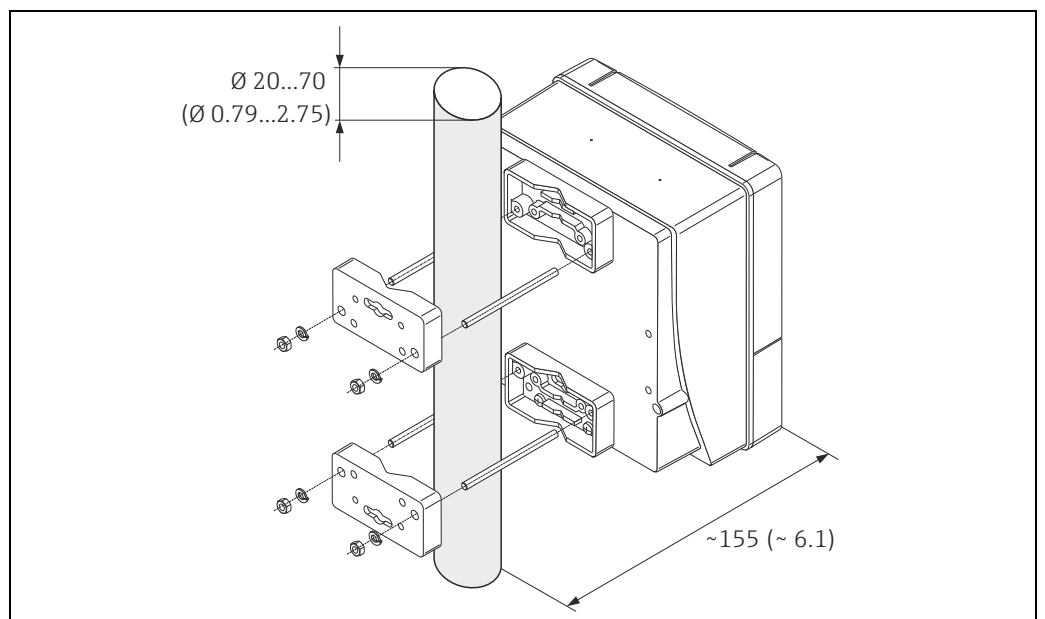
Fig. 11:   Pipe mounting (wall-mount housing)

4.2.3   Turning the local display

1. Unscrew cover of the electronics compartment from the transmitter housing.

2. Press the side latches on the display module and remove the module from the electronics compartment cover plate.

3. Rotate the display to the desired position (max. 4 × 45 ˚ in both directions), and reset it onto the electronics compartment cover plate.

4. Screw the cover of the electronics compartment firmly back onto the transmitter housing.
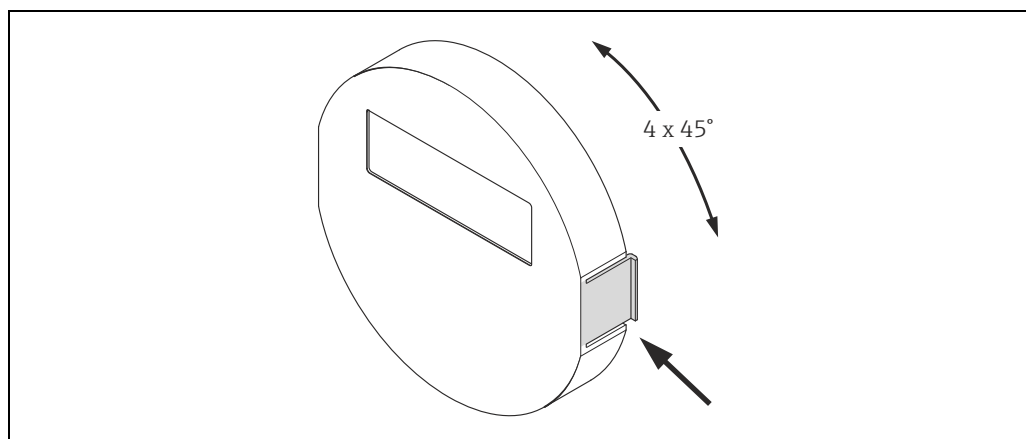
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*Fig. 12:   Turning the local display (field housing)*

4.3   Post-installation check

Perform the following checks after installing the measuring device in the pipe:

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	–
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, measuring range etc.?	→ 🖺 7
Installation	Notes
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	–
Are the measuring point number and labeling correct (visual inspection)?	–
Is the orientation chosen for the sensor correct, in other words suitable for sensor type, fluid properties (outgassing, with entrained solids) and fluid temperature?	→ 🖺 11
Process environment / process conditions	Notes
Is the measuring device protected against moisture and direct sunlight?	–

5 Wiring

⚠ Warning!
When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions. Please do not hesitate to contact your Endress+Hauser sales office if you have any questions.

✎ Note!
The measuring device does not have an internal disconnecting device. Therefore, assign a switch or circuit breaker to the measuring device with which the voltage supply line can be disconnected from the power system.

5.1 Shielding and grounding

When planning the shielding and grounding for a fieldbus system, there are three important points to consider:
• Electromagnetic compatibility (EMC)
• Explosion protection
• Employee safety

To ensure the optimum electromagnetic compatibility of systems, it is important that the system components and above all the cables, which connect the components, are shielded and that no portion of the system is unshielded. Ideally, the cable shields are connected to the normally metal housings of the connected field devices. Since these are generally connected to the protective ground, the shield of the bus cable is grounded many times. Make sure that the stripped and twisted lengths of cable shield to the terminals are as short as possible. This approach, which provides the best electromagnetic compatibility and employee safety, can be used without restriction in systems with optimum potential equalization.

In the case of systems without potential equalization, a mains frequency (50 Hz) equalizing current can flow between two grounding points which can destroy the cable in unfavorable cases, e.g. when it exceeds the permissible shield current. To suppress the low frequency equalizing currents on systems without potential equalization, it is therefore recommended to connect the cable shield directly to the building ground (or protective ground) at one end only and to use capacitive coupling to connect all other grounding points.

☞ Caution!
The legal EMC requirements are fulfilled **only** when the cable shield is grounded on both sides.

5.2   Connecting the remote version

5.2.1   Connecting cable for sensor/transmitter

⚠ Warning!
- Risk of electric shock. Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective ground to the ground terminal on the housing before the power supply is applied.
- You may only connect the sensor to the transmitter with the same serial number. Communication errors can occur if this is not observed when connecting the devices.

1.   Remove the cover (d) from the connection compartment or sensor housing.

2.   Feed the connecting cable (e) through the appropriate cable runs.

3.   Establish the wiring between the sensor and transmitter in accordance with the wiring diagram ($\rightarrow$ �« 13 or wiring layout in the screw cap).

4.   Seal the connection compartment or the transmitter housing again.

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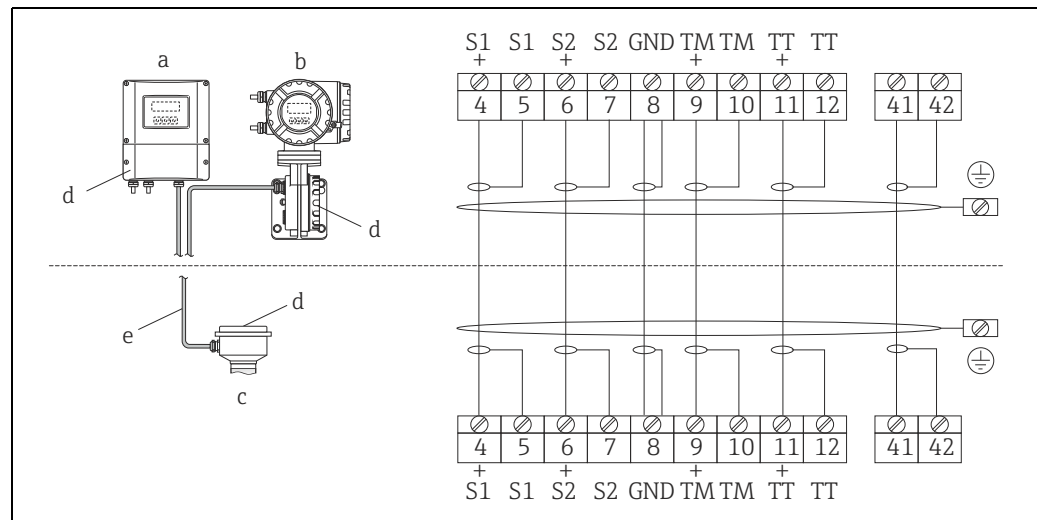
Fig. 13:   Connecting the remote version

a   Transmitter wall-mount housing: non-hazardous area $\rightarrow$ separate documentation
b   Transmitter wall-mount housing: ATEX II2G / Zone 1 / NEC/CEC $\rightarrow$ separate Ex documentation
c   Sensor connection housing
d   Cover of connection compartment or connection housing
e   Connecting cable

Terminal No.: 4/5 = gray; 6/7 = green; 8 = yellow; 9/10 = pink; $11/12$ = white; 41/42 = brown

5.2.2   Cable specification, connecting cable

The specifications of the cable connecting the transmitter and the sensor of the remote version are as follows:
- 6×0.38 mm^2 (20 AWG) PVC cable with common shield and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km (≤ 0.015 Ω/ft)
- Capacitance core/shield: ≤ 140 pF/m (≤ 42.7 pF/ft)
- Cable length: max. 20 m (65.6 ft)
- Permanent operating temperature: max. +105 °C (+221 °F)

✎ Note!
The cable must be installed securely, to prevent movement.

5.3 Connecting the measuring unit

5.3.1 Transmitter connection

⚠ Warning!
- Risk of electric shock. Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective ground to the ground terminal on the housing before the power supply is applied unless special protection measures have been taken (e. g. galvanically isolated power supply SELV or PELV).
- Compare the specifications on the nameplate with the local supply voltage and frequency. The national regulations governing the installation of electrical equipment also apply.

1. Remove the cover of the connection compartment (a) from the transmitter housing.

2. Feed the power supply cable (b), signal cable (g) and fieldbus cable (d) through the appropriate cable entries.

3. Perform wiring in accordance with the respective terminal assignment and the associated wiring diagram.

    ☝ Caution!
    – Risk of damaging the fieldbus cable. Observe the information about shielding and grounding the fieldbus cable (→ 🕮 19).
    – We recommend that the fieldbus cable not be looped using conventional cable glands. If even just one measuring device is subsequently replaced, the bus communication will have to be interrupted.

4. Screw the cover of the connection compartment (a) firmly onto the transmitter housing.

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Fig. 14:   Connecting the transmitter (field housing), cable cross-section: max. 2.5 mm² (14 AWG)

a   Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC
   *–   Terminal **No. 1**: L1 for AC, L+ for DC*
   *–   Terminal **No. 2**: N for AC, L- for DC*
*b   Signal cable: Terminals **No. 20 to 27** → 🕮 22*
c   Ground terminal for protective ground
d   Ground terminal for signal cable shield
e   Service adapter for connecting service interface FXA193 (FieldCare)
f   Cover of the connection compartment
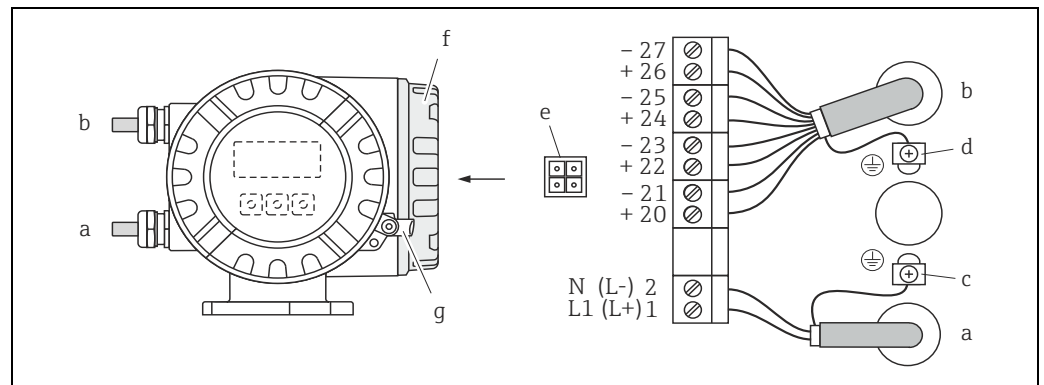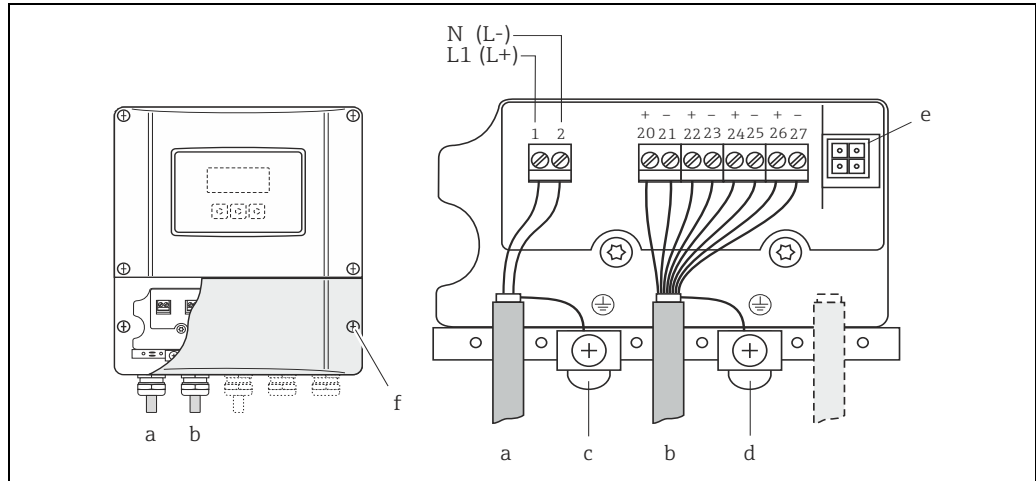*g   Securing clamp*

Fig. 15: Connecting the transmitter (wall-mount housing), cable cross-section: max. 2.5 mm² (14 AWG)

a   *Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC*
     *– Terminal **No. 1**: L1 for AC, L+ for DC*
     *– Terminal **No. 2**: N for AC, L- for DC*
b   *Signal cable: Terminals **No. 20 to 27** → 🖹 22*
c   *Ground terminal for protective ground*
d   *Ground terminal for signal cable shield*
e   *Service adapter for connecting service interface FXA193 (FieldCare)*
f   *Cover of the connection compartment*

5.3.2 Terminal assignment

Electrical values for inputs → 🖹 76.
Electrical values for outputs → 🖹 76.

Order characteristic for "inputs/outputs"	Terminal No. (inputs/outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 (+) / 27 (−)
Fixed communication boards (permanent assignment)				
S	–	–	Frequency output, Ex i, passive	Current output, Ex i, active, HART
T	–	–	Frequency output, Ex i, passive	Current output, Ex i, passive, HART
Flexible communication boards				
D	Status input	Relay output	Frequency output	Current output, HART
M	Status input	Frequency output 2	Frequency output 1	Current output, HART
1	Relay output	Frequency output 2	Frequency output 1	Current output, HART
2	Relay output	Current output 2	Frequency output	Current output 1, HART

5.3.3   HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) / 27(-)
- Connection by means of the 4 to 20 mA circuit

✎ Note!
- The measuring circuit's minimum load must be at least 250 Ω.
- The CURRENT SPAN function must be set to "4 to 20 mA" (individual options → "Description of Device Parameters" manual).
- See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

Connection of the HART handheld communicator

See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

A0004586
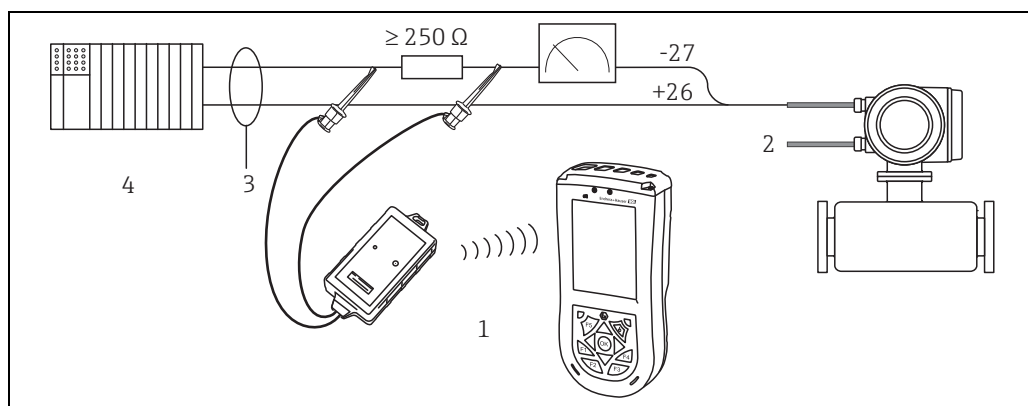
Fig. 16:   Electrical connection of HART handheld terminal

1   HART handheld terminal
2   Auxiliary energy
3   Shielding
4   Other switching units or PLC with passive input

Connection of a PC with an operating software

In order to connect a PC with operating software (e.g. FieldCare), a HART modem (e.g. Commubox FXA195) is needed.

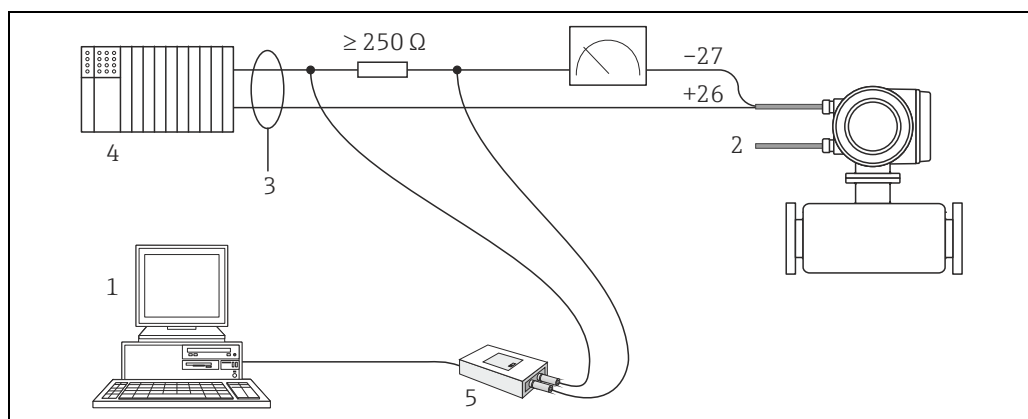A0004592

Fig. 17:   Electrical connection of a PC with operating software

1   PC with operating software
2   Auxiliary energy
3   Shielding
4   Other switching units or PLC with passive input
5   HART modem, e.g. Commubox FXA195

5.4 Degree of protection

The measuring device fulfills all the requirements for IP 67.

Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67 protection is maintained:
• The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
• The screws and screw covers must be firmly tightened.
• The cables used for connection must be of the specified outside diameter → 🖺 77, Cable entries.
• The cable entries must be firmly tightened (point **a** → 🔳 18).
• The cable must loop down in front of the cable entry ("water trap") (point **b** → 🔳 18). This arrangement prevents moisture penetrating the entry.

✎ Note!
The cable entries may not point up.
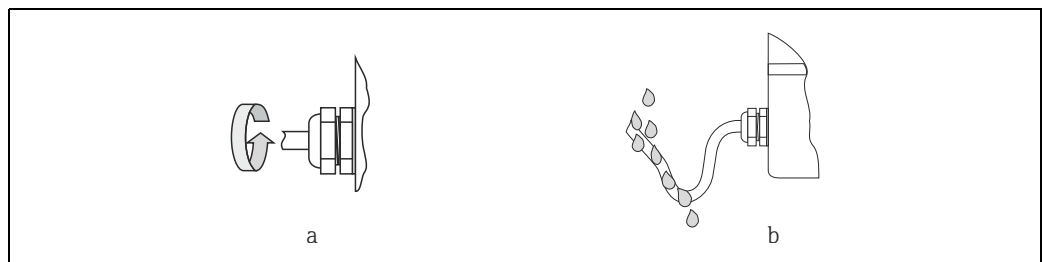
Fig. 18:   Installation instructions, cable entries

• Remove all unused cable entries and insert plugs instead.
• Do not remove the grommet from the cable entry.

Caution!
Do not loosen the screws of the sensor housing, as otherwise the degree of protection guaranteed by Endress+Hauser no longer applies.

5.5   Post-connection check

Perform the following checks after completing electrical installation of the measuring device:

| Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	–

Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	85 to 260 V AC (45 to 65 Hz) 20 to 55 V AC (45 to 65 Hz) 16 to 62 V DC
Do the cables comply with the specifications?	→ 🖺 20
Do the cables have adequate strain relief?	–
Is the cable type route completely isolated? Without loops and crossovers?	–
Are the power supply and signal cables correctly connected?	→ Wiring diagram inside the cover of the terminal compartment
Only remote version: Is the flow sensor connected to the matching transmitter electronics?	Check serial number on nameplates of sensor and connected transmitter.
Only remote version: Is the connecting cable between sensor and transmitter connected correctly?	→ 🖺 20
Are all screw terminals firmly tightened?	–
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 🖺 24, "Degree of protection" section
Are all housing covers installed and firmly tightened?	–

6 Operation

6.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device using the "Quick Setup" or the function matrix.
The display consists of four lines; this is where measured values and/or status variables (direction of flow, empty pipe, bar graph etc.) are displayed. You can change the assignment of display lines to different variables to suit your needs and preferences (→ "Description of Device Parameters" manual, GP00001D/06).

A0001172
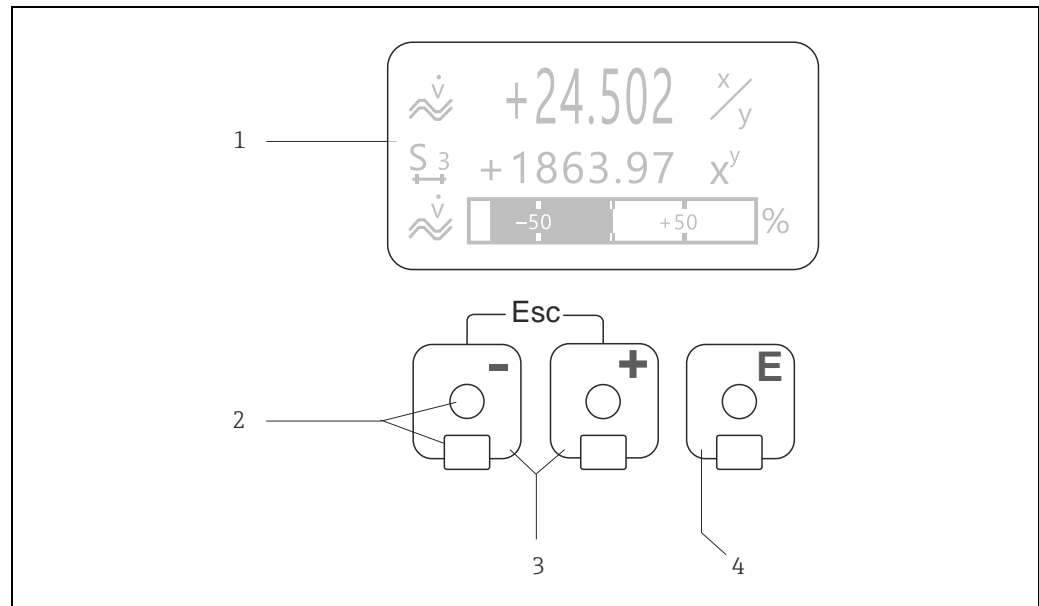
Fig. 19:   Display and operating elements

1   Liquid crystal display
The backlit, four-line liquid crystal display shows measured values, dialog texts, fault messages and notice messages. HOME position (operating mode) is the term given to the display during normal operation.
Readings displayed
2   Optical sensors for "Touch Control"
3   Plus/minus keys
    – HOME position → Direct access to totalizer values and actual values of inputs/outputs
    – Enter numerical values, select parameters
    – Select different blocks, groups and function groups within the function matrix
    Press the +/- keys (⊡/⊡) simultaneously to trigger the following functions:
    – Exit the function matrix step by step → HOME position
    – Press and hold the ⊞/⊟ keys for longer than 3 seconds → Return directly to home position
    – Cancel data entry
4   Enter key
    – HOME position → Entry into the function matrix
    – Save the numerical values you input or settings you change

6.1.1   Readings displayed (operation mode)

The display area consists of three lines in all; this is where measured values are displayed, and/or status variables (direction of flow, bar graph etc.). You can change the assignment of display lines to different variables to suit your needs and preferences (→ "Description of Device Parameters" manual).

Multiplex mode
A maximum of two different display variables can be assigned to each line. Variables multiplexed in this way alternate every 10 seconds on the display.

Error messages
Display and presentation of system/process errors → 📄 31.

A0001173
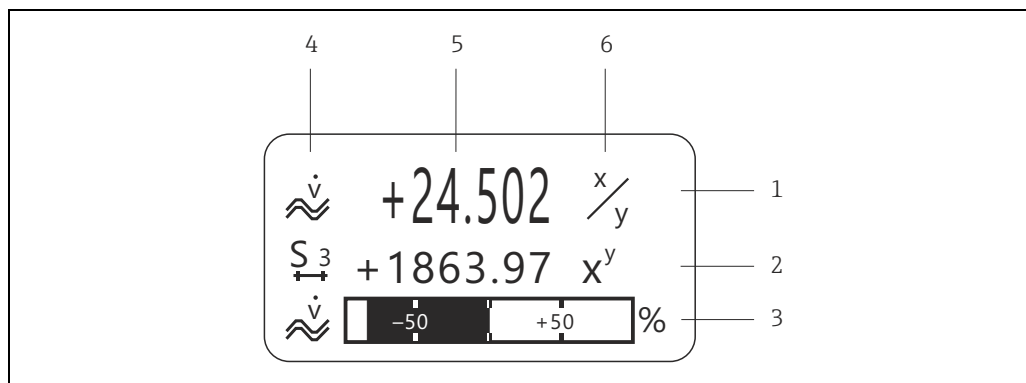
Fig. 20:   Typical display for normal operating mode (HOME position)

1   Main display line: shows primary measured values, e.g. mass flow in [kg/h]
2   Additional line: shows measured variables and status variables, e.g. totalizer No. 3 in [t]
3   Information line: shows additional information on the measured variables and status variables, e.g. bar graph display of the full scale value achieved by the mass flow
4   "Info icons" field: icons representing additional information on the measured values are shown in this field. For a full list of the icons and their meanings see → 📄 28
5   "Measured values" field: the current measured values appear in this field
6   "Unit of measure" field: the units of measure and time defined for the current measured values appear in this field

6.1.2   Additional display functions

From HOME position, use the ⊞⊟ keys to open an "Info Menu" containing the following information:
• Totalizer (including overflow)
• Actual values or states of the configured inputs/outputs
• Device TAG number (user-definable)

⊞ → Scan of individual values within the Info Menu
⊟⊞(Esc key) → Back to HOME position

6.1.3   Icons

The icons which appear in the field on the left make it easier to read and recognize measured variables, device status, and error messages.

Icon	Meaning	Icon	Meaning
S	System error	P	Process error
ϟ	Fault message (with effect on outputs)	!	Notice message (without effect on outputs)
| 1 to n	Current output 1 to n	P 1 to n	Pulse output 1 to n
F 1 to n	Frequency output	S 1 to n	Status/relay output 1 to n (or status input)
Σ 1 to n	Totalizer 1 to n		
A0001181	Measuring mode; PULSATING FLOW	A0001182	Measuring mode; SYMMETRY (bidirectional)
A0001183	Measuring mode; STANDARD	A0001184	Counting mode, totalizer; BALANCE (forward and reverse flow)
A0001185	Counting mode, totalizer; forward	A0001186	Counting mode, totalizer; reverse
A0001187	Status input	A0001188	Volume flow
A0001200	Fluid density	A0001208	Reference density
A0001207	Medium temperature	a0001206	Configuration via remote operation Active device operation via: • HART, e.g. FieldCare, Field Xpert

6.2   Brief guide to the function matrix

✎ Note!
- See the general notes → 🖹 30
- Function descriptions → see the "Description of Device Parameters" manual

1.   HOME position → E → Entry into the function matrix.

2.   Select a block (e.g. OUTPUTS).

3.   Select a group (e.g. CURRENT OUTPUT 1).

4.   Select a function group (e.g. SETTINGS).

5.   Select a function (e.g. TIME CONSTANT).
     Change parameter / enter numerical values:
     ± → Select or enter enable code, parameters, numerical values
     E → Save your entries

6.   Exit the function matrix:
     – Press and hold down Esc key (⊟⊞) for longer than 3 seconds → HOME position.
     – Repeatedly press Esc key (⊟⊞) → Return step by step to HOME position.
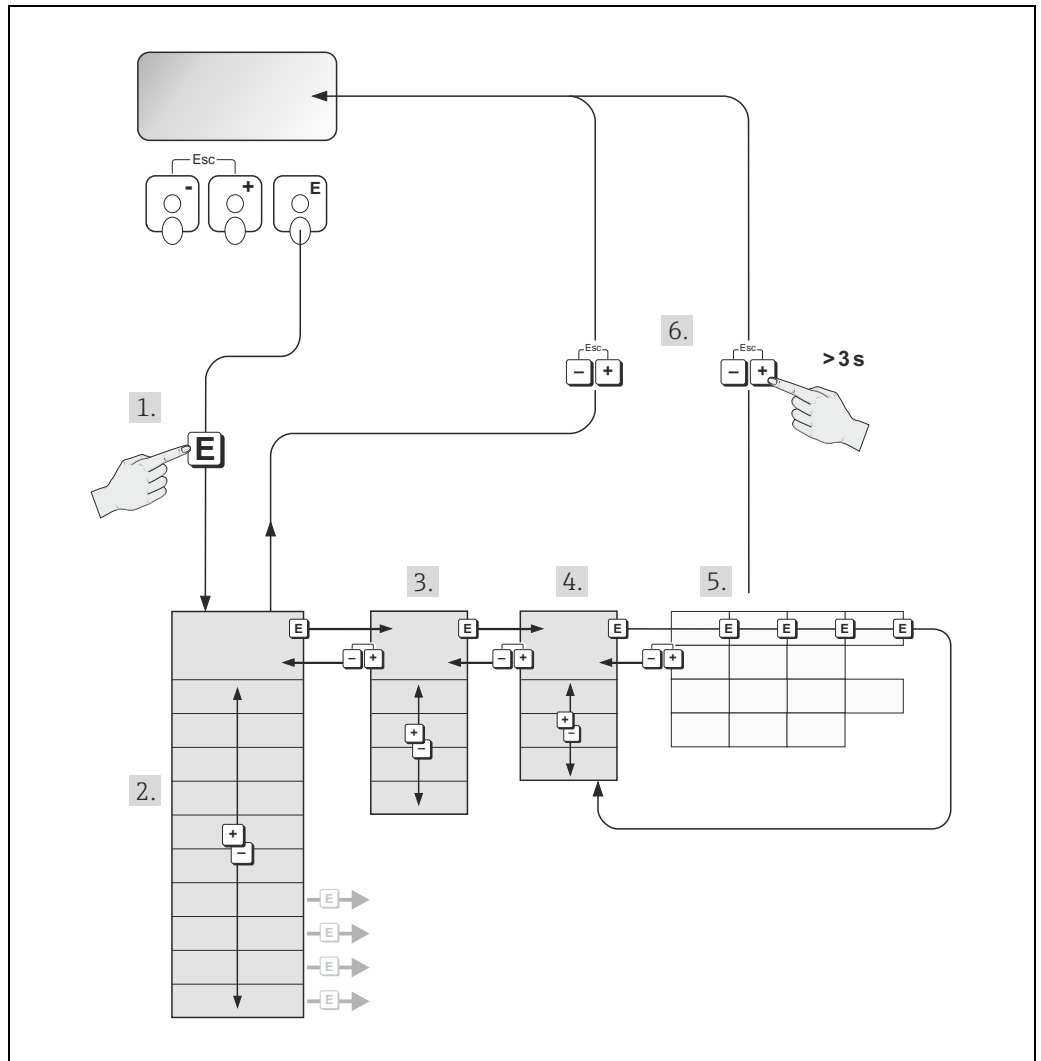
Fig. 21:   Selecting functions and configuring parameters (function matrix)

A0001210

6.2.1   General notes

The Quick Setup menu contains the default settings that are adequate for commissioning. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged on a number of menu levels (blocks, groups, and function groups).

Comply with the following instructions when configuring functions:
- You select functions as described already → 🗐 29. Each cell in the function matrix is identified by a numerical or letter code on the display.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press P to select "SURE [YES]" and press F to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.
- Programming mode is disabled automatically if a key is not pressed within 60 seconds following automatic return to the HOME position.

☞ Caution!
All functions are described in detail, as is the function matrix itself, in the "Description of Device Parameters" manual which is a separate part of these Operating Instructions.

✎ Note!
- The transmitter continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in the normal way.
- If the supply voltage fails all preset and parameterized values remain safely stored in the EEPROM.

6.2.2   Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings. A numerical code (factory setting = 84) has to be entered before settings can be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ "Description of Device Parameters" manual).

Comply with the following instructions when entering codes:
- If programming is disabled and the ⊞ operating elements are pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is entered as the customer's code, programming is always enabled.
- Your Endress+Hauser representative can be of assistance if you mislay your personal code.

☞ Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy.
There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to Endress+Hauser representatives.
Please contact Endress+Hauser if you have any questions.

6.2.3   Disabling the programming mode

Programming mode is disabled if you do not press an operating element within 60 seconds following automatic return to the HOME position.
Programming can also be disabled by entering any number (other than the customer's code) in the "ACCESS CODE" function.

6.3   Error messages

6.3.1   Type of error

Errors that occur during commissioning or measuring are displayed immediately. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.

The measuring system distinguishes between two types of error:
- **System error**
  This group comprises all device errors, e.g. communication errors, hardware errors etc. →
  🖹 62
- **Process error**
  This group includes all application errors, e.g. fluid not homogeneous etc. → 🖹 66

A0001211
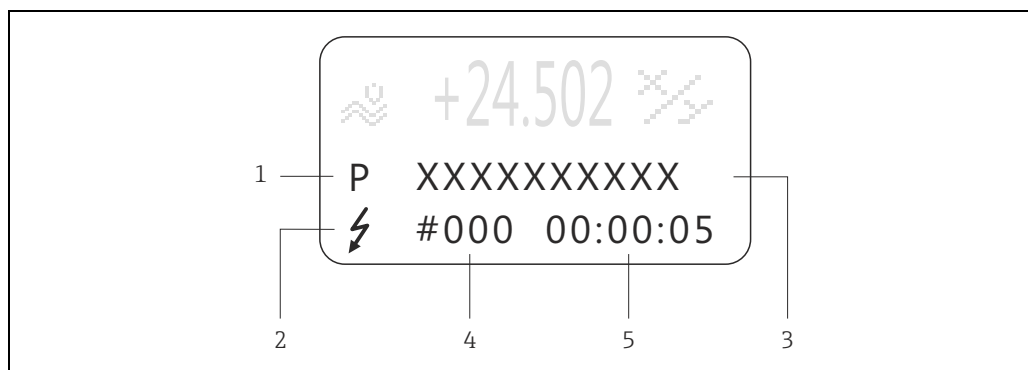
Fig. 22:   Error messages on the display (example)

1   Error type: P = process error, S = system error
2   Error message type: ⚡ = Fault message, ! = Notice message
3   Error designation: e.g. FLUID INHOM. = fluid is not homogeneous
4   Error number: e.g. #702
5   Duration of most recent error occurrence (in hours, minutes and seconds)

6.3.2   Error message type

The measuring device always assigns system and process errors which occur to two types of error messages (**fault** or **notice messages**), resulting in different weightings.
Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

Notice message (!)
- The error in question has no effect on the current operating mode and on the outputs of the measuring device.
- Displayed as → Exclamation mark (!), type of error (S: system error, P: process error)

Fault message (⚡)
- The error in question interrupts or stops running operation and has a direct effect on the outputs. The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix.
- Displayed as → Lightning flash (⚡), type of error (S: system error, P: process error)

✎   Note!
- Error conditions can be output via the relay outputs or fieldbus communication.
- If an error message occurs, an upper or lower signal level for the breakdown information according to NAMUR recommendation NE 43 can be output via the current output.

6.3.3 Confirming error messages

For the sake of plant and process safety, the measuring device can be configured in such a way that fault messages displayed (⚡) always have to be rectified and acknowledged locally by pressing Ⓔ. Only then do the error messages disappear from the display. This option can be switched on or off by means of the "ACKNOWLEDGE FAULT MESSAGES" function (→ "Description of Device Parameters" manual).

✎ Note!
• Fault messages (⚡) can also be reset and confirmed via the status input.
• Notice messages (!) do not require acknowledgment. Note, however, that they remain visible until the cause of the error has been rectified.

6.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4 to 20 mA current output HART → 🕮 23.
The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes.
The HART master, e.g. a handheld terminal or PC-based operating programs (such as FieldCare), require device description (DD) files which are used to access all the information in a HART device. Information is exclusively transferred using so-called "commands".

There are three different command groups:
• **Universal Commands**
  These are associated with the following functionalities for example: Universal commands are supported and used by all HART devices.
  – Recognizing HART devices
  – Reading digital measured values (volume flow, totalizer etc.)
• **Common Practice Commands**
  Common practice commands offer functions which are supported and can be executed by most but not all field devices.
• **Device-specific Commands**
  These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, amongst other things, such as empty/full pipe calibration values, low flow cut off settings etc.

✎ Note!
The measuring device has access to all three command classes.
List of all "Universal Commands" and "Common Practice Commands": → 🕮 34

6.4.1   Operating options

For the complete operation of the measuring device, including device-specific commands, there are DD files available to the user to provide the following operating aids and programs:

✎ Note!
- In the CURRENT RANGE function (current output 1), the HART protocol demands the setting "4 to 20 mA HART" or "4- to 20 mA (25 mA) HART".
- HART write protection can be disabled or enabled by means of a jumper on the I/O board → 📖 42.

HART handheld terminal Field Xpert

Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix.
The HART manual in the carrying case of the HART Communicator contains more detailed information on the device.

Operating program "FieldCare"

FieldCare is Endress+Hauser's FDT-based plant asset management tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flowmeters are accessed via a HART interface FXA 195 or via the service interface FXA 193.

6.4.2   Current device description files

The following table illustrates the suitable device description file for the operating tool in question and then indicates where these can be obtained.

HART protocol:

Valid for software:	3.01.00	→ Function DEVICE SOFTWARE
Device data HART Manufacturer ID: Device ID:	 11_{hex} (ENDRESS+HAUSER) 49_{hex}	 → Function MANUFACT ID → Function DEVICE ID
HART version data:	Device Revision 8 / DD Revision 1	
Software release:	11.2009	
Operating program:	**Sources for obtaining device descriptions:**	
Field Xpert handheld terminal	• Use update function of handheld terminal	
Fieldcare / DTM	• www.endress.com (→ Download →Software →Driver) • CD-ROM (Endress+Hauser order number 56004088)	

6.4.3   Device and process variables

Device variables

The following device variables are available using the HART protocol:

Code (decimal)	Device variable	Code (decimal)	Device variable
0	OFF (unassigned)	8	Reference density
2	Mass flow	9	Temperature
5	Volume flow	250	Totalizer 1
6	Corrected volume flow	251	Totalizer 2
7	Density	252	Totalizer 3

Process variables

At the factory, the process variables are assigned to the following device variables:
- Primary process variable (PV) → Mass flow
- Secondary process variable (SV) → Totalizer 1
- Third process variable (TV) → Density
- Fourth process variable (FV) → Temperature

✎ Note!
You can set or change the assignment of device variables to process variables using Command 51→ 🖹 38.

6.4.4   Universal/Common practice HART commands

Universal Commands

Command No. HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
0 Read unique device identifier Access type = read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12-byte device ID: – Byte 0: Fixed value 254 – Byte 1: Manufacturer ID, 17 = Endress+Hauser – Byte 2: Device type ID, e.g. 73 = Cubemass DCI – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-spec. commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Byte 9-11: Device identification
1 Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: Primary process variable *Factory setting:* Primary process variable = Mass flow ✎ Note! • You can set the assignment of device variables to process variables using Command "51". • Manufacturer-specific units are represented using the HART unit code "240".

Universal Commands

Command No. HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
2 Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Bytes 0-3: Actual current of the primary process variable in mA – Bytes 4-7: Percentage of the set measuring range *Factory setting:* Primary process variable = Mass flow ✎ Note! You can set the assignment of device variables to process variables using Command "51".
3 Read the primary process variable as current in mA and four (preset using Command 51) dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: Primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: Primary process variable – Byte 9: HART unit code of the second process variable – Bytes 10-13: Second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: Third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: Fourth process variable *Factory setting:* • Primary process variable = Mass flow • Second process variable = Totalizer 1 • Third process variable = Density • Fourth process variable = Temperature ✎ Note! • You can set the assignment of device variables to process variables using Command "51". • Manufacturer-specific units are represented using the HART unit code "240".
6 Set HART short form address Access type = write	Byte 0: desired address (0 to 15) *Factory setting:* 0 ✎ Note! With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address
11 Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12-byte device ID if the given TAG agrees with the one saved in the measuring device: – Byte 0: Fixed value 254 – Byte 1: Manufacturer ID, 17 = Endress+Hauser – Byte 2: Device type ID, 73 = Cubemass DCI – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-spec. commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Byte 9-11: Device identification
12 Read user message Access type = read	none	Bytes 0-24: User message ✎ Note! You can write the user message using Command "17".

Universal Commands

Command No. HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
13	Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: Descriptor – Byte 18-20: Date ✎ Note! You can write the TAG, descriptor and date using Command "18".
14	Read sensor information on primary process variable	none	– Bytes 0-2: Sensor serial number – Byte 3: HART unit code of sensor limits and measuring range of the primary process variable – Bytes 4-7: Upper sensor limit – Bytes 8-11: Lower sensor limit – Bytes 12-15: Minimum span ✎ Note! • Die The data relate to the primary process variable (= Mass flow). • Manufacturer-specific units are represented using the HART unit code "240".
15	Read output information of primary process variable Access type = read	none	– Byte 0: Alarm selection ID – Byte 1: Transfer function ID – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: Upper range, value for 20 mA – Bytes 7-10: Start of measuring range, value for 4 mA – Bytes 11-14: Attenuation constant in [s] – Byte 15: Write protection ID – Byte 16: OEM manufacturer ID, 17 = Endress+Hauser *Factory setting:* Primary process variable = Mass flow ✎ Note! • You can set the assignment of device variables to process variables using Command "51". • Manufacturer-specific units are represented using the HART unit code "240".
16	@Read the device production number Access type = read	none	Bytes 0-2: Production number
17	Write user message Access = write	You can save any 32-character long text in the device under this parameter: Bytes 0-23: Desired user message	Displays the current user message in the device: Bytes 0-23: Current user message in the device
18	Write TAG, descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: Descriptor – Byte 18-20: Date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: Descriptor – Byte 18-20: Date

Common Practice Commands

| Command No. HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
34	Write damping value for primary process variable Access = write	Bytes 0-3: Damping value of the primary process variable in seconds *Factory setting:* Primary process variable = Mass flow	Displays the current damping value in the device: Bytes 0-3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1-4: End of measuring range, value for 20 mA – Bytes 5-8: Start of measuring range, value for 4 mA *Factory setting:* Primary process variable = Mass flow ✎ Note! • You can set the assignment of device variables to process variables using Command "51". • If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1-4: Upper range, value for 20 mA – Bytes 5-8: Start of measuring range, value for 4 mA ✎ Note! Manufacturer-specific units are represented using the HART unit code "240".
38	Device status reset (Configuration changed) Access = write	none	none
40	Simulate output current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Byte 0-3: Output current in mA *Factory setting:* Primary process variable = Mass flow ✎ Note! You can set the assignment of device variables to process variables with Command "51".	The momentary output current of the primary process variable is displayed as a response: Byte 0-3: Output current in mA
42	Perform master reset Access = write	none	none
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only unit which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable = Mass flow ✎ Note! • If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. • If you change the unit of the primary process variable, this has no impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code ✎ Note! Manufacturer-specific units are represented using the HART unit code "240".

Common Practice Commands

Command No. HART command / Access type	Command data (numeric data in decimal form)	Response data (numeric data in decimal form)
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: → table → 🕮 39
50	Read assignment of the device variables to the four process variables Access = read	none	Display of the current variable assignment of the process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Factory setting:* • Primary process variable: Code 1 for mass flow • Second process variable: Code 250 for totalizer 1 • Third process variable: Code 7 for density • Fourth process variable: Code 9 for temperature ✎ Note! You can set the assignment of device variables to process variables with Command "51".
51	Write assignments of the device variables to the four process variables Access = write	Setting of the device variables to the four process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Code of the supported device variables:* → Data → 🕮 34 *Factory setting:* • Primary process variable = Mass flow • Second process variable = Totalizer 1 • Third process variable = Density • Fourth process variable = Temperature	The variable assignment of the process variables is displayed as a response: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable
53	Write device variable unit Access = write	This command sets the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: Device variable code – Byte 1: HART unit code *Code of the supported device variables:* → Data → 🕮 34 ✎ Note! • If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. • If you change the unit of the device variable, this has no impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: Device variable code – Byte 1: HART unit code ✎ Note! Manufacturer-specific units are represented using the HART unit code "240".
59	Write number of preambles in response message Access = write	This parameter sets the number of preambles which are inserted in the response messages: Byte 0: Number of preambles (2 to 20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: Number of preambles

6.4.5   Device status/Error messages

You can read the extended device status, in this case, current error messages, via Command "48". The command delivers bit-encoded information (→ table below).

✎ Note!
For a detailed explanation of the device status and error messages and their elimination → 🖺 62

Byte-bit	Error No.	Short error description → 🖺 61
0-0	001	Serious device error
0-1	011	Measuring amplifier has faulty EEPROM
0-2	012	Error when accessing data of the measuring amplifier EEPROM
1-1	031	S-DAT: Defective or missing
1-2	032	S-DAT: Error accessing saved values
1-3	041	T-DAT: Defective or missing
1-4	042	T-DAT: Error accessing saved values
1-5	051	I/O board and the amplifier board are not compatible.
3-3	111	Totalizer checksum error
3-4	121	I/O board and the amplifier board (software versions) are not compatible.
3-6	205	T-DAT: Data download not successful
3-7	206	T-DAT: Data upload not successful
4-3	251	Internal communication fault on the amplifier board.
4-4	261	No data reception between amplifier and I/O board
5-7	339	Flow buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-0	340	
6-1	341	
6-2	342	
6-3	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-4	344	
6-5	345	
6-6	346	
6-7	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
7-0	348	
7-1	349	
7-2	350	

Byte-bit	Error No.	Short error description → 🖹 61
7-3	351	Current output: The actual value for the flow lies outside the set limits.
7-4	352	
7-5	353	
7-6	354	
7-7	355	Frequency output: The actual value for the flow lies outside the set limits.
8-0	356	
8-1	357	
8-2	358	
8-3	359	Pulse output: Pulse output frequency is out of range.
8-4	360	
8-5	361	
8-6	362	
9-0	379	The measuring tube oscillation frequency is outside the permitted range.
9-1	380	
9-2	381	The temperature sensor on the measuring tube is likely defective.
9-3	382	
9-4	383	The temperature sensor on the carrier tube is likely defective.
9-5	384	
9-6	385	One of the measuring tube coils (on the inlet or outlet side) is probably defective.
9-7	386	
10-0	387	
10-1	388	Amplifier error
10-2	389	
10-3	390	
11-6	471	Max. permitted batching time has been exceeded.
11-7	472	Underbatching: the minimum quantity was not reached. Overbatching: the maximum permitted batching quantity was exceeded.
12-0	473	The predefined batch quantity point was exceeded. End of filling process approaching.
12-1	474	Maximum flow value entered is overshot.
12-7	501	New amplifier software version is loaded. Currently no other commands are possible.
13-0	502	Upload and download of device files. Currently no other commands are possible.
13-2	571	Batching process in progress (valves are open)
13-3	572	Batching process has been stopped (valves are closed)
13-5	586	The fluid properties do not allow normal measuring operation.
13-6	587	Extreme process conditions exist. The measuring system can therefore not be started.
13-7	588	Overdriving of the internal analog to digital converter. A continuation of the measurement is no longer possible.
14-3	601	Positive zero return active

Byte-bit	Error No.	Short error description → 🖹 61
14-7	611	Simulation current output active
15-0	612	
15-1	613	
15-2	614	
15-3	621	Simulation frequency output active
15-4	622	
15-5	623	
15-6	624	
15-7	631	Simulation pulse output active
16-0	632	
16-1	633	
16-2	634	
16-3	641	Simulation status output active
16-4	642	
16-5	643	
16-6	644	
16-7	651	Simulation relay output active
17-0	652	
17-1	653	
17-2	654	
17-3	661	Simulation current input active
17-4	662	
17-5	663	
17-6	664	
17-7	671	Simulation status input active
18-0	672	
18-1	673	
18-2	674	
18-3	691	Simulation of response to error (outputs) active
18-4	692	Simulation of volume flow active
19-0	700	The process fluid density is outside the upper or lower limit values.
19-1	701	The maximum current value for the measuring tube exciter coils has been reached, since certain process fluid characteristics are extreme.
19-2	702	Frequency control is not stable, due to inhomogeneous fluid.
19-3	703	NOISE LIM. CH0 Overdriving of the internal analog to digital converter. A continuation of the measurement is still possible.
19-4	704	NOISE LIM. CH1 Overdriving of the internal analog to digital converter. A continuation of the measurement is still possible.
19-5	705	The electronics' measuring range will be exceeded. The mass flow is too high.
20-5	731	The zero point adjustment is not possible or has been canceled.
22-4	61	F-Chip is faulty or not plugged into the I/O board.
24-5	363	Current input: The actual value for the current lies outside the set limits.

6.4.6 Switching HART write protection on and off

A jumper on the I/O board provides the means of switching HART write protection on or off.

⚠ Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.

2. Remove the I/O board → 🖺 70 or → 🖺 72.

3. Switch HART write protection on or off, as applicable, by means of the jumper (→ 🖻 23).

4. Installation of the I/O board is the reverse of the removal procedure.
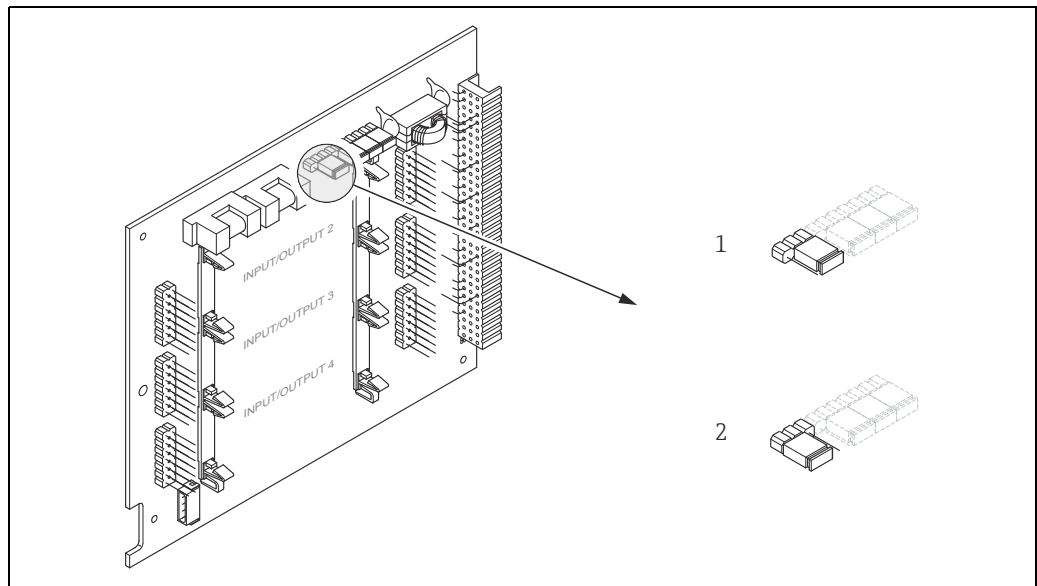
A0001212

Fig. 23:   Switching HART write protection on and off

1   Write protection OFF (default), that is: HART protocol unlocked
2   Write protection ON, that is: HART protocol locked

7   Commissioning

7.1   Function check

Make sure that all the final checks have been completed before commissioning the
measuring point:
- Checklist for "Post-installation check" → 📖 18.
- Checklist for "Post-connection check" → 📖 25.

7.2   Switching on the measuring device

If the post-connection checks have been performed, the supply voltage can be switched on.
The device is now operational.
The measuring device performs a number of power on self-tests. As this procedure
progresses the following sequence of messages appears on the local display:

Cubemass DCI **START-UP** **RUNNING**	Startup message
▼	
Cubemass DCI **DEVICE SOFTWARE** **V XX.XX.XX**	Current software version
▼	
CURRENT OUTPUT **FREQUENCY OUTPUT 1** **FREQUENCY OUTPUT 2** **STATUS INPUT**	List of installed input/output modules
▼	
SYSTEM OK → **OPERATION**	Beginning of normal measuring mode
▼	
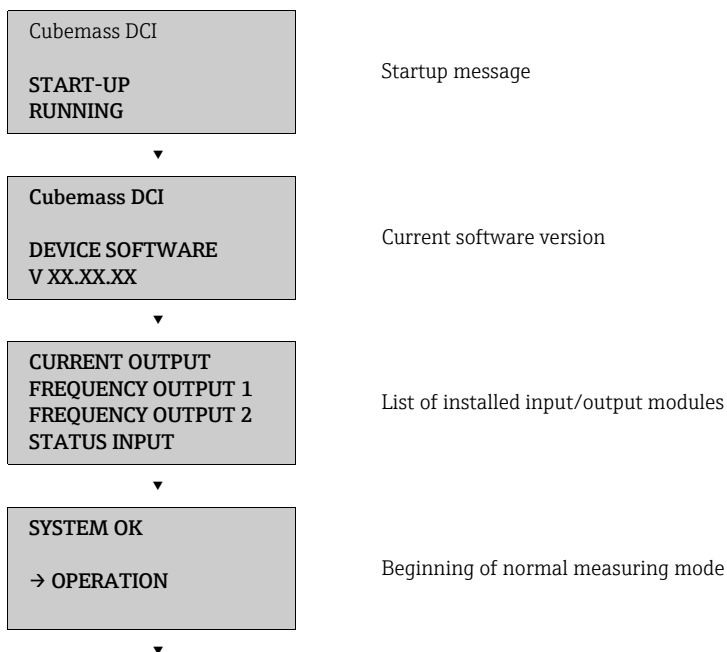
Normal measuring mode commences as soon as startup completes.
Various measured value and/or status variables appear on the display (HOME position).

✎ Note!
If startup fails, an error message indicating the cause is displayed.

7.3   Quick Setup

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the configuration program, e.g. FieldCare. If the measuring device is equipped with a local display, all the important device parameters for standard operation can be configured quickly and easily by means of the "Commissioning" Quick Setup menu.

- Quick Setup "Commissioning", see below
- Quick Setup "Pulsating Flow" → 🖹 46
- Quick Setup "Gas measurement"→ 🖹 49

7.3.1   Quick Setup "Commissioning"

✎ Note!
- The display returns to the function SETUP COMMISSIONING (1002) if you press the ⊞ key combination during parameter interrogation. The stored parameters remain valid.
- The "COMMISSIONING" Quick Setup must be performed before another Quick Setup is run.

1 The "DELIVERY SETTINGS" option sets every selected unit to the factory setting.
   The "ACTUAL SETTING" option accepts the units you previously configured.

2 Only units not yet configured in the current Setup are offered for selection in each cycle. The unit for mass, volume and corrected volume is derived from the corresponding flow unit.

3 The "YES" option remains visible until all the units have been configured.
   "NO" is the only option displayed when no further units are available.

4 The prompt only appears if a current and/ or pulse/frequency output is available. Only the outputs not yet configured in the current Setup are offered for selection in each cycle.

5 The "YES" option remains visible until all the outputs have been configured.
   "NO" is the only option displayed when no further outputs are available.

6 The "automatic parameterization of the display" option contains the following basic settings/factory settings:

   YES   Main line = Mass flow
              Additional line = Totalizer 1
              Information line = Operating/system conditions

   NO   The existing (selected) settings remain.

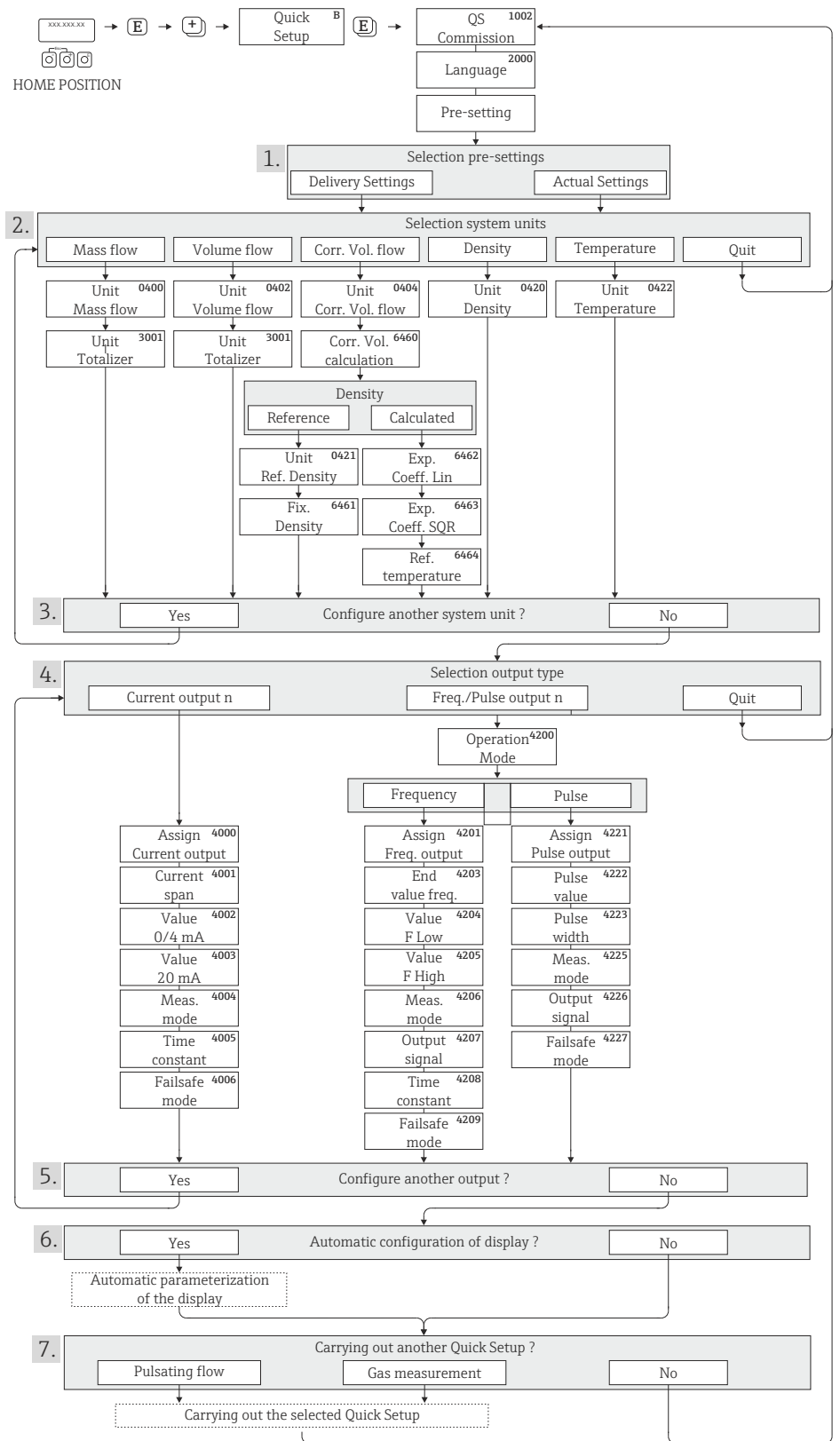7 The process for executing other Quick Setups is described in the following chapters.

Fig. 24:   Quick Setup for quick commissioning

7.3.2   Quick Setup "Pulsating Flow"

✎   Note!
The "Pulsating Flow" Quick Setup is only available if the device has a current output or a pulse/ frequency output.

Certain types of pump such as reciprocating, peristaltic and cam-type pumps, for example, create a flow characterized by severe periodic fluctuations. Negative flows can occur with pumps of these types on account of the closing volume of the valves or valve leaks.

✎   Note!
Before carrying out the Quick Setup "Pulsating Flow", the Quick Setup "Commissioning" has to be executed → 🕮 44.
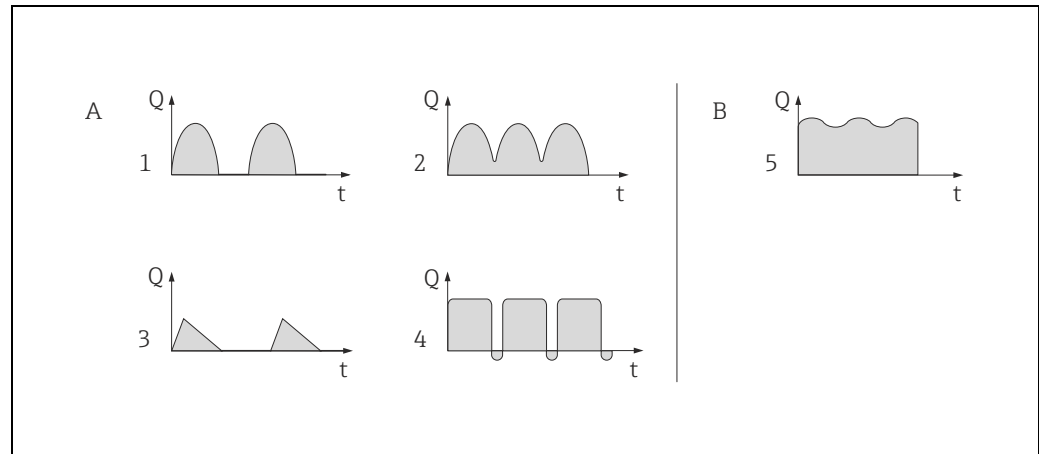
Fig. 25:   Flow characteristics of various types of pump

A   With severely pulsating flow
B   With low pulsating flow

1   1-cylinder cam pump
2   2-cylinder cam pump
3   Magnetic pump
4   Peristaltic pump, flexible connecting hose
5   Multi-cylinder reciprocating pump

Severely pulsating flow

Once several device functions have been configured in the "Pulsating flow" Quick Setup menu, flow fluctuations of this nature can be compensated over the entire flow range and pulsating fluid flows measured correctly. You will find detailed instructions on how to use this Quick Setup in the following section.

✎   Note!
It is always advisable to work through the "Pulsating flow" Quick Setup menu if there is any uncertainty about the exact flow characteristic.

Slightly pulsating flow

If flow fluctuations are no more than minor, as is the case, for example with gear-type, three-cylinder or multi-cylinder pumps, it is **not** absolutely necessary to work through the Quick Setup menu.
In cases of this nature, however, it is advisable to adapt the functions listed below in the function matrix (→ "Description of Device Parameters" manual) to suit local process conditions in order to ensure a stable, unvarying output signal:

- Measuring system damping: "FLOW DAMPING" function. → Increase value
- Current output damping: TIME CONSTANT function → increase the value

Performing the "Pulsating flow" Quick Setup

This Quick Setup menu guides you systematically through the setup procedure for all the device functions that have to be parameterized and configured for measuring pulsating flows. Note that this has no effect on values configured beforehand, such as measuring range, current range or full scale value.
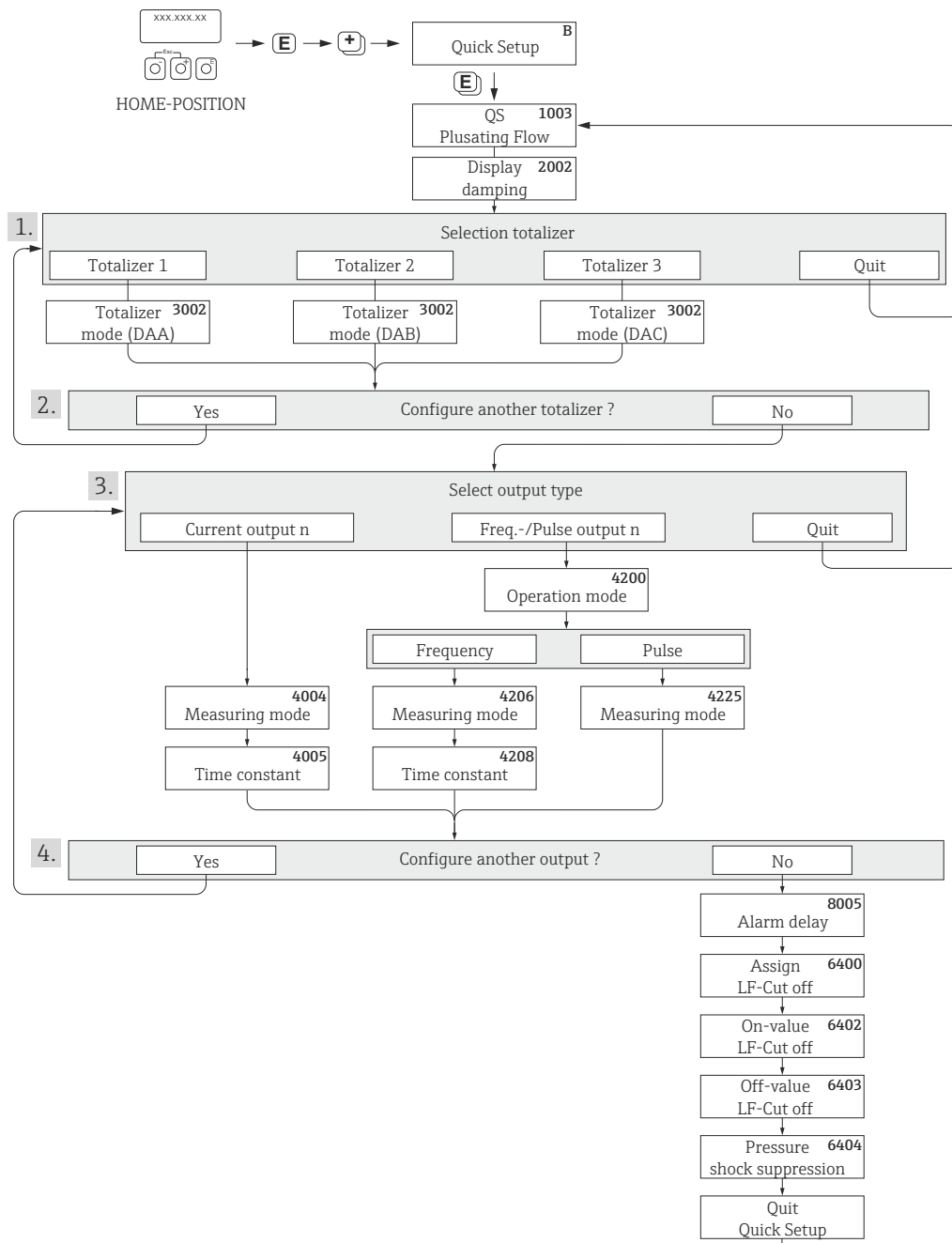
Fig. 26:   Quick Setup for measuring severely pulsating flows

1   Only totalizers not yet configured in the current Setup are offered for selection in each cycle.

2   The "YES" option remains visible until all the totalizers have been configured.
    "NO" is the only option displayed when no further totalizers are available.

3   Only the output not yet configured in the current Setup is offered for selection in the second cycle.

4   The "YES" option remains visible until both outputs have been configured.
    "NO" is the only option displayed when no further outputs are available.

✎ Note!
- The display returns to the function QUICK SETUP PULSATING FLOW (1003) if you press the ⊞⊟ key combination.
- You can call up the Setup menu either directly from the "COMMISSIONING" Quick Setup menu or manually by means of the function QUICK SETUP PULSATING FLOW (1003).

Recommended settings

Quick Setup "Pulsating Flow"		
HOME position → ⌷ → MEASURED VARIABLE → ⊞ → QUICK SETUP → ⌷ → QS PULSATING FLOW (1003)		
Function No.	Function name	Selection with ⊞⊟ To next function with ⌷
1003	QS PULS. FLOW	YES After ⌷ is pressed by way of confirmation, the Quick Setup menu calls up all the subsequent functions in succession.

▼

Basic configuration		
2002	DISPLAY DAMPING	1 s
3002	TOTALIZER MODE (DAA)	BALANCE (Totalizer 1)
3002	TOTALIZER MODE (DAB)	BALANCE (Totalizer 2)
3002	TOTALIZER MODE (DAC)	BALANCE (Totalizer 3)
Signal type for "CURRENT OUTPUT 1 to n"		
4004	MEASURING MODE	PULSATING FLOW
4005	TIME CONSTANT	1 s
Signal type for "FREQ./PULSE OUTPUT 1 to n" (for FREQUENCY mode of operation)		
4206	MEASURING MODE	PULSATING FLOW
4208	TIME CONSTANT	0 s
Signal type for "FREQ./PULSE OUTPUT 1 to n" (for PULSE mode of operation)		
4225	MEASURING MODE	PULSATING FLOW
Other settings		
8005	ALARM DELAY	0 s
6400	ASSIGN LOW FLOW CUTOFF	MASS FLOW
6402	ON-VALUE LOW FLOW CUT OFF	Setting depends on diameter [kg/h]: DN 1 = 0.08 DN 2 = 0.4 DN 4 = 1.8 DN 6 = 4
6403	OFF-VALUE LOW FLOW CUTOFF	50%
6404	PRESSURE SHOCK SUPPRESSION	0 s

▼

Back to the HOME position: → Press and hold down Esc key ⌷⊞ for longer than three seconds or → Repeatedly press and release Esc key ⌷⊞ → Exit the function matrix step by step

7.3.3   Quick Setup "Gas measurement"

The measuring device is primarily designed for measuring liquid flow. The measurement of gases is also possible.

✎   Note!
- Before carrying out the Quick Setup "Gas measurement", the Quick Setup "Commissioning" has to be executed → 🕮 44.
- Only mass and Corrected volume flow can be measured and output with the gas measurement mode. Note that direct density and/or volume measurement is not possible.
- If corrected volume flow (e.g. in Nm³/h) is to be measured and output instead of the mass flow (e.g. in kg/h), change the setting for the CORRECTED VOLUME CALCULATION function to "FIXED REFERENCE DENSITY" in the "Commissioning" Quick Setup menu. Corrected volume flow can be assigned as follows:
  – to a display line,
  – to the current output,
  – to the pulse/frequency output.

7.3.4   Data back-up/transfer

You can use the T-DAT SAVE/LOAD function to transfer data (device parameters and settings) between the T-DAT (removable memory) and the EEPROM (device memory).

This is required for the following applications:
• Creating a backup: current data are transmitted from an EEPROM to the T-DAT.
• Replacing a transmitter: current data are copied from an EEPROM to the T-DAT, then transmitted to the EEPROM of the new transmitter.
• Duplicating data: current data are copied from an EEPROM to the T-DAT, then transmitted to EEPROMs of identical measuring points.

✎ Note!
Installing and removing the T-DAT → 🗎 70.
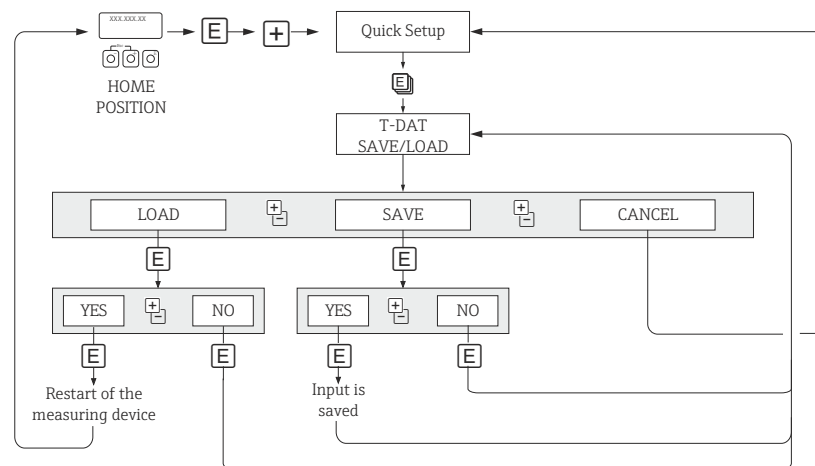
A0001221-en

Fig. 27:   Data storage/transmission with T-DAT SAVE/LOAD

Notes on the LOAD and SAVE options:

LOAD: Data are transmitted from the T-DAT to the EEPROM.

✎ Note!
• Previously saved settings on the EEPROM are deleted.
• This option is only available if the T-DAT contains valid data.
• This selection can be made only if the software version of the T-DAT is the same or newer than that of the EEPROM. Otherwise, the error message "TRANSM. SW-DAT" appears after the restart and the LOAD function is subsequently no longer available.

SAVE: Data are transmitted from the EEPROM to the T-DAT.

7.4   Configuration

⚠   Warning!
In the case of explosion-protected equipment, observe a cooling or discharge time of 10 minutes before opening the device.

7.4.1   Current output: active/passive

The current outputs are configured as "active" or "passive" by means of various jumpers on the I/O board or the current submodule.

⚠   Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1.   Switch off power supply.

2.   Remove the I/O board → 🖹 70.

3.   Set the jumpers (→ 🖾 28).

      🖑   Caution!
      Risk of destroying the measuring device. Set the jumpers exactly as shown in → 🖾 28. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.

4.   Installation of the I/O board is the reverse of the removal procedure.

A0001214
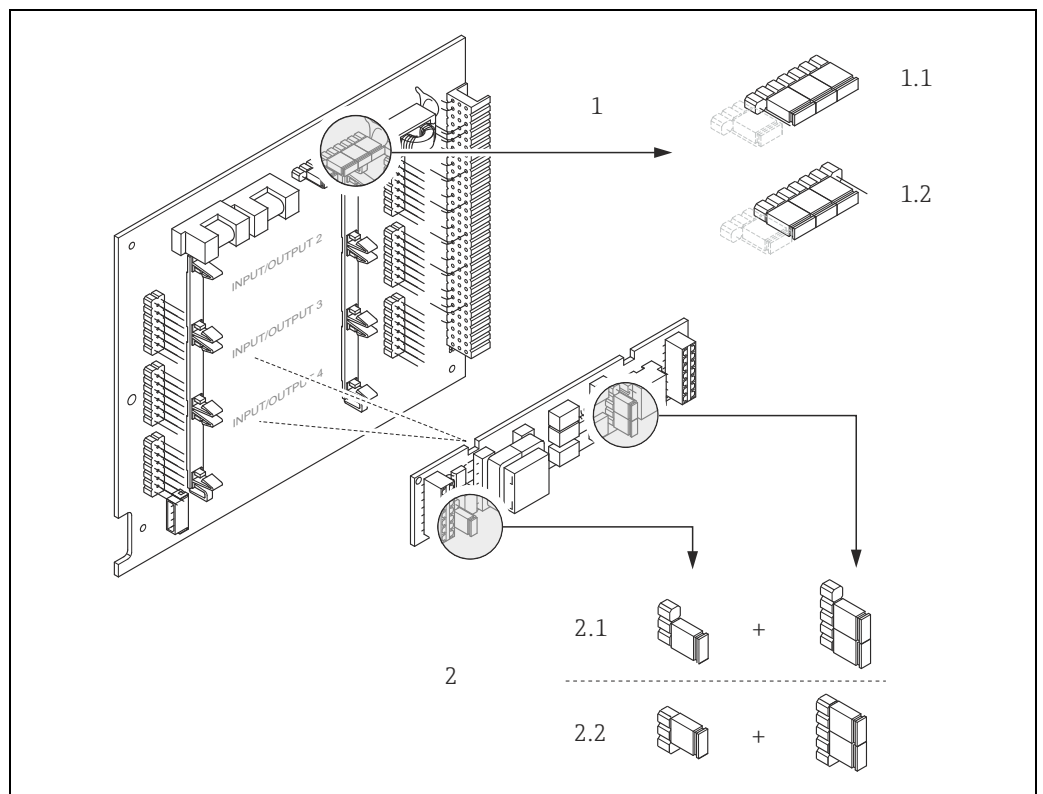
Fig. 28:   Configuring current output with the aid of jumpers (I/O board)

1   Current output 1 with HART
1.1   Active current output (default)
1.2   Passive current output
2   Current output 2 (optional, plug-in module)
2.1   Active current output (default)
2.2   Passive current output

7.4.2   Pulse/frequency outputs 1 and 2

The configuration of the pulse/frequency outputs with line monitoring "On" or "Off" takes place by means of various jumpers on the pulse/frequency output submodule.

⚠ Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.

2. Remove the I/O board → 🕮 70.

3. Set the jumpers (→ 🖾 29).

    ☝ Caution!
    Risk of destroying the measuring device. Set the jumpers exactly as shown in the diagram. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.

4. Installation of the I/O board is the reverse of the removal procedure.

A0001802
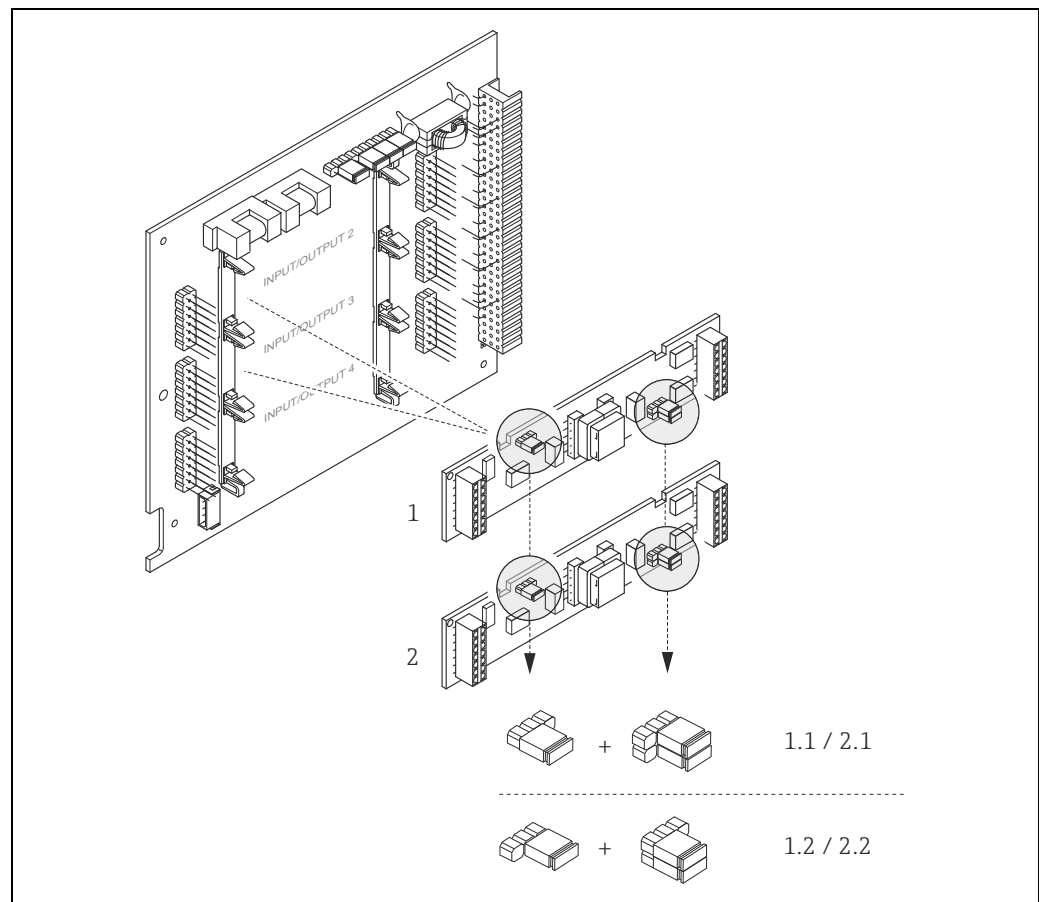
Fig. 29:   *Configuring pulse/frequency outputs with the aid of jumpers (I/O board)*

1   *Pulse/frequency output 1*
1.1   *Line monitoring ON (factory setting)*
1.2   *Line monitoring OFF*
2   *Pulse/frequency output 2*
2.1   *Line monitoring ON (factory setting)*
2.2   *Line monitoring OFF*

7.4.3 Relay contacts: Normally closed/Normally open

The relay contact can be configured as normally open (NO or make) or normally closed (NC or break) contacts by means of two jumpers on the I/O board or on the pluggable submodule. This configuration can be called up at any time with the ACTUAL STATUS RELAY (4740) function.

⚠ Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

1. Switch off power supply.

2. Remove the I/O board → 🖹 70.

3. Set the jumpers (→ 🖾 30).

   ✋ Caution!
   – If you change the setting you must always change the positions of **both** jumpers. Note precisely the specified positions of the jumpers.
   – Note that the position of the relay submodule on the I/O board can vary, depending on the version ordered, and that the terminal assignment in the connection compartment of the transmitter varies accordingly → 🖹 22.

4. Installation of the I/O board is the reverse of the removal procedure.
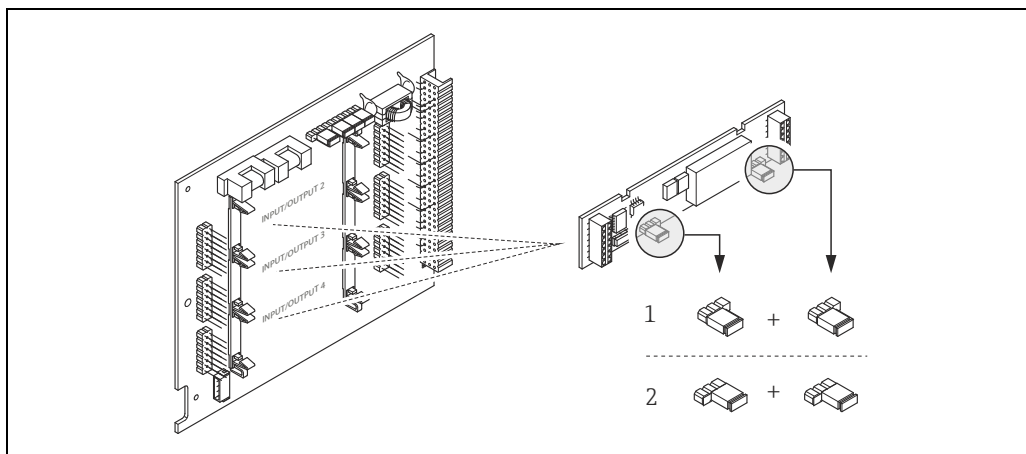

A0001215

Fig. 30:   Configuring relay contacts (NC / NO) using jumpers on the convertible I/O board (submodule).

1   Configured as NO contact (default, relay 1)
2   Configured as NC contact (default, relay 2, if installed))

7.5 Adjustment

7.5.1 Zero point adjustment

All measuring devices are calibrated with state-of-the-art technology. Calibration takes place under reference operating conditions → 🖺 78. Consequently zero point adjustment is generally **not** necessary for Cubemass DCI.

Experience shows that the zero point adjustment is advisable only in special cases:
• To achieve highest measuring accuracy also with very small flow rates.
• Under extreme process or operating conditions (e.g. very high process temperatures).

Preconditions for a zero point adjustment

Note the following before you perform a zero point adjustment:
• Adjustment can only be performed on homogeneous fluids.
• Zero point adjustment is performed at zero flow (v = 0 m/s). This can be achieved, for example, with shutoff valves upstream and/or downstream of the sensor or by using existing valves and gates.
  – Normal operation → valves 1 and 2 open
  – Zero point adjustment **with** pump pressure → Valve 1 open / valve 2 closed
  – Zero point adjustment **without** pump pressure → Valve 1 closed / valve 2 open
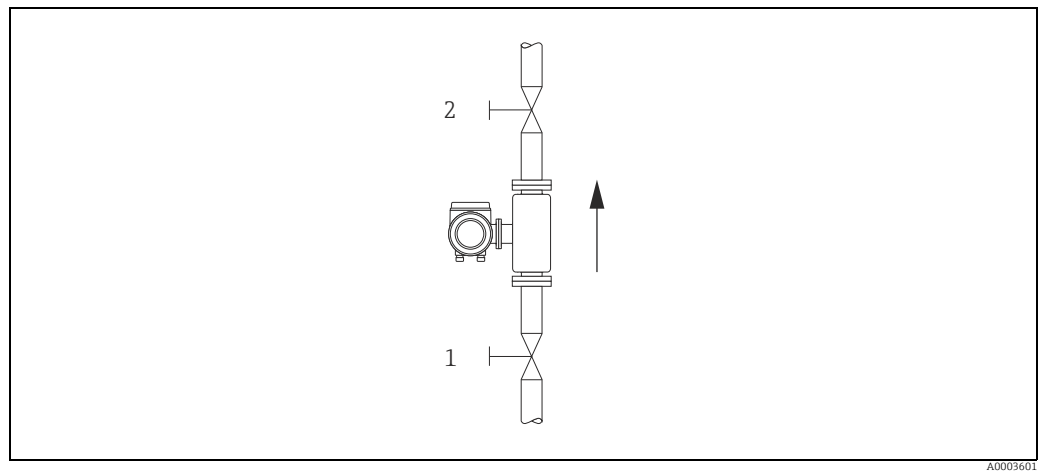

A0003601

Fig. 31:   Zero point adjustment and shutoff valves

Caution!
• The currently valid zero point value can be viewed using the "ZEROPOINT" function (→ "Description of Device Parameters" manual).

Performing a zero point adjustment

1. Operate the system until operating conditions have settled.

2. Stop the flow (v = 0 m/s).

3. Check the shutoff valves for leaks.

4. Check that operating pressure is correct.

5. Using the local display, select the ZEROPOINT ADJUSTMENT function in the function matrix: BASIC FUNCTIONS → PROCESSPARAMETER → ADJUSTMENT → ZERO POINT ADJUSTMENT

6. When you press ⊞ or ⊟ you are automatically prompted to enter the access code if the function matrix is still disabled. Enter the code (factory setting = 84).

7. Use ⊞ or ⊟ to select START and confirm with Ⓔ.
   Select YES at the prompt and press Ⓔ again to confirm.
   Zero point adjustment now starts.
   – The message "ZEROPOINT ADJUST RUNNING" appears on the display for 30 to 60 seconds while adjustment is in progress.
   – If the flow in the pipe exceeds 0.1 m/s, the following error message appears on the display: "ZERO ADJUST NOT POSSIBLE".
   – When the zero point adjustment completes, the "ZERO ADJUST." function reappears on the display.

8. Back to the HOME position:
   – Press and hold down Esc key (⊟⊞) for longer than three seconds or
   – Repeatedly press and release the Esc key (⊟⊞).

7.5.2   Density adjustment

It is always advisable to perform density adjustment when optimum measuring accuracy is required for calculating density-dependent values. 1-point or 2-point density adjustment is required depending on application conditions:

1-point density adjustment (with one fluid):
This type of density adjustment is necessary under the following conditions:
- The sensor does not exactly measure the density value which the operator expects based on laboratory trials.
- The fluid properties are outside the measuring points set at the factory, or the reference conditions used to calibrate the measuring device.
- The plant is used solely for measuring a fluid whose density is to be determined very accurately under constant conditions.
  Example: Brix density measurement for apple juice

2-point density adjustment (with two fluids):
This type of adjustment is always to be carried out if the measuring tubes have been mechanically altered by material buildup, abrasion or corrosion for example. In such cases, the resonance frequency of the measuring tubes has been affected by these factors and is no longer compatible with the calibration data determined at the factory. The 2-point density adjustment takes these mechanical changes into account and calculates new, adjusted calibration data.

Performing 1-point or 2-point density adjustment

Caution!
- Onsite density adjustment can be performed only if the user has detailed knowledge of the fluid density, obtained, for example, from detailed laboratory analyses.
- The target density value specified in this way must not deviate from the measured fluid density by more than ±10%.
- An error when entering the target density affects all calculated density and volume functions.
- 2-point density adjustment is only possible if the two target density values differ by at least 0.2 kg/l. Otherwise error message #731 (adjustment not possible) appears on the display.

- Density adjustment changes the density calibration values set at the factory or by the service technician.
- The functions outlined in the following instructions are described in detail in the "Description of Device Parameters" manual.

1. Fill the sensor with fluid. Make sure that the measuring tubes are completely filled and that the fluid is free from gas bubbles.

2. Wait until the temperature difference between the fluid and measuring tube has equalized. The time you have to wait for equalization depends on the fluid and the current temperature level.

3. Using the local display, select the SETPOINT DENSITY function in the function matrix and perform density adjustment as follows:

Function No.	Function name	Setting to be selected (⊞ or ⊟) (to next function with 🗉)
6482	SETPOINT DENSITY	Use ⊞ to select whether 1- or 2-point density adjustment is to be performed. ✎ Note! When you press ⊞ you are automatically prompted to enter the access code if the function matrix is still disabled. Enter the code.
6483	DENSITY SET VAL 1	Use ⊞ to enter the target density of the first fluid and press 🗉 to save this value (input range = current density value ±10%).
6484	MEASURE FLUID 1	Use ⊞ to select START and press 🗉. The message "DENSITY MEASUREMENT RUNNING" appears on the display for approximately 10 seconds. During this time Cubemass DCI measures the current density of the first fluid (actual density value).

<div align="center">▼</div>

<div align="center">For 2-point density adjustment only:</div>

6485	DENSITY SET VAL 2	Use ⊞ to enter the target density of the second fluid and press 🗉 to save this value (input range = actual density value ±10%).
6486	MEASURE FLUID 2	Use ⊞ to select START and press 🗉. The message "DENSITY MEASUREMENT RUNNING" appears on the display for approximately 10 seconds. During this time Cubemass DCI measures the current density of the second fluid (actual density value).

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6487	DENSITY ADJUST	Use ⊞ to select DENSITY ADJUST and press 🗉. The measuring device compares the current density value and the target density value and calculates the new density coefficients.
6488	RESTORE ORIGINAL	If density adjustment does not run correctly, you can select the RESTORE ORIGINAL function to reactivate the default density coefficients.

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Back to the HOME position: → Press and hold down Esc key (┘┴) for longer than three seconds or → Repeatedly press and release Esc key (┘┴) → Exit the function matrix step by step

7.6 Purge and pressure monitoring connections

The sensor housing protects the inner electronics and mechanics and is filled with dry nitrogen. Furthermore, it also has an additional secondary containment function up to a specific measuring pressure.

⚠ Warning!
For process pressures above the specified containment pressure, the housing does not provide an additional secondary containment function. If there is a danger of the measuring tube rupturing due to process characteristics, e.g. in the event of corrosive process fluids, we recommend the use of sensors whose housings are equipped with special pressure monitoring connections (ordering option). With the help of these connections, fluid collected in the housing in the event of a tube rupture can be drained off. This reduces the risk of mechanical overload of the housing, which could lead to a housing failure and is thus associated with increased potential danger. The connections can also be used for gas purging (gas detection).

If measuring gases with high pressures, in particular, we recommend the use of sensors whose housings are fitted with a rupture element. Users can choose from a rupture disk with defined or undefined fluid exit. The burst pressure is between 10 and 15 bar (145 to 217.5 psi) for both options.

Note the following when working with purge and pressure monitoring connections:
- Do not open the purge connections unless the containment can be filled with a dry inert gas immediately afterwards.
- Use only low overpressure to purge. Maximum pressure 5 bar (72.5 psi).

7.7 Memory (HistoROM)

At Endress+Hauser, the term HistoROM refers to various types of data storage modules on which process and measuring device data are stored. By unplugging and plugging such modules, device configurations can be duplicated onto other measuring devices, to cite just one example.

7.7.1 HistoROM/S-DAT (sensor-DAT)

The S-DAT is an exchangeable data storage device in which all sensor relevant parameters are stored, e.g. diameter, serial number, calibration factor, zero point.

7.7.2 HistoROM/T-DAT (transmitter-DAT)

The T-DAT is an exchangeable data storage device in which all transmitter parameters and settings are stored.
Storing of specific parameter settings from the EEPROM to the T-DAT and vice versa has to be carried out by the user (= manual save function). Detailed instructions regarding this can be found in the manual "Description of Device Parameters", GP002D/06, (function "T-DAT SAVE/LOAD", No. 1009).

8   Maintenance

No special maintenance work is required.

8.1   External cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing and the seals.

9   Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

9.1   Device-specific accessories

9.1.1   For the Transmitter

Accessories	Description
Mounting set for transmitter	Mounting set for wall-mount housing (remote version). Suitable for: • Wall mounting • Pipe mounting • Installation in control panel Mounting set for aluminum field housing: Suitable for pipe mounting (¾" to 3")

9.1.2   For the Sensor

Accessories	Description
Mounting set for sensor	Mounting set, comprising: – 2 process connections – Seals
Mounting plate for sensor	Mounting plate, comprising: – mounting plate – 4 × M5

9.2   Communication-specific accessories

Accessories	Description
HART Communicator Field Xpert handheld terminal	Handheld terminal for remote parameterization and for obtaining measured values via the current output HART (4 to 20 mA). Contact your Endress +Hauser representative for more information.
Commubox FXA195 HART	The Commubox FXA195 connects intrinsically safe smart transmitters with the HART protocol with the USB port of a personal computer. This enables remote operation of the transmitter with operating software (e.g. FieldCare). Power is supplied to the Commubox via the USB port.

9.3   Service-specific accessories

| Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: • Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections • Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: • Via the Internet: https://wapps.endress.com/applicator • On CD-ROM for local PC installation
W@M	Life cycle management for your plant. W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records. W@M is available: • Via the Internet: www.endress.com/lifecyclemanagement • On CD-ROM for local PC installation
FieldCare	FieldCare is Endress+Hauser's FDT-based plant asset management tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flowmeters are accessed via a service interface or via the service interface FXA193.
FXA291	Service interface from the measuring device to the PC for operation via FieldCare.

9.4   System components

Accessories	Description
Memograph M graphic display recorder	The Memograph M graphic display recorder provides information on all the relevant process variables. Measured values are recorded correctly, limit values are monitored and measuring points analyzed. The data are stored in the 256 MB internal memory and also on a DSD card or USB stick. Memograph M boasts a modular design, intuitive operation and a comprehensive security concept. The ReadWin® 2000 PC software is part of the standard package and is used for configuring, visualizing and archiving the data captured. The mathematics channels which are optionally available enable continuous monitoring of specific power consumption, boiler efficiency and other parameters which are important for efficient energy management.

10   Troubleshooting

10.1   Troubleshooting instructions

Always start troubleshooting with the following checklist if faults occur after commissioning or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

Check the display	
No display visible and no output signals present.	1. Check the supply voltage → Terminal 1, 2 2. Check device fuse → 🕮 74 　　85 to 260 V AC: 0.8 A slow-blow / 250 V 　　20 to 55 V AC and 16 to 62 V DC: 　　2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → 🕮 69.
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → 🕮 69. 2. Display module defective → order spare parts → 🕮 69 3. Measuring electronics defective → order spare parts → 🕮 69
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the 🔳 keys and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output	Measuring electronics defective →order spare parts → 🕮 69

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Error messages on display	

Errors that occur during commissioning or measuring are displayed immediately. Error messages consist of a variety of icons. The meanings of these icons are as follows (example):

– Type of error: **S** = System error, **P** = Process error
– Error message type: ϟ = Fault message, **!** = Notice message
– **FLUID INHOM.** = Error designation (e.g. fluid is not homogeneous)
– **03:00:05** = Duration of error occurrence (in hours, minutes and seconds)
– **#702** = Error number

👆　　Caution!
See the information on → 🕮 31.

Error number: No. 001 - 399 No. 501 - 699	System error (device error) has occurred → 🕮 62
Error number: No. 400 - 499 No. 700 - 799	Process error (application error) has occurred → 🕮 66

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Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → 🕮 67

10.2   System error messages

Serious system errors are **always** recognized by the device as "Fault message", and are shown as a lightning flash (⚡) on the display. Fault messages immediately affect the outputs. Simulations and positive zero return, on the other hand, are classed and displayed as "Notice messages".

☞ Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. Procedures must be carried out before you return a flowmeter to Endress+Hauser for repair or calibration → 🖺 5, → 🖺 75.

✎ Note!
• The listed error message types below correspond to the factory setting.
• See also the information on → 🖺 31.

No.	Error message / Type	Cause	Remedy / spare part
S = System error ⚡ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without any effect on the inputs and outputs)			
No. # 0xx → Hardware error			
001	S: CRITICAL FAILURE ⚡: # 001	Serious device error.	Replace the amplifier board. Spare parts → 🖺 69.
011	S: AMP HW EEPROM ⚡: # 011	Amplifier: Defective EEPROM.	Replace the amplifier board. Spare parts → 🖺 69.
012	S: AMP SW EEPROM ⚡: # 012	Measuring amplifier: Error when accessing data of the EEPROM.	The EEPROM data blocks in which an error has occurred are displayed in the "TROUBLESHOOTING" function. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the erroneous parameter values. ✎ Note! The measuring device has to be restarted if an error has occurred in a totalizer block (→ also error No. 111 / CHECKSUM TOTAL.).
031	S: SENSOR HW DAT ⚡: # 031	Sensor DAT: 1. S-DAT is defective. 2. S-DAT is not plugged into the amplifier board or is missing.	1. Replace the S-DAT. Spare parts → 🖺 69. Check the spare part set number to ensure that the new, replacement DAT is compatible with the measuring electronics. 2. Plug the S-DAT into the amplifier board → 🖺 70 or → 🖺 72.
032	S: SENSOR SW DAT ⚡: # 032	Sensor DAT: Error accessing the calibration values stored in the S-DAT.	1. Check whether the S-DAT is correctly plugged into the amplifier board → 🖺 70 or → 🖺 72. 2. Replace the S-DAT if it is defective. Spare parts → 🖺 69. Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → 🖺 69.
041	S: TRANSM. HW DAT ⚡: # 041	Sensor DAT: 1. T-DAT is defective. 2. T-DAT is not plugged into the amplifier board or is missing.	1. Replace the T-DAT. Spare parts → 🖺 69. Check the spare part set number to ensure that the new, replacement DAT is compatible with the measuring electronics. 2. Plug the T-DAT into the amplifier board → 🖺 70 or → 🖺 72.

No.	Error message / Type	Cause	Remedy / spare part
042	S: TRANSM. SW DAT ⚡: # 042	Sensor DAT: Error accessing the calibration values stored in the S-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board → 📖 70 or → 📖 72. 2. Replace the T-DAT if it is defective. Spare parts → 📖 69. Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → 📖 69.
No. # 1xx → Software error			
121	S: A / C COMPATIB. !: # 121	Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality). ✎ Note! – This message is only listed in the error history. – Nothing is displayed on the display.	Module with lower software version has either to be updated by FieldCare with the required software version or the module has to be replaced. Spare parts → 📖 69.
No. # 2xx → Error in DAT / no communication			
205	S: LOAD T-DAT !: # 205	Transmitter DAT: Data backup (downloading) to T-DAT failed, or error when accessing (uploading) the calibration values stored in the T-DAT.	1. Check whether the T-DAT is correctly plugged into the amplifier board → 📖 70 or → 📖 72. 2. Replace the T-DAT if it is defective. Spare parts → 📖 69. Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → 📖 69.
206	S: SAVE T-DAT !: # 206		
251	S: COMMUNICATION I/O ⚡: # 251	Internal communication fault on the amplifier board.	Remove the amplifier board. Spare parts → 📖 69.
261	S: COMMUNICATION I/O ⚡: # 261	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts.
271	S: POWER BRK. DOWN ⚡: # 271	Power supply interrupted. Error message appears during device startup in custody transfer mode after a power failure.	Confirm with the ENTER key or reset via the auxiliary input (status input).
No. # 3xx → System limits exceeded			
339 to 342	S: STACK CUR OUT n ⚡: # 339...342	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE (⚡): – Configure the fault response of the output to "ACTUAL VALUE", so that the temporary buffer can be cleared. → 📖 69. – Clear the temporary buffer by the measures described under Item 1.
343 to 346	S: STACK FREQ. OUT n ⚡: # 343...346		

No.	Error message / Type	Cause	Remedy / spare part
347 to 350	S: STACK PULSE OUT n !: # 347 to 350	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Increase the setting for pulse weighting. 2. Increase the max. pulse frequency if the totalizer can handle a higher number of pulses. 3. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE (⚡): – Configure the fault response of the output to "ACTUAL VALUE", so that the temporary buffer can be cleared. → 📄 69. – Clear the temporary buffer by the measures described under Item 1.
351 to 354	S: CURRENT RANGE n ⚡: # 351...354	Current output: The actual value for the flow lies outside the set limits.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 to 358	S: FREQ. RANGE n !: # 355 to 358	Frequency output: The actual value for the flow lies outside the set limits.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
359 to 362	S: PULSE RANGE ⚡: # 359...362	Pulse output: Pulse output frequency is out of range.	1. Increase the setting for pulse weighting. 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Version 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Version 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $$\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$$ a0004437 3. Reduce flow.
379 to 380	S: FREQ. LIM ⚡: # 379...380	The measuring tube oscillation frequency is outside the permitted range. Causes: – Change the upper or lower limit setting, as applicable. – Increase or reduce flow, as applicable.	Contact your Endress+Hauser representative.
381	S: FLUIDTEMP.MIN. ⚡: # 381	The temperature sensor on the measuring tube is likely defective.	Check the following electrical connections before you contact your Endress+Hauser representative: – Verify that the sensor signal cable connector is correctly plugged into the amplifier board → 📄 70 or → 📄 72. – Remote version: Check sensor and transmitter terminal connections No. 9 and 10 → 📄 20.
382	S: FLUIDTEMP.MAX. ⚡: # 382		
383	S: CARR.TEMP.MIN ⚡: # 383	The temperature sensor on the carrier tube is likely defective.	Check the following electrical connections before you contact your Endress+Hauser representative: – Verify that the sensor signal cable connector is correctly plugged into the amplifier board → 📄 70 or → 📄 72. – Remote version: Check sensor and transmitter terminal connections No. 11 and 12 → 📄 20.
384	S: CARR.TEMP.MAX ⚡: # 384		

No.	Error message / Type	Cause	Remedy / spare part
385	S: INL.SENS.DEF. ⚡: # 385	One of the measuring tube exciter coils (inlet) is likely defective.	Check the following electrical connections before you contact your Endress+Hauser representative: – Verify that the sensor signal cable connector is correctly plugged into the amplifier board → 🕮 70 or → 🕮 72. – Remote version: Check sensor and transmitter terminal connections No. 4, 5, 6 and 7 → 🕮 20.
386	S: OUTL.SENS.DEF. ⚡: # 386	One of the measuring tube exciter coils (outlet) is likely defective.	
387	S: SEN.ASY.EXCEED ⚡: # 387	One of the measuring tube exciter coils is likely defective.	
388 to 390	S: AMP. FAULT ⚡: # 388...390	Amplifier error.	Contact your Endress+Hauser representative.
No. # 5xx → Application error			
501	S: SW.-UPDATE ACT. !: # 501	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until process is finished. The device will restart automatically.
502	S: UP-/DOWNLOAD ACT. !: # 502	Up- or downloading the device data via configuration program. Currently no other functions are possible.	Wait until process is finished.
586	S: OSC. AMP. LIMIT ⚡: # 586	The fluid properties do not allow a continuation of the measurement. Causes: – Extremely high viscosity. – Process fluid is very inhomogeneous (gas or solid content).	Change or improve process conditions.
587	S: TUBE OSC. NOT ⚡: # 587	Extreme process conditions exist. The measuring system can therefore not be started.	Change or improve process conditions.
588	S: GAIN RED.IMPOS ⚡: # 588	Overdriving of the internal analog to digital converter. Causes: – Cavitation – Extreme pressure pulses – High gas flow velocity A continuation of the measurement is no longer possible.	Change or improve process conditions, e.g. by reducing the flow velocity.
No. # 6xx → Simulation mode active			
601	S: POSITIVE ZERO RETURN !: # 601	Positive zero return active. ☞ Caution! This message has the highest display priority.	Switch off positive zero return.
611 to 614	S: SIM. CURR. OUT. n !: # 611 to 614	Simulation current output active.	
621 to 624	S: SIM. FREQ. OUT n !: # 621 to 624	Simulation frequency output active.	Switch off simulation.
631 to 634	S: SIM. PULSE n !: # 631 to 634	Simulation pulse output active.	Switch off simulation.
671 to 674	S: SIM. STAT. IN n !: # 671 to 674	Simulation status input active.	Switch off simulation.
691	S: SIM. FAILSAFE !: # 691	Simulation of response to error (outputs) active.	Switch off simulation.
692	S: SIM. MEASURAND !: # 692	Simulation of measuring variables (e.g. mass flow).	Switch off simulation.
698	S: DEV. TEST AKT. !: # 698	The measuring device is being checked on site via the test and simulation device.	-

10.3   Process error messages

Process errors can be defined as either "Fault" or "Notice" messages and can thereby be weighted differently. You can define messages in this way with the aid of the function matrix (→ "Description of Device Parameters" manual).

✎ Note!
  • The listed error message types below correspond to the factory setting.
  • See also the information on → ▤ 31.

No.	Error message / Type	Cause	Remedy / spare part
P = Process error ⚡ = Fault message (with an effect on the inputs and outputs) ! = Notice message (without any effect on the inputs and outputs)			
700	P: EMPTY PIPE ⚡: # 700	The process fluid density is outside the upper or lower limit values set in the "EPD" function. Causes: – Air in the measuring tube – Partly filled measuring tube	1. Ensure that there is no gas content in the process liquid. 2. Adapt the values in the "EPD RESPONSE TIME" function to the current process conditions.
701	P: EXC. CURR. LIM ⚡: # 701	The maximum current value for the measuring tube exciter coils has been reached, since certain process fluid characteristics are extreme, e.g. high gas or solid content. The device continues to work correctly.	In particular with outgassing fluids and/or increased gas content, the following measures are recommended to increase system pressure: 1. Install the device at the outlet side of a pump. 2. Install the device at the lowest point of an ascending pipeline.
702	P: FLUID INHOM. ⚡: # 702	Frequency control is not stable, due to inhomogeneous process fluid, e.g. gas or solid content.	3. Install a flow restriction, e.g. reducer or orifice plate, downstream from the device.
703	P: NOISE LIM. CH0 ⚡: # 703	Overdriving of the internal analog to digital converter. Causes: – Cavitation – Extreme pressure pulses – High gas flow velocity A continuation of the measurement is still possible.	Change or improve process conditions, e.g. by reducing the flow velocity.
704	P: NOISE LIM. CH1 ⚡: # 704		
705	P: FLOW LIMIT ⚡: # 705	The mass flow is too high. The electronics' measuring range will be exceeded.	Reduce flow.
731	P: ADJ. ZERO FAIL !: # 731	The zero point adjustment is not possible or has been canceled.	Make sure that zero point adjustment is carried out at "zero flow" only (v = 0 m/s) → ▤ 54.

10.4   Process errors without messages

Symptoms	Rectification
Comment: You may have to change or correct certain settings of the function matrix in order to rectify faults. The functions outlined below, such as DISPLAY DAMPING, are described in detail in the "Description of Device Parameters" manual.	
Measured value reading fluctuates even though flow is steady.	1. Check the fluid for presence of gas bubbles. 2. "TIME CONSTANT" function → increase value (→ OUTPUTS / CURRENT OUTPUT / CONFIGURATION) 3. "DISPLAY DAMPING" function → increase value (→ USER INTERFACE / CONTROL / BASIC CONFIG.)
Flow values are negative, even though the fluid is flowing forwards through the pipe.	Change the "INSTALLATION DIRECTION SENSOR" function accordingly.
Measured-value reading or measured-value output pulsates or fluctuates, e.g. because of reciprocating pump, peristaltic pump, diaphragm pump or pump with similar delivery characteristic.	Run the "Pulsating Flow" Quick Setup → 🖹 46. If the problem persists despite these measures, a pulsation damper will have to be installed between pump and measuring device.
There are differences between the flowmeter's internal totalizer and the external metering device.	This symptom is due primarily to backflow in the piping, because the pulse output cannot subtract in the "STANDARD" or "SYMMETRY" measuring modes. The problem can be solved as follows: Allow for flow in both directions. Set the "MEASURING MODE" function to "PULSATING FLOW" for the pulse output in question.
Measured value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check the fluid for presence of gas bubbles. 2. Activate the "ON-VAL. LF-CUTOFF" function, i.e. enter or increase the value for the low flow cut off (→ BASIC FUNCTION / PROCESSPARAMETER / CONFIGURATION).
The error cannot be eliminated or another error pattern is present. In these instances, please contact your Endress+Hauser service organization.	The following solutions are possible: **Request the services of an Endress+Hauser service technician** If you request the services of a service technician, please be ready with the following information: – Brief error description – Nameplate specifications: order code and serial number → 🖹 6 **Return the devices to Endress+Hauser** Procedures must be carried out before you return a flowmeter to Endress+Hauser for repair or calibration → 🖹 5, → 🖹 75. **Replace the transmitter electronics** Parts of the measuring electronics defective → order spare part → 🖹 75

10.5 Response of outputs to errors

✎ Note!
The failsafe mode of totalizers, current, pulse and frequency outputs can be customized by means of various functions in the function matrix. Detailed information → "Description of Device Parameters" manual.

You can use positive zero return to set the signals of the current, pulse and status outputs to their fallback value, for example when measuring has to be interrupted while a pipe is being cleaned. This function takes priority over all other device functions. Simulations, for example, are suppressed.

Failsafe mode of outputs and totalizers		
	Process/system error is present	Positive zero return is activated
☝ Caution! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See also the information on → 📄 31.		
Current output	MIN. CURRENT The current output will be set to the lower value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (→ "Description of Device Parameters" manual). MAX. CURRENT The current output will be set to the upper value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (→ "Description of Device Parameters" manual). HOLD VALUE Measured value display on the basis of the last saved value preceding occurrence of the fault. ACTUAL VALUE Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"
Pulse output	FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Frequency output	FALLBACK VALUE Signal output → 0 Hz FAILSAFE VALUE Output of the frequency specified in the FAILSAFE VALUE function. HOLD VALUE Last valid value (preceding occurrence of the fault) is output. ACTUAL VALUE Fault is ignored, i.e. normal measured value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"
Totalizer	STOP The totalizers are paused until the fault is rectified. ACTUAL VALUE The fault is ignored. The totalizer continues to count in accordance with the current flow value. HOLD VALUE The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops

10.6   Spare parts

The previous sections contain detailed troubleshooting instructions → 🕮 61.
The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages.
Fault rectification can entail replacing defective components with tested spare parts. For an overview of the spare parts that can be delivered → 🖾 32.
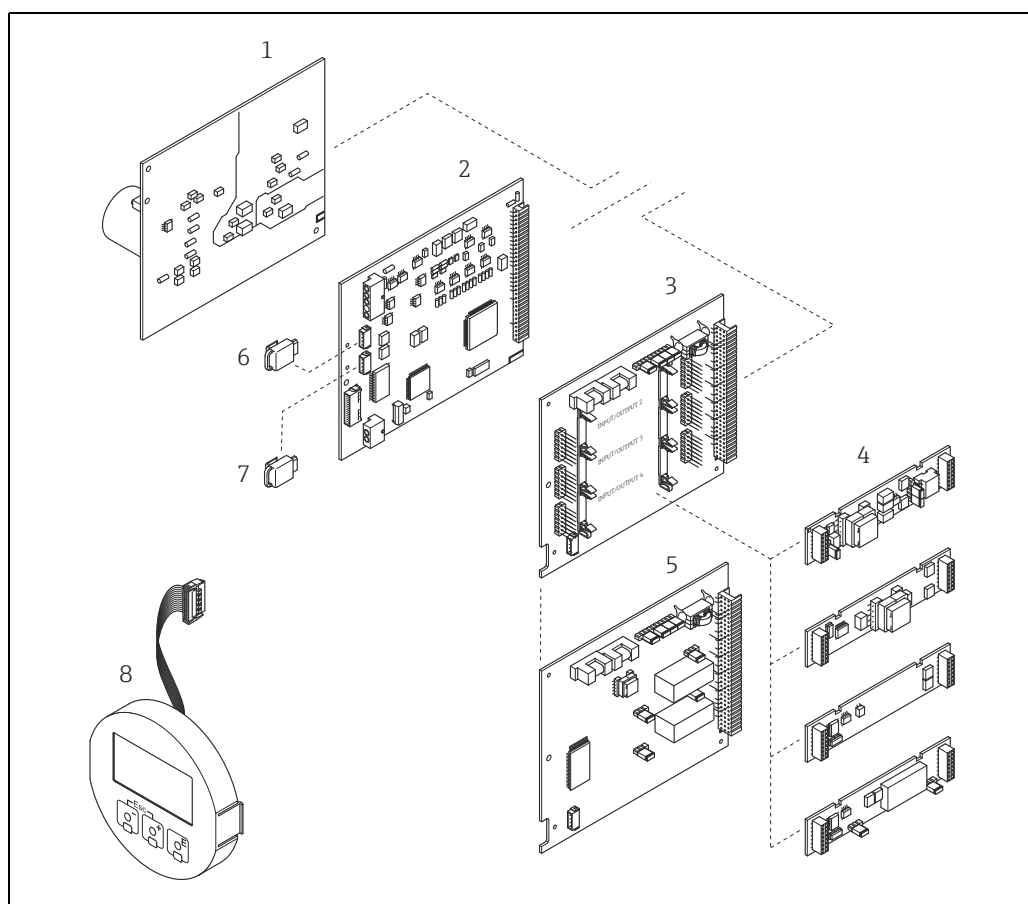
✎ Note!
Spare parts can be ordered directly from your Endress+Hauser representative by providing the serial number printed on the transmitter's nameplate (→ 🕮 6).

Spare parts are shipped as sets comprising the following parts:
• Spare part
• Additional parts, small items (threaded fasteners etc.)
• Mounting instructions
• Packaging

A0006363

Fig. 32:   Spare parts for transmitter (field and wall-mount housings)

1   Power unit board (85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC)
2   Amplifier board
3   I/O board (COM module), flexible assignment
4   Pluggable input/output submodules
5   I/O board (COM module), permanent assignment
6   S-DAT (sensor data memory)
7   T-DAT (transmitter data memory)
8   Display module

10.6.1   Removing and installing printed circuit boards

Field housing

Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection).
  Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purposely built for electrostatically sensitive devices.
- If you cannot guarantee that the dielectric strength of the measuring device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.

Caution!
Use only original Endress+Hauser parts.

Installing and removing the boards → 🖻 33:

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the local display (1) as follows:
    – Press in the latches (1.1) at the side and remove the display module.
    – Disconnect the ribbon cable (1.2) of the display module from the amplifier board.

3. Remove the screws and remove the cover (2) from the electronics compartment.

4. Remove power unit board (4) and I/O board (6):
    Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.

5. Remove submodules (6.1) (optional):
    No tools are required for removing the submodules (outputs) from the I/O board. Installation is also a no-tools operation.

    Caution!
    Only certain combinations of submodules on the I/O board are permissible → 🖺 22.
    The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:
    – Slot "INPUT / OUTPUT 3" = Terminals 22/23
    – Slot "INPUT / OUTPUT 4" = Terminals 20/21

6. Remove amplifier board (5):
    – Disconnect the plug of the sensor signal cable (5.1) including S-DAT (5.3) from the board.
    – Gently disconnect the plug of the excitation current cable (5.2) from the board, i.e. without moving it back and forward.
    – Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.

7. Installation is the reverse of the removal procedure.
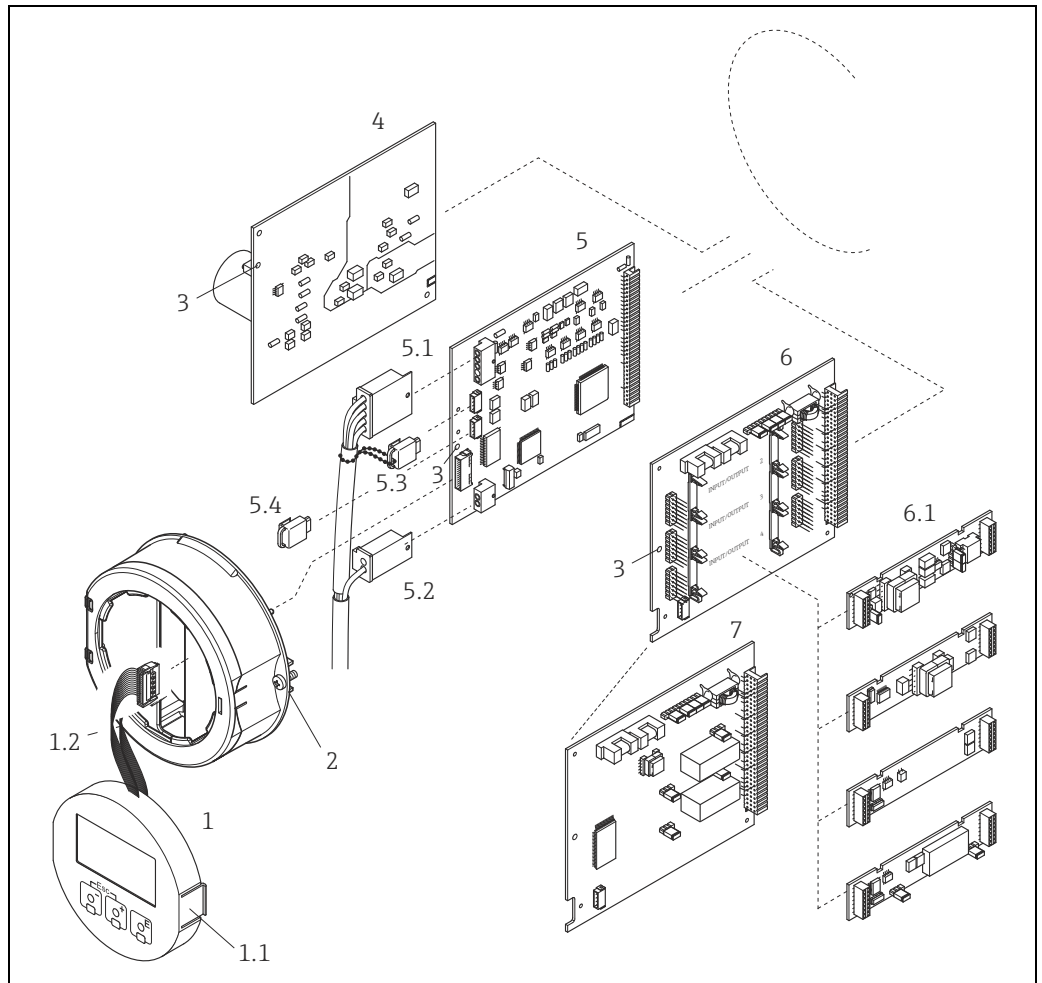
A0006364

Fig. 33:   Field housing: removing and installing printed circuit boards

1   Local display
1.1   Latch
1.2   Ribbon cable (display module)
2   Screws of electronics compartment cover
3   Aperture for installing/removing boards
4   Power unit board
5   Amplifier board
5.1   Signal cable (sensor)
5.2   Excitation current cable (sensor)
5.3   S-DAT (sensor data memory)
5.4   T-DAT (transmitter data memory)
6   I/O board (flexible assignment)
6.1   Pluggable submodules (status input and current input, current output, pulse/frequency output and relay output)
7   I/O board (permanent assignment)

Wall-mount housing

Warning!
• Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
• Risk of damaging electronic components (ESD protection).
  Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purposely built for electrostatically sensitive devices.
• If you cannot guarantee that the dielectric strength of the measuring device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.

Caution!
Use only original Endress+Hauser parts.

Installing and removing the boards → 🖻 34:

1. Remove the screws and open the hinged cover (1) of the housing.

2. Remove the screws securing the electronics module (2). Then push up electronics module and pull it as far as possible out of the wall-mount housing.

3. Disconnect the following cable plugs from amplifier board (7):
    – Sensor signal cable plug (7.1) including S-DAT (7.3)
    – Unplug excitation current cable (7.2):
      Gently disconnect the plug, i.e. without moving it back and forward.
    – Ribbon cable plug (3) of the display module.

4. Remove the cover (4) from the electronics compartment by loosening the screws.

5. Remove the boards (6, 7, 8):
    Insert a thin pin into the hole (5) provided for the purpose and pull the board clear of its holder.

6. Remove submodules (8.1) (optional):
    No tools are required for removing the submodules (outputs) from the I/O board. Installation is also a no-tools operation.

    Caution!
    Only certain combinations of submodules on the I/O board are permissible → 🖺 22.
    The individual slots are marked and correspond to certain terminals in the connection compartment of the transmitter:

    Slot "INPUT / OUTPUT 2" = Terminals 24/25
    Slot "INPUT / OUTPUT 3" = Terminals 22/23
    Slot "INPUT / OUTPUT 4" = Terminals 20/21

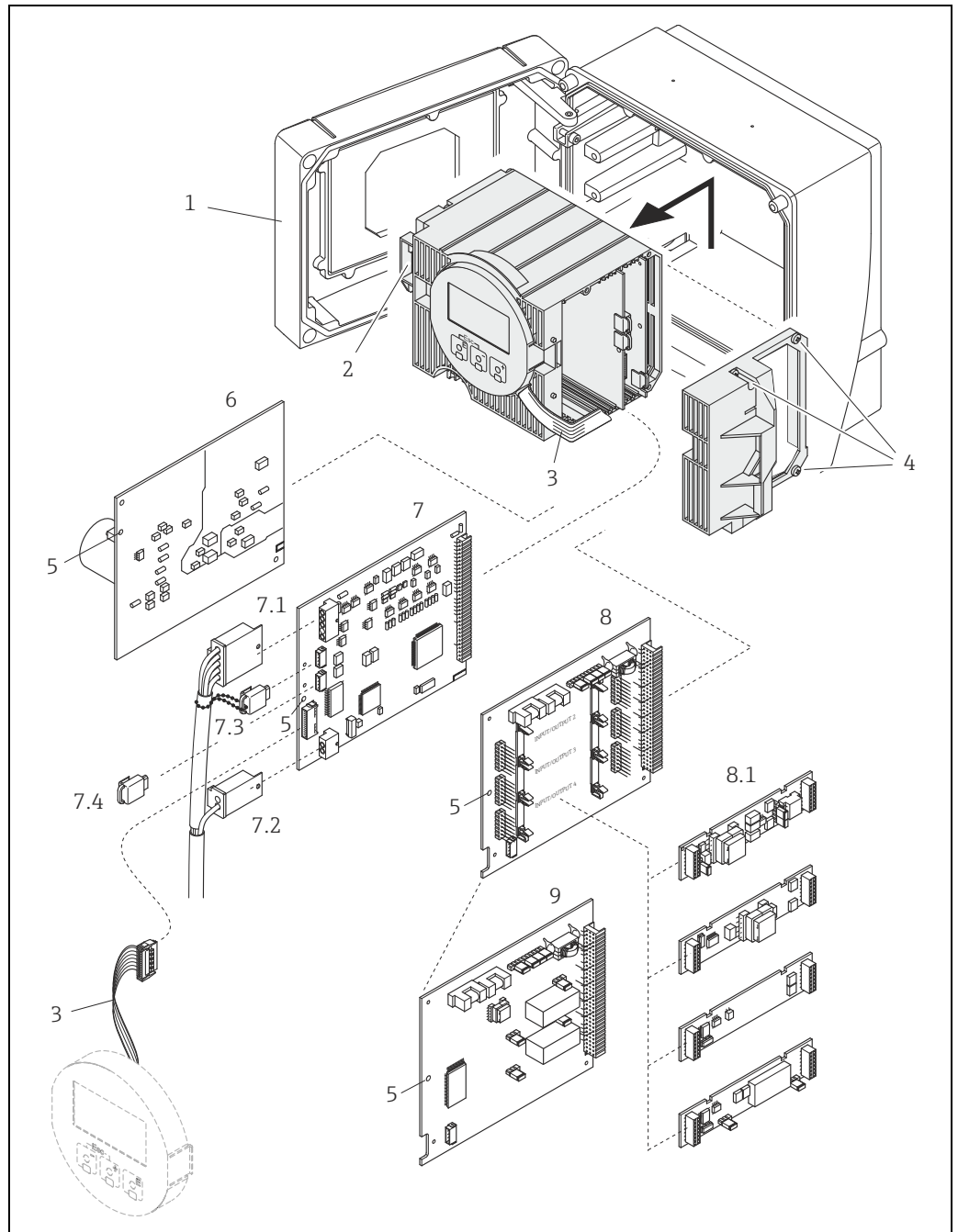7. Installation is the reverse of the removal procedure.

A0006365

Fig. 34:   Wall-mount housing: removing and installing printed circuit boards

1   Housing cover
2   Electronics module
3   Ribbon cable (display module)
4   Screws of electronics compartment cover
5   Aperture for installing/removing boards
6   Power unit board
7   Amplifier board
7.1   Signal cable (sensor)
7.2   Excitation current cable (sensor)
7.3   S-DAT (sensor data memory)
7.4   T-DAT (transmitter data memory)
8   I/O board (flexible assignment)
8.1   Pluggable submodules (status input and current input, current output, pulse/frequency output and relay output)
9   I/O board (permanent assignment)

10.6.2   Replacing the device fuse

⚠ Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

The main fuse is on the power unit board → ▣ 35.
Replace the fuse as follows:

1. Switch off power supply.

2. Remove the power unit board → 🖹 70.

3. Remove the protection cap (1) and replace the device fuse (2).
    Only use the following fuse type:
    – 20 to 55 V AC / 16 to 62 V DC → 2.0 A slow-blow / 250 V; 5.2 × 20 mm
    – Power supply 85 to 260 V AC → 0.8 A slow-blow / 250 V; 5.2 × 20 mm
    – Ex-rated devices →Ex documentation

4. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.
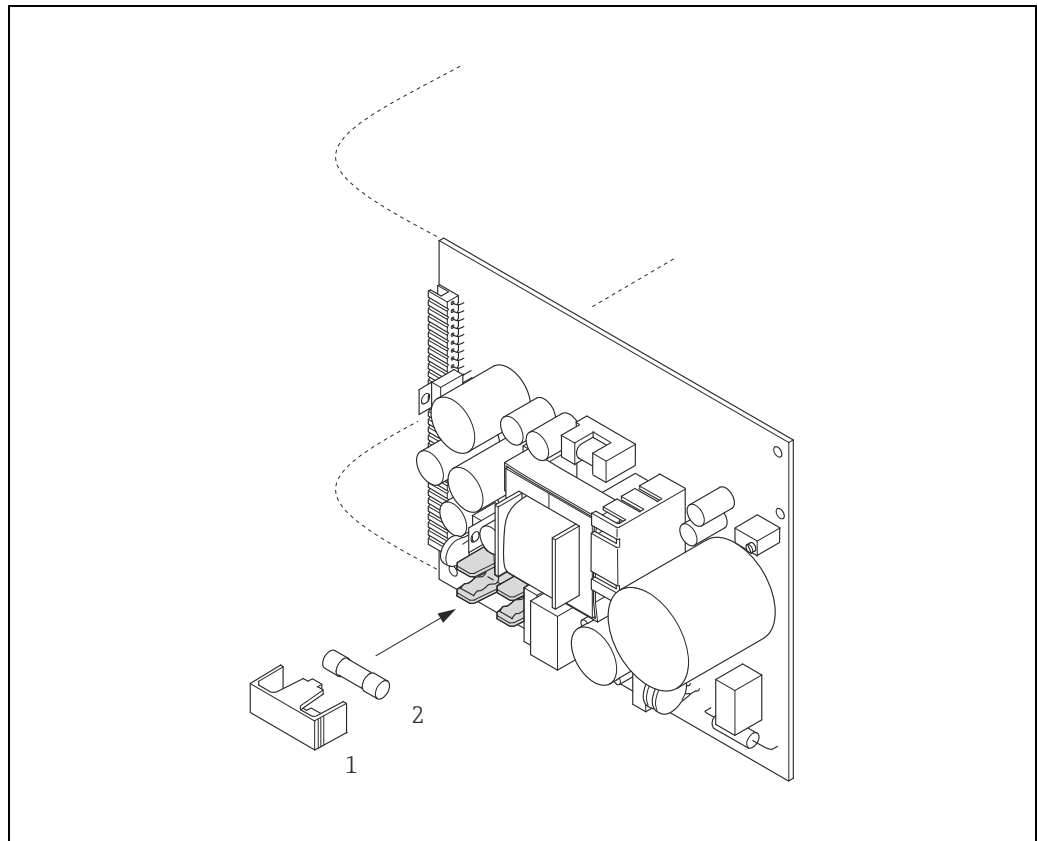
A0001148

Fig. 35:   Replacing the device fuse on the power unit board

1   Protective cap
2   Device fuse

10.7   Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material.

10.8   Disposal

Observe the regulations applicable in your country.

10.9   Software history

Date	Software version	Changes to software	Operating Instructions
11.2015	3.01.xx	Original software	71240743/ 13.15
11.2009	3.01.00	Original software	71112146/ 04.10

11   Technical data

11.1   Applications

→ 🕮 4

11.2   Function and system design

Measuring principle   Mass flow measurement by the Coriolis principle

Measuring system   → 🕮 6

11.3   Input

Measured variable
- Mass flow (proportional to the phase difference between two sensors mounted on the measuring tube to register a phase shift in the oscillation)
- Volume flow (calculated using mass flow and density)
- Fluid density (proportional to the resonance frequency of the measuring tube)
- Fluid temperature (measured with temperature sensors)

Measuring range   **Measuring ranges for liquids**

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[in]	[kg/h]	[lb/min]
1	$\frac{1}{24}$"	0...20,00	0...0,735
2	$\frac{1}{12}$"	0...100,0	0...3,675
4	$\frac{1}{8}$"	0...450,0	0...16,54
6	$\frac{1}{4}$"	0...1000	0...36,75

Operable flow range   1 : 1000

Input signal   *Status input (auxiliary input)*

U = 3 to 30 V DC, R_i = 5 kΩ, galvanically isolated.
Switching level: 3 to 30 V DC, polarity-independent.
Configurable for: totalizer reset, positive zero return, error message reset, start zero point adjustment.

11.4   Output

Output signal   *Current output*

Active/passive selectable, galvanically isolated, time constant selectable (0.05 to 100 s), full scale value selectable, temperature coefficient: typically 0.005% o.r. / ˚C, resolution: 0.5 μA
- Active: 0/4 to 20 mA, R_L < 700 Ω
- Passive: 4 to 20 mA; supply voltage V_S: 18 to 30 V DC; R_i≥ 150 Ω

o.r. = of reading

Pulse/frequency output

Active/passive can be selected, galvanically isolated
- Active: 24 V DC, 25 mA (max. 250 mA during 20 ms), R_L > 100 Ω
- Passive: open collector, 30 V DC, 250 mA
- Frequency output: end frequency 2 to 10000 Hz (f_{max} = 12500 Hz), on/off ratio 1:1, pulse width max. 2 s
- Pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.05 to 2000 ms)

Signal on alarm	*Current output* Failsafe mode selectable (for example, according to NAMUR Recommendation NE 43) *Pulse/frequency output* Failsafe mode selectable *Relay output* De-energized in the event of fault or power supply failure
Switching output	*Relay output* Normally closed (NC or break) or normally open (NO or make) contacts available (factory setting: relay 1 = normally open), max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated.
Load	→ "Output signal"
Galvanic isolation	All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

11.5   Power supply

Terminal assignment	→ 🗏 22
Supply voltage	85 to 260 V AC, 45 to 65 Hz 20 to 55 V AC, 45 to 65 Hz 16 to 62 V DC
Power consumption	AC: < 15 VA (including sensor) DC: < 15 W (including sensor) Switch-on current - max. 13.5 A (< 50 ms) at 24 V DC - max. 3 A (< 5 ms) at 260 V AC
Power supply failure	Lasting min. 1 power cycle: - EEPROM or HistoROM T-DAT saves measuring system data if power supply fails. - HistoROM/S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point etc.)
Electrical connections	→ 🗏 19
Potential equalization	No measures necessary. For explosion-protected equipment →separate Ex-documentation supplied

Cable entries

Power supply and signal cables (inputs/outputs):
- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Threads for cable entries, ½" NPT, G ½"

Connecting cable for remote version:
- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Threads for cable entries, ½" NPT, G ½"

Cable specifications

Remote version → 🗐 20

11.6   Performance characteristics

Reference operating conditions

- Error limits following ISO 11631
- Water, typically +15 to +45 ℃ (+59 to +113 ℉); 2 to 6 bar (29 to 87 psi)
- Specification as per calibration protocol ±5 ℃ (±9 ℉) and ±2 bar (±30 psi)
- Data on the measured error based on accredited calibration rigs traced back to ISO 17025

To obtain measured errors, use the Applicator sizing tool *Applicator*: → 🗐 60.

Maximum measured error

Design fundamentals → 🗐 80

o.r. = of reading; 1 g/cm^3= 1 kg/l; T = fluid temperature

Base accuracy

Mass flow and volume flow (liquids)

- ±0.10% o.r. (mass flow)
- ±0.10% o.r. (volume flow)

Mass flow (gases)

- ±0.5% o.r.

Density (liquids)

- Reference conditions: ±0.0005 g/cm^3
- Standard density calibrations: ±0.02 g/cm^3 (valid over the entire measuring range of the sensor → 🗐 82)
- Wide-range density specification: ±0.002 g/cm^3 (valid range for special density calibration: +5 to +80 ℃ (+41 to +176 ℉))

Temperature

±0.5 ℃ ± 0.005 · T ℃ (±1.0 ℉ ± 0.003 · (T − 32) ℉)

Zero point stability

DN		Zero point stability	
[mm]	[in]	[kg/h]	[lb/min]
1	¹⁄₂₄"	0.0008	0.00003
2	¹⁄₁₂"	0.002	0.00007
4	⅛"	0.014	0.0005
6	¼"	0.02	0.0007

Flow values

Flow values as turndown parameter depending on nominal diameter.

SI units

DN	1:1	1:10	1:20	1:50	1:100	1:500
[mm]	[kg/h]	[kg/h]	[kg/h]	[kg/h]	[kg/h]	[kg/h]
1	20.00	2.000	1.000	0.400	0.200	0.040
2	100.0	10.00	5.000	2.000	1.000	0.200
4	450.0	45.00	22.50	9.000	4.500	0.900
6	1000	100.0	50.00	20.00	10.00	2.000

US units

DN	1:1	1:10	1:20	1:50	1:100	1:500
[in]	[lb/min]	[lb/min]	[lb/min]	[lb/min]	[lb/min]	[lb/min]
$\frac{1}{24}$"	0.735	0.074	0.037	0.015	0.007	0.001
$\frac{1}{12}$"	3.675	0.368	0.184	0.074	0.037	0.007
$\frac{1}{8}$"	16.54	1.654	0.827	0.330	0.165	0.033
$\frac{1}{4}$"	36.75	3.675	1.838	0.735	0.368	0.074

Accuracy of outputs

o.r. = of reading; o.f.s. = of full scale value

The output accuracy must be factored into the measured error if analog outputs are used, but can be ignored for fieldbus outputs (e.g. Modbus RS485).

Current output

Accuracy: Max. ±0.025 % o.f.s. or ±5 µA

Pulse/frequency output

Accuracy: Max. ±50 % ppm o.r.

Repeatability	Design fundamentals → 🖺 80

o.r. = of reading; 1 g/cm^3= 1 kg/l; T = fluid temperature

Base repeatability

Mass flow and volume flow (liquids)

- ±0.05% o.r. (mass flow)
- ±0.05% o.r. (volume flow)

Mass flow (gases)

- ±0.25% o.r. (mass flow)

Density (liquids)

- ±0.00025 g/cm^3

Temperature

±0.25 ℃ ± 0.0025 · T ℃ (±0.45 ℉ ± 0.0015 · (T − 32) ℉)

Response time	• The response time depends on the configuration (damping). • Response time in the event of erratic changes in the measured variable (only mass flow): after 100 ms 95 % of the full scale value.

Influence of medium temperature	When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error is ±0.0002% of the full scale value / ℃ (±0.0001% of the full scale value / ℉).

Influence of medium pressure

The tables below shows the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure.

DN		Medium pressure	
[mm]	[in]	[% o.r./bar]	[% o.r./psi]
1	$^1\!/_{24}$"	−0.001	−0.00007
2	$^1\!/_{12}$"	0	0
4	$^1\!/_8$"	−0.005	−0.0004
6	$^1\!/_4$"	−0.003	−0.0002

Design fundamentals

o.r. = of reading
BaseAccu = base accuracy in % o.r.
BaseRepeat = base repeatability in % o.r.
MeasValue = measured value (in flow units consistent with the zero point stability value → 🕮 78)
ZeroPoint = zero point stability

Calculation of the maximum measured error depending on flowrate

Flowrate (in flow units consistent with the zero point stability value → 🕮 78)	Maximum measured error in % o.r.
$\geq \dfrac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$ A0021332	$\pm \text{BaseAccu}$ A0021339
$< \dfrac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$ A002133	$\pm \dfrac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$ A0021334

Calculation of the repeatability depending on flowrate

Flowrate (in flow units consistent with the zero point stability value → 🕮 78)	Repeatability in % o.r.
$\geq \dfrac{\tfrac{1}{2} \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$ A0021335	$\pm \text{BaseRepeat}$ A0021340
$< \dfrac{\tfrac{1}{2} \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$ A0021336	$\pm \tfrac{1}{2} \cdot \dfrac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$ A0021337

Example for maximum measured error
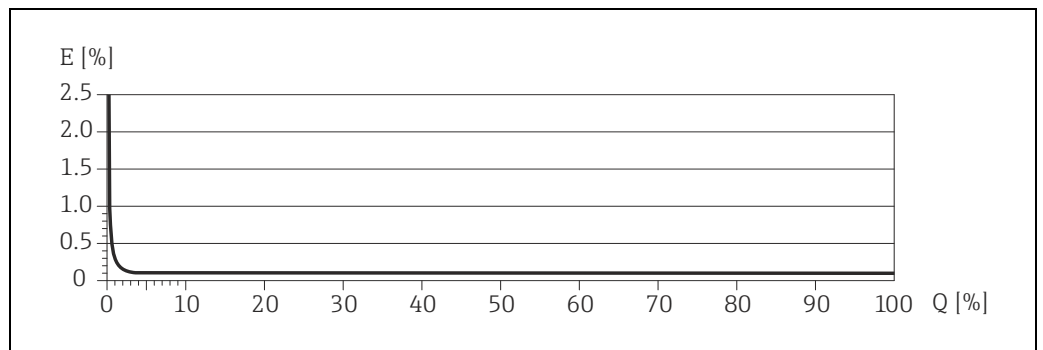
Fig. 36:   E = Error: Maximum measured error as % o.r.

Q = Flow rate as %

11.7   Installation

Installation instructions	→ 🗎 11

Inlet and outlet runs	There are no installation requirements regarding inlet and outlet runs.

Connection cable length, remote version	Max. 20 m (max. 66 ft)

11.8   Environment

Ambient temperature range	Sensor and transmitter: • Standard: –20 to +60 °C (–4 to +140 °F) • Optional: –40 to +60 °C (–40 to +140 °F) Note! • Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions. • At ambient temperatures below –20 °C (–4 °F), the readability of the display may be impaired.

Storage temperature	–40 to +80 °C (–40 to +175 °F), preferably at +20 °C (+68 °F)

Degree of protection	Standard: IP 67 (NEMA 4X) for transmitter and sensor

Shock resistance	According to IEC/EN 60068-2-31

Vibration resistance	Acceleration up to 1 g, 10 to 150 Hz, following IEC/EN 60068-2-6

CIP cleaning	Yes

SIP cleaning	Yes

Electromagnetic compatibility (EMC)	As per IEC/EN 61326 and NAMUR Recommendation NE 21.

11.9   Process

Medium temperature range	**Sensor**
	• –50 to +200 °C (–58 to +392 °F)

Seals (only for mounting sets with threaded connections):

- Viton: –15 to 200 °C (–5 to +392 °F)
- EPDM: –40 to +160 °C (–40 to +320 °F)
- Silicone: –60 to +200 °C (–76 to +392 °F)
- Kalrez: –20 to +275 °C (–4 to +527 °F)

Medium density	0...5000 kg/m³ (0 to 312 lb/cf)

Secondary containment pressure rating

The sensor housing is filled with dry nitrogen and protects the electronics and mechanics inside.

The following secondary containment pressure rating is only valid for a fully welded sensor housing and/or a device equipped with closed purge connections (never opened, as delivered).

DN		Secondary containment rating (designed with a safety factor ≥ 4)		Burst pressure of secondary containment	
[mm]	[in]	[bar]	[psi]	[bar]	[psi]
1	¹⁄₂₄"	40	580	190	2780
2	¹⁄₁₂"	40	580	190	2780
4	⅛"	40	580	190	2780
6	¼"	40	580	190	2780

✎ Note!
In case a danger of measuring tube failure exists due to process characteristics, e.g. with corrosive process fluids, we recommend the use of sensors whose secondary containment is equipped with special pressure monitoring connections (ordering option). With the help of these connections, fluid collected in the secondary containment in the event of tube failure can be bled off. This is especially important in high pressure gas applications. These connections can also be used for gas circulation and/or gas detection.

Do not open the purge connections unless the containment can be filled immediately with a dry inert gas. Use only low gauge pressure to purge. Maximum pressure: 5 bar (72.5 psi).

If a device fitted with purge connections is connected to the purge system, the maximum nominal pressure is determined by the purge system itself or by the device, depending on which component has the lower nominal pressure. If, on the other hand, the device is fitted with a rupture disk, the rupture disk is decisive for the maximum nominal pressure (→ 🖺 82).

Pressure-temperature ratings	An overview of the Pressure-temperature ratings for the process connections is provided in the "Technical Information" document.

Rupture disk	To increase the level of safety, a device version with a rupture disk with a triggering pressure of 10 to 15 bar (145 to 217.5 psi) can be used. Special mounting instructions: (→ 🖺 14).

Limiting flow   → 🕮 76, "Measuring range"

The suitable nominal diameter is determined by optimizing the settings between the required flow range and the permissible pressure loss. An overview of the maximum possible full scale values is provided in the "Measuring range" section.
- The minimum recommended full scale value is approx. 1/20 of the max. full scale value.
- In most applications, 20 to 50% of the maximum full scale value can be considered ideal.
- Select a low full scale value for abrasive substances, such as liquids with entrained solids (flow velocity < 1 m/s (3 ft/s)).

Pressure loss   To calculate the pressure loss, use the *Applicator* sizing tool (→ 🕮 60).

System pressure   → 🕮 12

11.10   Mechanical construction

Design / dimensions   The dimensions and lengths of the sensor and transmitter are provided in the separate "Technical Information" document on the measuring device in question. This can be downloaded as a PDF file from www.endress.com. A list of the "Technical Information" documents available is provided in the "Documentation" section → 🕮 86.

Weight

Compact version		Remote version	
[kg]	[lb]	[kg]	[lb]
5.5	12.1	3.3	7.3

Material   **Transmitter housing**

- Compact version
  – Aluminum housing: powder-coated die-cast aluminum

- Remote version
  – Wall-mount housing: powder coated die-cast aluminum
  – Field housing: powder-coated die-cast aluminum

Sensor connection housing (remote version)

- Powder-coated die-cast aluminum

Sensor housing / secondary containment

- Acid-resistant and alkali-resistant external surface
- Stainless steel 1.4301 (304)

Process connections

Process connection	Material
4-VCO-4 coupling 4-VCO-8 coupling	Stainless steel, 1.4539 (904L);
Mounting kit: flange according to EN1092-1 (DIN 2501) Mounting kit: flange according to ASME B16.5 Mounting kit: JIS B2220, flange	Stainless steel, 1.4539 (904L); Loose flange (not wetted): stainless steel, 1.4404 (F316/316L)
Mounting kit: NPTF threaded adapter ¼" Mounting kit: NPTF threaded adapter ½"	Stainless steel, 1.4539 (904L);

Measuring tube

• 1.4539 (904L)

Seals for mounting set

• Viton
• EPDM
• Silicone
• Kalrez

| Process connections | → 🖹 83, process connections |

11.11 Operability

| Local display | **Display elements** |

• Liquid crystal display: illuminated, four lines with 16 characters per line
• Selectable display of different measured values and status variables
• 3 totalizers
• At ambient temperatures below −20 ℃ (−4 ℉), the readability of the display may be impaired.

Operating elements

• Onsite operation with three optical sensor keys (⊟/⊞/Ⓔ)
• Application specific Quick Setup menus for straightforward commissioning

| Language groups | Language groups available for operation in different countries: |

• Western Europe and America (WEA): English, German, Spanish, Italian, French, Dutch and Portuguese
• Eastern Europe/Scandinavia (EES): English, Russian, Polish, Norwegian, Finnish, Swedish, Czech
• South and East Asia (SEA): English, Japanese, Indonesian
• China (CN): English, Chinese

✎ Note!
You can change the language group via the operating program FieldCare.

| Remote operation | Operation by means of HART protocol. |

11.12 Certificates and approvals

| CE mark | The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark. |

| C-tick mark | The measuring system meets the EMC requirements of the Australian Communications and Media Authority (ACMA). |

| Ex approval | Information about currently available Ex versions (ATEX, NEC/CEC etc.) can be supplied by your Endress+Hauser representative on request. All explosion protection data are given in a separate documentation, which is also available upon request → 🖹 86. |

HART certification	The flowmeter has successfully passed all the test procedures carried out and is certified and registered by the HCF (Hart Communication Foundation). The device thus meets all the requirements of the following specifications: • Certified in accordance with HART Revisions 5 and 7 (device certification number: available on request) • The measuring device can also be operated with certified devices of other manufacturers (interoperability).
Functional safety	SIL 2: in accordance with IEC 61508/IEC 61511-1 (FDIS)

Pressure measuring device approval	The measuring devices can be ordered with or without PED (Pressure Equipment Directive). If a device with PED is required, this must be ordered explicitly. For devices with nominal diameters less than or equal to DN 25 (1"), this is neither possible nor necessary.
	• With the identification PED/G1/III on the sensor nameplate, Endress+Hauser confirms conformity with the "Basic safety requirements" of Appendix I of the Pressure Equipment Directive 97/23/EC.
	• Devices with this identification (with PED) are suitable for the following types of fluid:
	  – Fluids of Group 1 and 2 with a steam pressure greater than, or smaller and equal to 0.5 bar (7.3 psi)
	  – Unstable gases
	• Devices without this identification (without PED) are designed and manufactured according to good engineering practice. They correspond to the requirements of Art. 3, Section 3 of the Pressure Equipment Directive 97/23/EC. Their application is illustrated in Diagrams 6 to 9 in Appendix II of the Pressure Equipment Directive 97/23/EC.

Other standards and guidelines	• EN 60529: Degrees of protection provided by enclosures (IP code) • EN 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use • IEC/EN 61326: Electromagnetic compatibility (EMC requirements) • NAMUR Recommendation NE 21: Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment • NAMUR Recommendation NE 43: Standardization of the signal level for the breakdown information of digital transmitters with analog output signal. • NAMUR Recommendation NE 53: Software of field devices and signal-processing devices with digital electronics

11.13   Accessories/spare parts

→ 🖹 59

11.14   Documentation

- Flow measurement (FA00005D/06)
- Description of Device Parameters (GP00002D/06)
- Technical Information (TI00099D/06)
- Ex-Supplementary documentation ATEX (II2G): (XA00139D/06)
- Ex-Supplementary documentation NEC/CEC (Div. 1): (XA00141D/06)
- Ex-Supplementary documentation NEPSI (Zone 1, Zone 21): (XA00142D/06)

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