Level	Pressure	Flow	Temperature	Liquid Analysis	Registration	Systems Components	Services	Solutions

Operating Instructions

Cubemass

MODBUS RS485
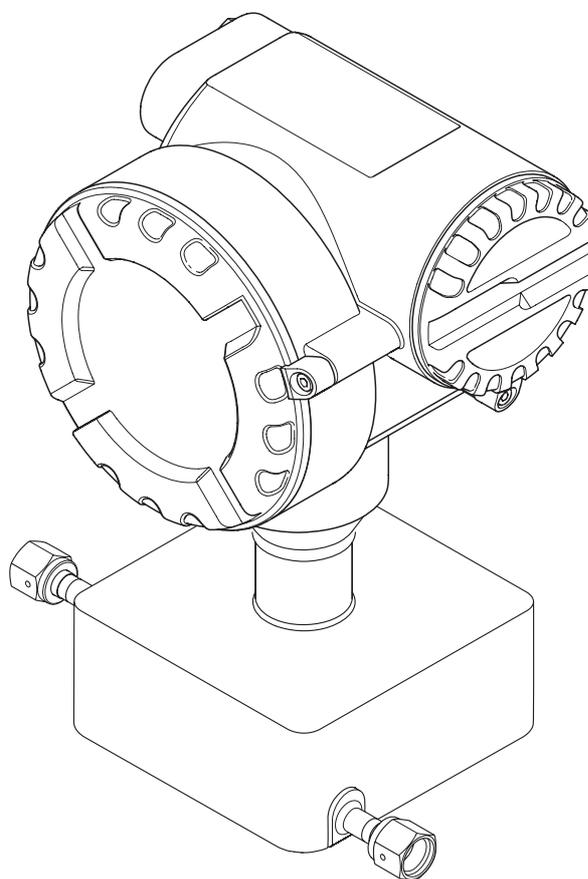
Coriolis mass flow measuring system

Endress+Hauser

People for Process Automation

Table of contents

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. 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 ($\rightarrow$ ▨ 4) is intact, the rupture disk is also intact.
- 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.

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

■ 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

The following procedures must be carried out before a flowmeter requiring repair or calibration, for example, is returned to Endress+Hauser:
■ Always enclose a duly completed "Declaration of Contamination" form. Only then can Endress+Hauser transport, examine and repair a returned device.
■ Enclose special handling instructions if necessary, for example a safety data sheet as per Regulation (EC) 1907/2006 REACH.
■ Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic etc.

Note!
You will find a preprinted "Declaration of Contamination and Cleaning" form at the back of this operating manual.

Warning!
■ Do not return a measuring device if it is 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.

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". They can, however, 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

2.1   Device designation

The "Cubemass" flow measuring system is a compact measuring device.

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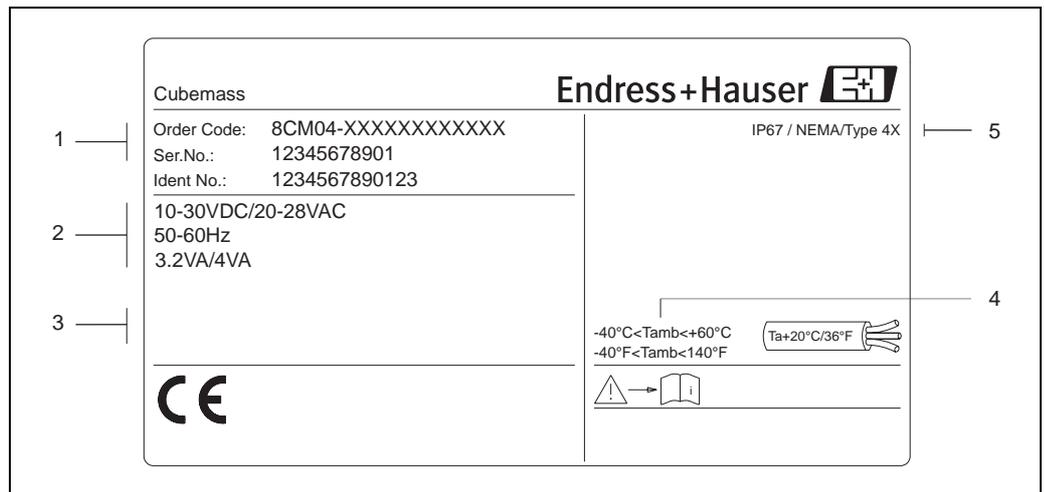
Fig. 1:   Nameplate specifications for the transmitter (example)

*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 / Power consumption
3   Reserved for information on special products
4   Ambient temperature range
5   Degree of protection

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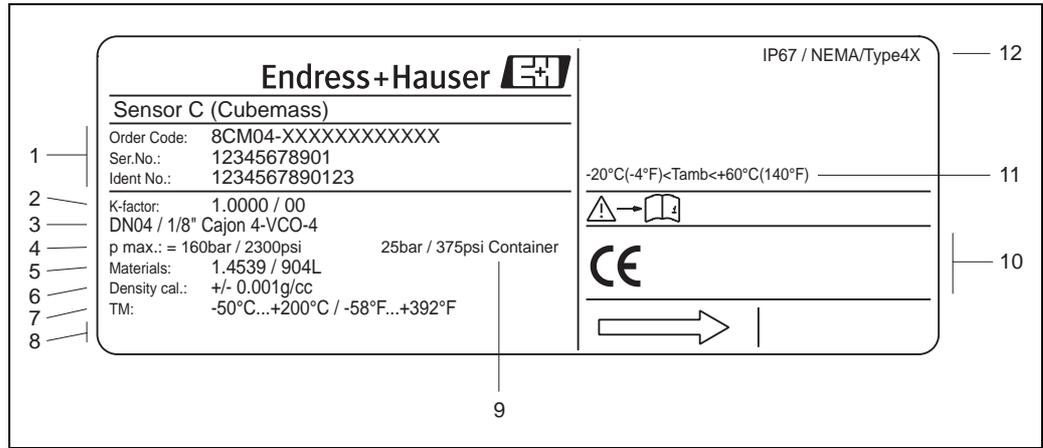
Fig. 2: Nameplate specifications for the sensor (example)

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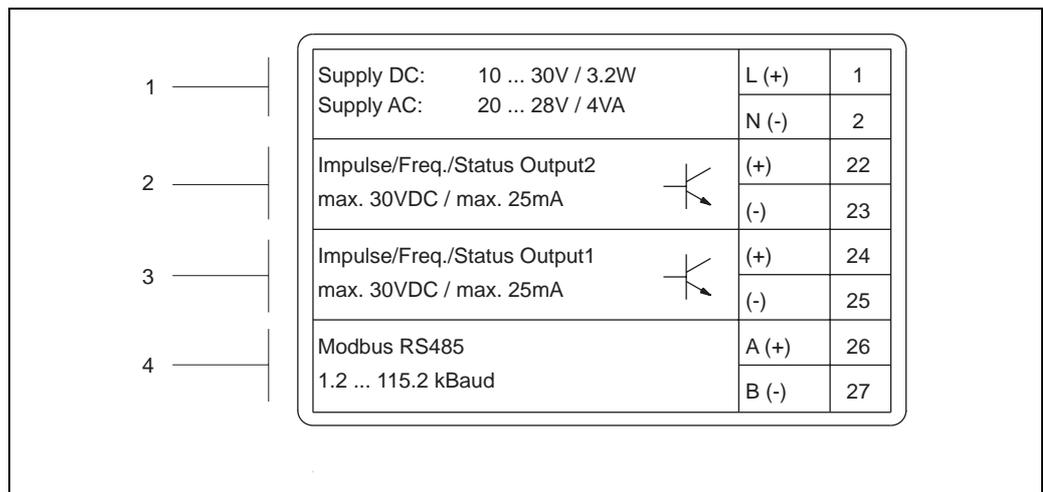
Fig. 3: Nameplate specifications for transmitter connections (example)

1   Terminal assignment for power supply
2   Terminal assignment pulse/frequency/status output
3   Terminal assignment pulse/frequency/status output
4   Terminal assignment MODBUS RS485

2.1.4   Additional sign – position of the rupture disk

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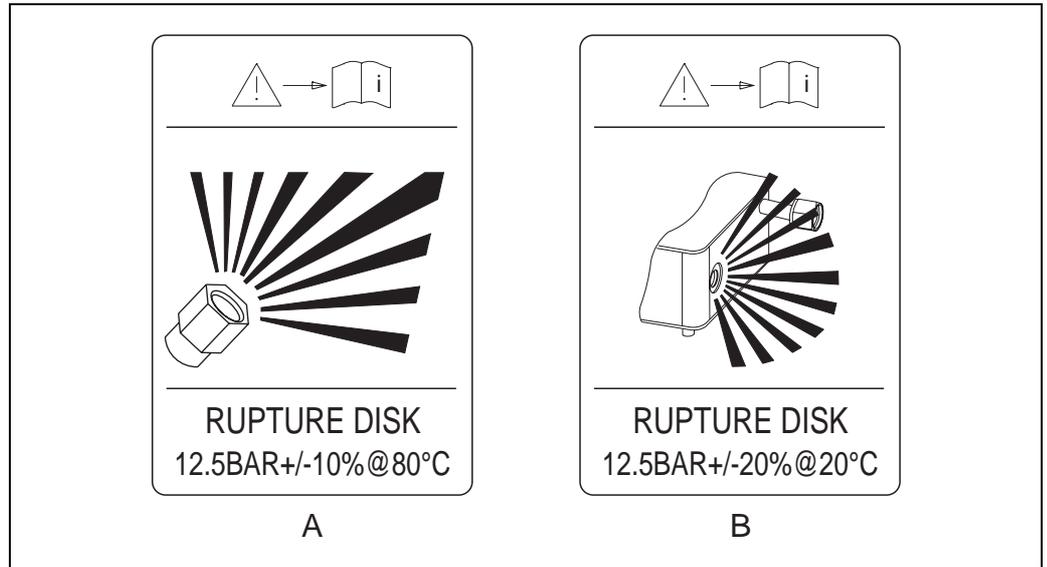
Fig. 4:   Additional sign regarding the position of the rupture disk (RUPTURE DISK)

A   Sensor housing with rupture element (incl. rupture disk) ➔ defined fluid exit
A   Sensor housing with rupture disk ➔ undefined fluid exit

✎ Note!
Additional information on the burst pressure of the secondary containment → 📄 53.

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).

The measuring device meets all the requirements of the MODBUS/TCP conformity and integration test and holds the "MODBUS/TCP Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out and is certified by the "MODBUS/TCP Conformance Test Laboratory" of the University of Michigan.

2.3   Registered trademarks

MODBUS®
Registered trademark of the MODBUS Organization

HistoROM™, S–DAT®, FieldCare®, Fieldcheck®, Applicator®
Registered or registration–pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 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?

3.1.2 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.

3.1.3 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.

3.2 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.

3.2.1 Dimensions

All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation entitled "Technical Information" → 🖹 56.

3.2.2   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.
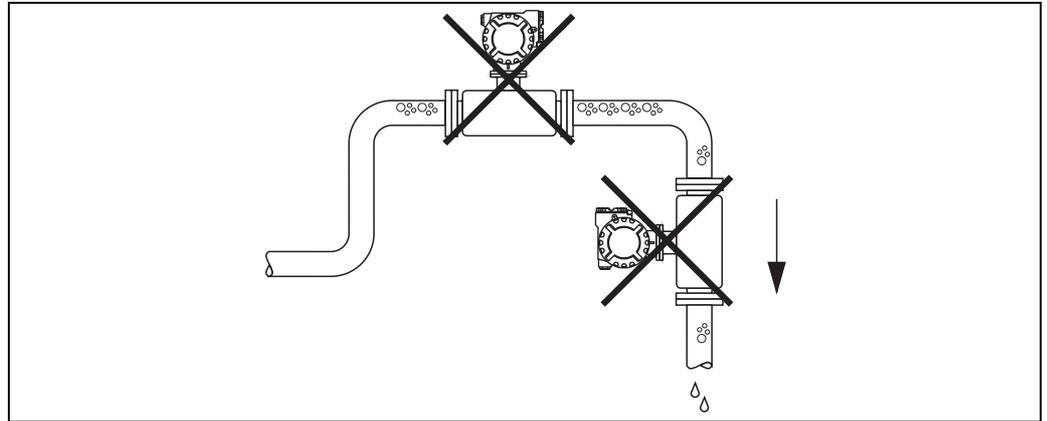
Fig. 5:   Mounting location

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.
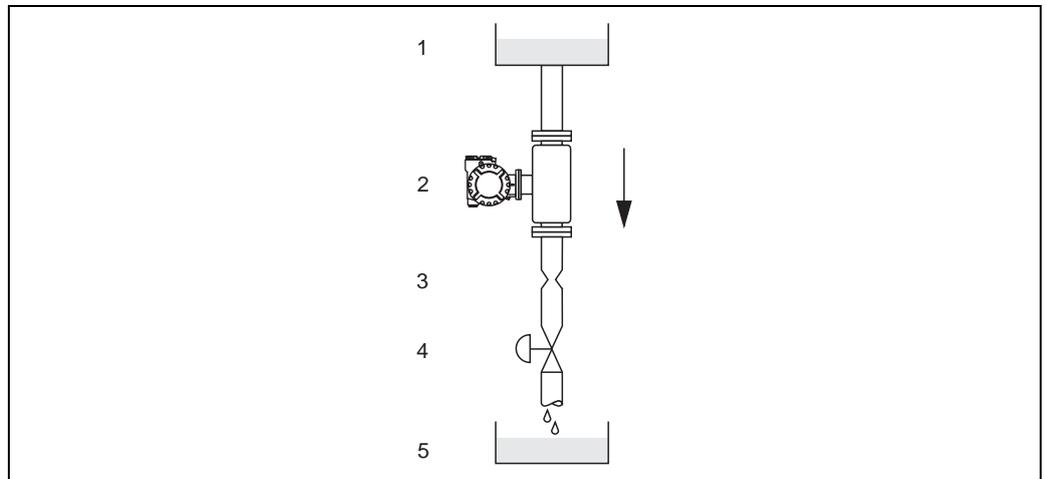
Fig. 6:   Installation in a down pipe (e.g. for batching applications)

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

DN		∅ Orifice plate, pipe restriction	
mm	inch	mm	inch
1	1/24"	0.8	0.03
2	1/12"	1.5	0.06
4	1/8"	3.0	0.12
6	¼"	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

3.2.3   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.
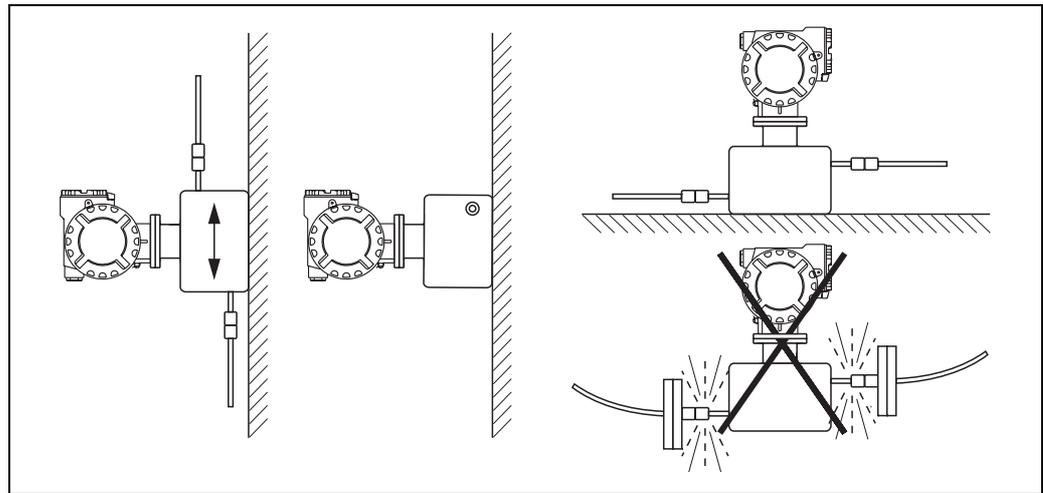
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Fig. 7:   Vertical and horizontal orientation

3.2.4   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 (≥ 0.0011")
- For information on the permitted temperature ranges → 🖹 52
  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.

3.2.5   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.

3.2.6   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.

3.2.7   Limiting flow

Limiting flow information can be found in the separate "Technical Information" document, → 🖹 56.

3.3   Installation instructions

3.3.1   Turning the transmitter housing

The transmitter housing can be rotated counterclockwise continuously up to 360°.

1.   Loosen the Allen setscrew (1) partially, but do not unscrew it all the way.

2.   Rotate the transmitter housing into the desired position.

3.   Tighten the Allen setscrew (1).

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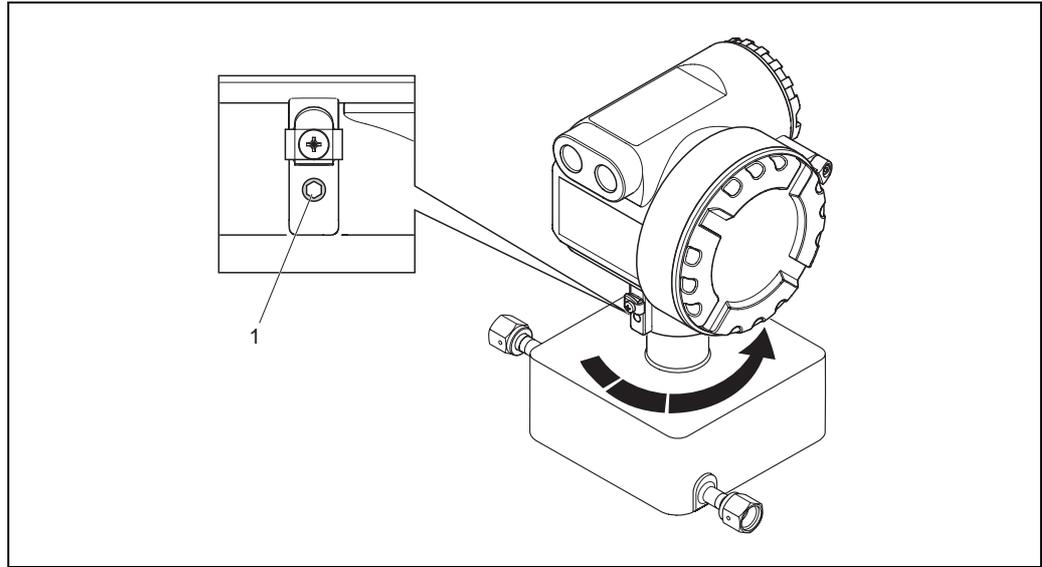
Fig. 8:   Rotating the transmitter housing

3.4   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.?	→ 🖹 8
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?	→ 🖹 10
Process environment / process conditions	Notes
Is the measuring device protected against moisture and direct sunlight?	–

4 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.

4.1 MODBUS RS485 cable specifications

In the EIA/TIA–485 standard, two versions (cable type A and B) are specified for the bus line and can be used for all transmission rates. However, we recommend you use cable type A. The cable specification for cable type A is provided in the following table:

Cable type A	
Characteristic impedance	135 to 165 Ω at a measuring frequency of 3 to 20 MHz
Cable capacitance	< 30 pF/m (< 9.2 pF/ft)
Core cross-section	> 0.34 mm² (AWG 22)
Cable type	Twisted pairs
Loop-resistance	≤ 110 Ω/km (≤ 0.034 Ω/ft)
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shielding	Copper braided shielding or braided shielding and foil shielding

Note the following points for the bus structure:
- All the measuring devices are connected in a bus structure (line).
- Using cable type A and with a transmission rate of 115200 Baud, the maximum line length (segment length) of the MODBUS RS485 system is 1200 m (3936 ft).
  The total length of the spurs may not exceed a maximum of 6.6 m (21.7 ft) here.
- A maximum of 32 users are permitted per segment.
- Each segment is terminated at either end with a terminating resistor.
- The bus length or the number of users can be increased by introducing a repeater.

4.1.1 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!

4.2 Connecting the measuring unit

4.2.1 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. Detach the safety claw (a) and remove the cover of the connection compartment (b) from the transmitter housing.

2. Feed the signal cable (c) and power supply cable (d) through the appropriate cable entries.

3. Perform wiring in accordance with the terminal assignment (→ 🗎 17).

4. Screw the cover of the connection compartment (b) firmly onto the transmitter housing and retighten the safety claw (a).
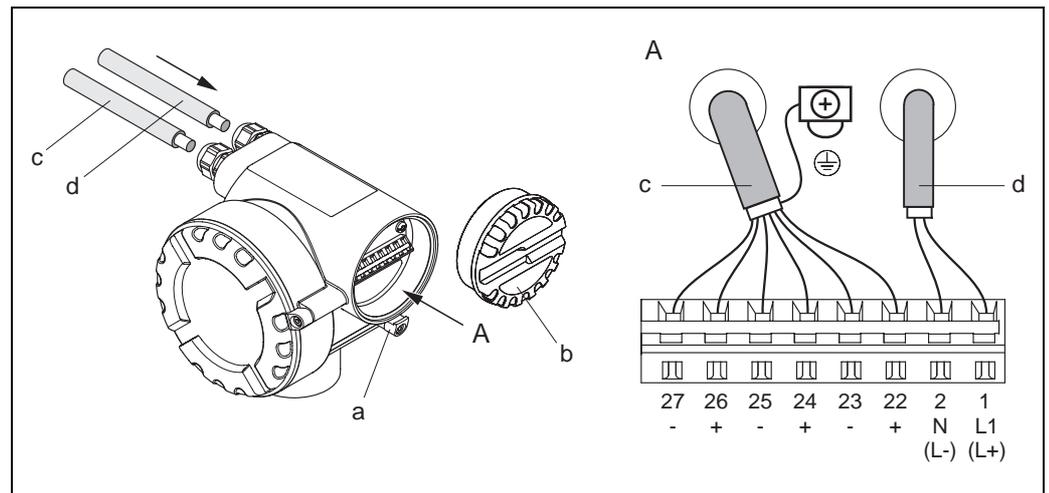
Fig. 9:   *Connecting the transmitter, cable cross-section: max. 2.5 mm² (14 AWG)*

A   *View A*

a   *Safety claw*
b   *Connection compartment cover*
c   *Signal cable: terminal Nos. 22 to 27*
    (shield for MODBUS RS485 is mandatory; shield for pulse, frequency and status outputs is not required, but recommended)
d   *Cable for power supply: 20 to 28 V AC, 10 to 30 V DC*
    – Terminal No. 1: L1 for AC, L+ for DC
    – Terminal No. 2: N for AC, L- for DC

4.2.2 Terminal assignment

Electrical values for outputs → 🗎 47.

Order version	Terminal No. (outputs)		
	22 (+) / 23 (-)	24 (+) / 25 (-)	26 (+) / 27 (–)
Fixed communication board (permanent assignment)			
8CM**-**B*********	Pulse / frequency /status output 2	Pulse / frequency /status output 1	MODBUS RS485

4.3   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 (8 to 12 mm / 0.32 to 0.47").
- The cable entries must be firmly tightened (point **a** → 🖼 10).
- The cable must loop down in front of the cable entry ("water trap") (point **b** → 🖼 10). This arrangement prevents moisture penetrating the entry.

✎   Note!
The cable entries may not point up.
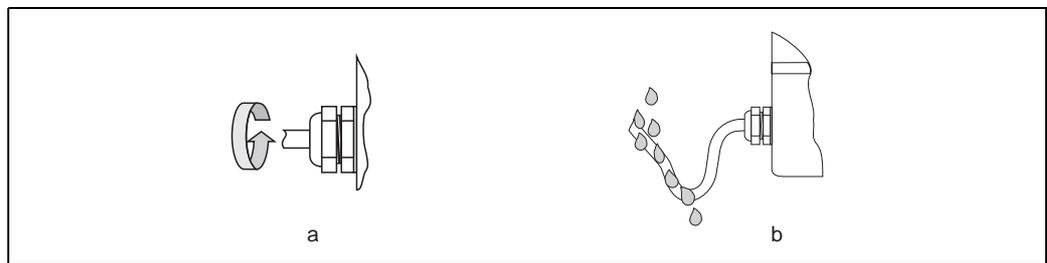
Fig. 10:   Installation instructions, cable entries

- 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.

4.4   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?	20 to 28 V AC (45 to 65 Hz) 10 to 30 V DC
Do the cables comply with the specifications?	→ 📄 15
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
Are all screw terminals firmly tightened?	–
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as "water traps"?	→ 📄 18, "Degree of protection" section
Are all housing covers installed and firmly tightened?	–
Fieldbus electrical connection	**Notes**
Has each fieldbus segment been terminated at both ends with a bus terminator?	→ 📄 15
Has the max. length of the fieldbus cable been observed in accordance with the specifications?	→ 📄 15
Has the max. length of the spurs been observed in accordance with the specifications?	→ 📄 15
Is the fieldbus cable fully shielded and correctly grounded?	→ 📄 16

5 Operation

5.1 Quick operation guide

You have the following option for configuring and commissioning the device:
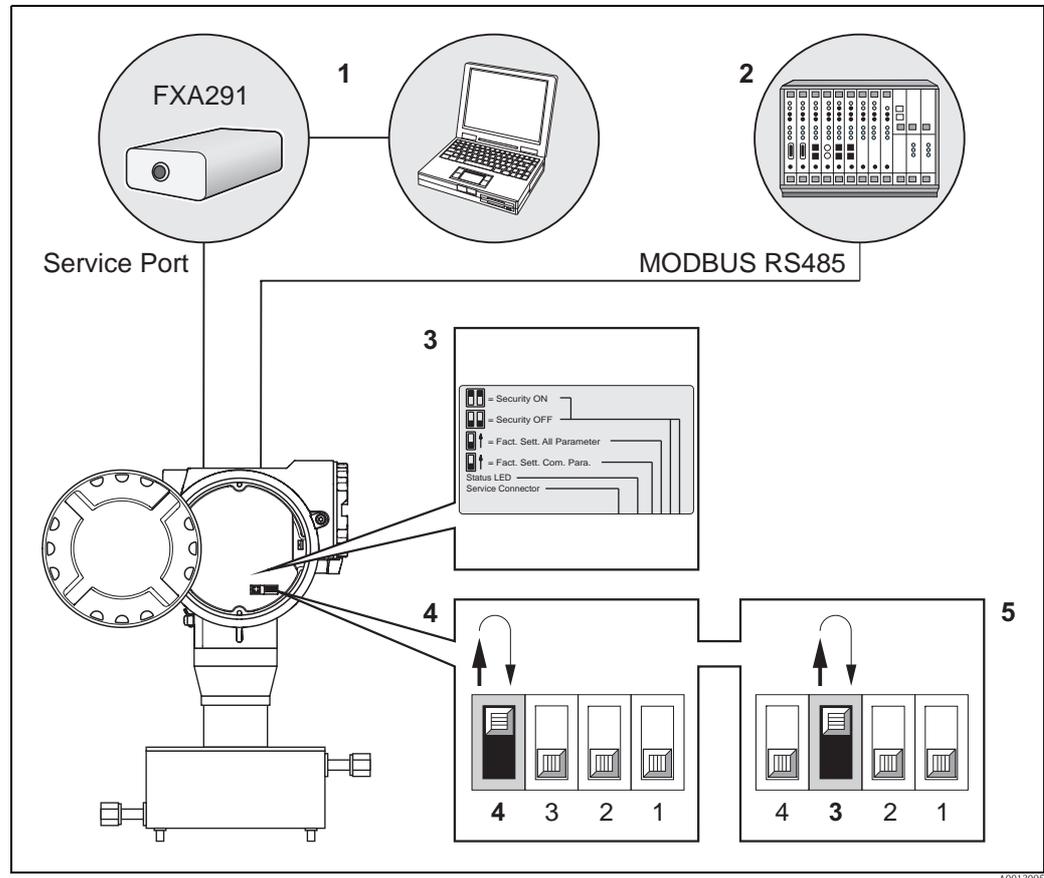
Fig. 11:   Method of operating MODBUS RS485 devices

1   Configuration/operating program for operating via the service interface FXA291 (e.g. FieldCare)
2   Operation via MODBUS RS485 process control system
3   Situation sticker of the various DIP switch positions and their function
4   Operation via device-internal DIP switch (4):
       If the DIP switch (4) is switched upwards, the device restores the factory settings of the communication parameters
       of the MODBUS RS485 (return it afterwards to its original lower position).
5   Operation via device-internal DIP switch (3):
       If the DIP switch (3) is switched upwards, the device restores the factory settings of all communication parameters
       of the MODBUS RS485 (return it afterwards to its original lower position).

✎ Note!
Setting back parameters can require several minutes, followed by a start-up of the device.
The power supply must not be switched off while the factory settings are being restored.

5.2 MODBUS RS485 communication

5.2.1 MODBUS RS485 technology

The MODBUS is an open, standardized fieldbus system which is deployed in the areas of manufacturing automation, process automation and building automation.

System architecture

The MODBUS RS485 is used to specify the functional characteristics of a serial fieldbus system with which distributed, digital automation systems are networked together.
The MODBUS RS485 distinguishes between master and slave devices.

- **Master devices**
  Master devices determine the data traffic on the fieldbus system. They can send data without an external request.

- **Slave devices**
  Slave devices, like this measuring device, are peripheral devices. They do not have their own access rights to the data traffic of the fieldbus system and only send their data due to an external request from a master.

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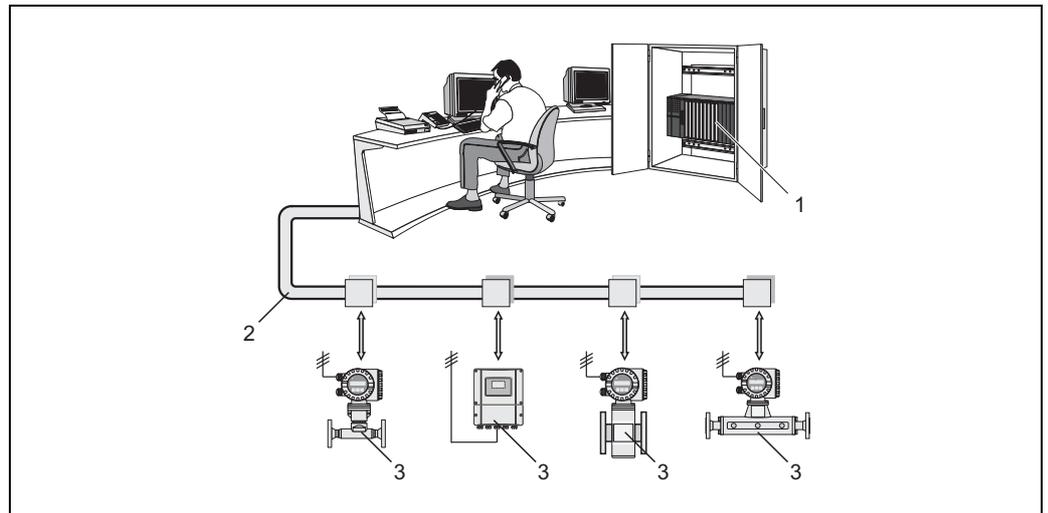
Fig. 12:   MODBUS RS485 system architecture

1   MODBUS master (PLC etc.)
2   MODBUS RS485
3   MODBUS slave (measuring devices etc.)

Master/slave communication

A distinction is made between two methods of communication with regard to master/slave communication via MODBUS RS485:

- **Polling (request–response–transaction)**
  The master sends a request telegram to **one** slave and waits for the slave's response telegram. Here, the slave is contacted directly due to its unique bus address (1 to 247).

Fig. 13:   MODBUS RS485 polling data traffic

1   MODBUS master (PLC etc.)
2   MODBUS RS485
3   MODBUS slave (measuring devices etc.)
a   Request telegram to this one specific MODBUS slave
b   Response telegram to the MODBUS master

- **Broadcast message**
  By means of the global address 0 (broadcast address), the master sends a command to all the slaves in the fieldbus system. The slaves execute the command without reporting back to the master. Broadcast messages are only permitted in conjunction with write function codes.

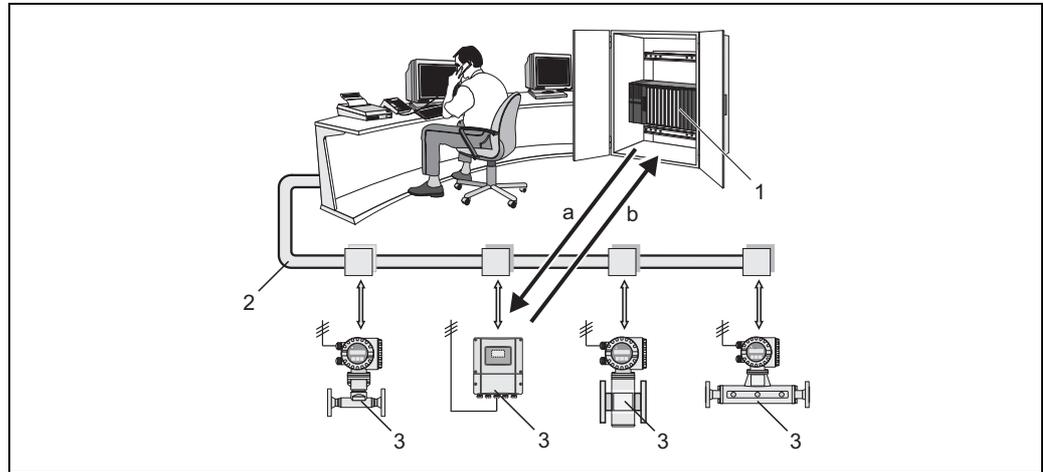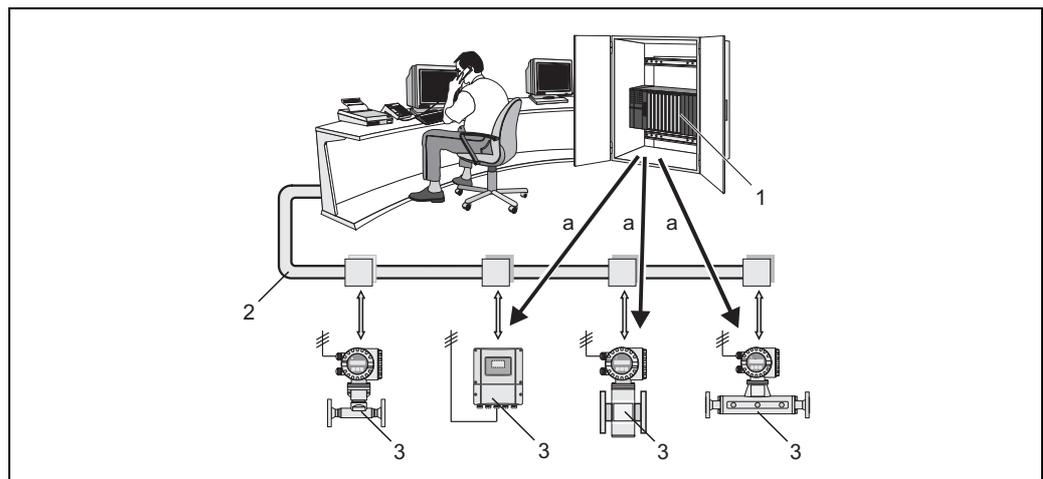*Fig. 14:   MODBUS RS485 polling data traffic*

1   MODBUS master (PLC etc.)
2   MODBUS RS485
3   MODBUS slave (measuring devices etc.)
a   Broadcast message – command to all MODBUS slaves (request is executed without a response telegram to the master)

5.2.2 MODBUS telegram

General

The master-slave process is used for data exchange. Only the master can initiate data transmission. Following the prompt, the slave sends the master the necessary data as a response telegram or executes the command requested by the master.

Telegram structure

The data is transferred between the master and slave by means of a telegram.
A request telegram from the master contains the following telegram fields:

Telegram structure:

Slave address	Function code	Data	Check sum

- Slave address
  The slave address can be in an address range from 1 to 247.
  The master talks to all the slaves simultaneously by means of the slave address 0 (broadcast message).
- Function code
  The function code determines which read, write and test operations should be executed by means of the MODBUS protocol.
  Function codes supported by the measuring device → 📄 24
- Data
  Depending on the function code, the following values are transmitted in this data field:
  – Register start address (from which the data are transmitted)
  – Number of registers
  – Write/read data
  – Data length
  – etc.
- Check sum (CRC or LRC check)
  The telegram check sum forms the end of the telegram.

The master can send another telegram to the slave as soon as it has received an answer to the previous telegram or once the time-out period set at the master has expired. This time-out period can be specified or modified by the user and depends on the slave response time.

If an error occurs during data transfer or if the slave cannot execute the command from the master, the slave returns an error telegram (exception response) to the master.

The slave response telegram consists of telegram fields which contain the requested data or which confirm that the action requested by the master has been executed. It also contains a check sum.

5.2.3   MODBUS function codes

The function code determines which read, write and test operations should be executed by means of the MODBUS protocol. The measuring device supports the following function codes:

Function code	Name in accordance with MODBUS specification	Description
03	READ HOLDING REGISTER	Reads one or more registers of the MODBUS slave. 1 to a maximum of 125 consecutive registers (1 register = 2 byte) can be read with a telegram. **Application:** For reading measuring device parameters with read and write access, such as reading the batch quantity.
04	READ INPUT REGISTER	Reads one or more registers of the MODBUS slave. 1 to a maximum of 125 consecutive registers (1 register = 2 byte) can be read with a telegram. **Application:** For reading measuring device parameters with read access, such as reading the measured values (mass flow, temperature etc.).
06	WRITE SINGLE REGISTERS	Writes **a single** slave register with a new value. **Application:** For writing just one measuring device parameter, such as writing the batch quantity or resetting the totalizer. ✎ Note! Function code 16 is used for writing several registers by means of just one telegram.
08	DIAGNOSTICS	Checks the communication connection between the master and slave. The following diagnostics codes are supported: ■ Sub-function 00 = Return query data (loopback test) ■ Sub-function 02 = Return diagnostics register
16	WRITE MULTIPLE REGISTERS	Writes several slave registers with a new value. A maximum of 120 consecutive registers can be written with a telegram. **Application:** For writing several measuring device parameters, such as writing the batch quantity and resetting the totalizer.
23	READ/WRITE MULTIPLE REGISTERS	Simultaneous reading and writing of 1 to max. 118 registers in a telegram. Write access is executed before read access. **Application:** For writing and reading several measuring device parameters, such as writing the batch quantity and the correction quantity and reading the totalizer value.

✎ Note!
- Broadcast messages are only permitted with function codes 06, 16 and 23.
- The measuring device does not differentiate between function codes 03 and 04. These codes have the same result.

5.2.4   Maximum number of writes

If a nonvolatile device parameter is modified via the MODBUS function codes 06, 16 or 23, this change is saved in the EEPROM of the measuring device.
The number of writes to the EEPROM is technically restricted to a maximum of 1 million. Attention must be paid to this limit since, if exceeded, it results in data loss and measuring device failure. For this reason, avoid constantly writing nonvolatile device parameters via the MODBUS!

5.2.5   MODBUS register addresses

Each device parameter has its own register address. The MODBUS master uses this register address to talk to the individual device parameters and access the device data.

The register addresses of the individual device parameters can be found in the "Description of Device Parameters" manual under the parameter description in question.
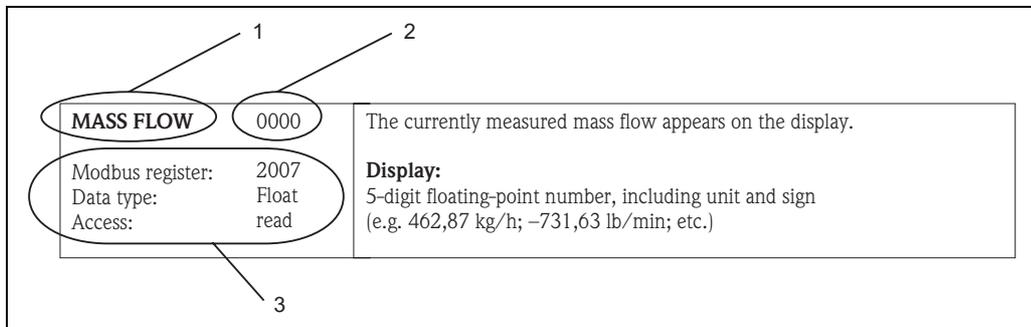

Fig. 15:   Example of how a function description is illustrated in the "Description of Device Parameters" manual

1   *Name of the function*
2   *Number of the function (appears on the local display; is **not** identical to the MODBUS register address)*
3   *Information on communication via MODBUS RS485*
       – MODBUS register (information in decimal numerical format)
       – Data type: Float, Integer or String
       – Possible ways of accessing the function:
         read = read access via function codes 03, 04 or 23
         write = write access via function codes 06, 16 or 23

MODBUS register address model

The MODBUS RS485 register addresses of the measuring device are implemented in accordance with "MODBUS Applications Protocol Specification V1.1".

✎ Note!
In addition to the specification mentioned above, systems are also deployed which work with a register address model in accordance with the "Modicon MODBUS Protocol Reference Guide (PI-MBUS-300 Rev. J)" specification. With this specification, the register address is extended, depending on the function code used. A "3" is put in front of the register address in the "read" access mode and a "4" in the "write" access mode.

Function code	Access type	Register in accordance with: "MODBUS Applications Protocol Specification"		Register in accordance with: "Modicon MODBUS Protocol Reference Guide"
03 04 23	Read	XXXX Example: mass flow = 2007	→	3XXXX Example: mass flow = 32007
06 16 23	Write	XXXX Example: reset totalizer = 6401	→	4XXXX Example: reset totalizer = 46401

Response times

The time it takes a measuring device to respond to a request telegram from the MODBUS master is typically 25 to 50 ms. If faster response times are needed for time-critical applications (e.g. batching applications), the "auto-scan buffer" is to be used.

✎ Note!
It may take longer for a command to be executed in the device. The data is not updated until the command has been executed. Especially write commands are affected by this!

Data types

The following data types are supported by the measuring device:

- **FLOAT** (floating-point numbers IEEE 754)
  Data length = 4 bytes (2 registers)

Byte 3	Byte 2	Byte 1	Byte 0
SEEEEEEE	EMMMMMMM	MMMMMMMM	MMMMMMMM

S = sign
E = exponent
M = mantissa

- **INTEGER**
  Data length = 2 bytes (1 register)

Byte 1	Byte 0
Most significant byte (MSB)	Least significant byte (LSB)

- **STRING**
  Data length = depends on device parameter,
  e.g. illustration of a device parameter with a data length = 18 bytes (9 registers):

Byte 17	Byte 16	to	Byte 1	Byte 0
Most significant byte (MSB)		to		Least significant byte (LSB)

Byte transmission sequence

Byte addressing, i.e. the transmission sequence of the bytes, is not specified in the MODBUS specification. For this reason, it is important to coordinate the addressing method between the master and slave during commissioning. This can be configured in the measuring device by means of the "BYTE ORDER" parameter (→ "Description of Device Parameters" manual).

The bytes are transmitted depending on the option selected in the "BYTE ORDER" parameter:

FLOAT:

	Sequence			
Selection	1st	2nd	3rd	4th
1 – 0 – 3 – 2 *	Byte 1 (MMMMMMMM)	Byte 0 (MMMMMMMM)	Byte 3 (SEEEEEEE)	Byte 2 (EMMMMMMM)
0 – 1 – 2 – 3	Byte 0 (MMMMMMMM)	Byte 1 (MMMMMMMM)	Byte 2 (EMMMMMMM)	Byte 3 (SEEEEEEE)
2 – 3 – 0 – 1	Byte 2 (EMMMMMMM)	Byte 3 (SEEEEEEE)	Byte 0 (MMMMMMMM)	Byte 1 (MMMMMMMM)
3 – 2 – 1 – 0	Byte 3 (SEEEEEEE)	Byte 2 (EMMMMMMM)	Byte 1 (MMMMMMMM)	Byte 0 (MMMMMMMM)

* = Factory setting
S = sign
E = exponent
M = mantissa

INTEGER:

Selection	Sequence	
	1st	2nd
1 – 0 – 3 – 2 * 3 – 2 – **1 – 0**	Byte 1 (MSB)	Byte 0 (LSB)
0 – 1 – 2 – 3 2 – 3 – **0 – 1**	Byte 0 (LSB)	Byte 1 (MSB)

* = Factory setting
MSB = most significant byte
LSB = least significant byte

STRING:
Illustration using the example of a device parameter with a data length of 18 bytes.

Selection	Sequence				
	1st	2nd	to	17th	18th
1 – 0 – 3 – 2 * 3 – 2 – **1 – 0**	Byte 1	Byte 0 (LSB)	to	Byte 17 (MSB)	Byte 16
0 – 1 – 2 – 3 2 – 3 – **0 – 1**	Byte 0 (LSB)	Byte 1	to	Byte 16	Byte 17 (MSB)

* = Factory setting
MSB = most significant byte
LSB = least significant byte

5.2.6 MODBUS error messages

If the MODBUS slave detects an error in the request telegram from the master, it sends a reply to the master in the form of an error message consisting of the slave address, function code, exception code and check sum. To indicate that this is an error message, the lead bit of the returned function code is used. The reason for the error is transmitted to the master by means of the exception code.

The following exception codes are supported by the measuring device:

Exception codes	Description
01	ILLEGAL_FUNCTION The function code sent by the master is not supported by the measuring device (slave). ✎ Note! Description of the function codes supported by the measuring device → 🖹 24.
02	ILLEGAL_DATA_ADDRESS The register addressed by the master is not assigned (i.e. it does not exist) or the length of the requested data is too big.
03	ILLEGAL_DATA_VALUE ■ The master is attempting to write to a register which only allows read access. ■ The value that appears in the data field is not permitted: e.g. range limits overshot or incorrect data format.
04	SLAVE DEVICE FAILURE The slave did not respond to the request telegram from the master or an error occurred when processing the request telegram.

5.2.7   MODBUS auto-scan buffer

Function description

The MODBUS master uses the request telegram to access the device parameters (data) of the measuring device. Depending on the function code, the master gains read or write access to a single device parameter or a group of consecutive device parameters. If the desired device parameters (registers) are not available as a group, the master has to send a request telegram to the slave for each parameter.
The measuring device has a special storage area, known as the auto-scan buffer, for grouping nonconsecutive device parameters. This can be used to flexibly group up to 16 device parameters (registers). The master can talk to this complete data block by means of just one request telegram.

Structure of the auto-scan buffer

The auto-scan buffer consists of two data records, the configuration area and the data area. In the configuration area, a list known as the scan list specifies which device parameters should be grouped. For this purpose, the corresponding register address, e.g. the register address 2007 for mass flow, is entered in the scan list. Up to 16 device parameters can be grouped.

The measuring device cyclically reads out the register addresses entered in the scan list and writes the associated device data to the data area (buffer). The request cycle runs automatically. The cycle starts again when the last entry in the scan list has been queried.
By means of MODBUS, the grouped device parameters in the data area can be read or written by the master with just one request telegram (register address 5051 to 5081).

Configuration of the scan list

During configuration, the MODBUS register addresses of the device parameters to be grouped must be entered in the scan list. The scan list can contain up to 16 entries. Float and Integer-type device parameters with read and write access are supported.

The scan list can be configured by means of:

1. The local display or a configuration program (FieldCare).
    The scan list is configured here by means of the function matrix:
    BASIC FUNCTION → MODBUS RS485 → SCAN LIST REG. 1 to SCAN LIST REG. 16

2. The MODBUS master.
    Here, the scan list is configured via
    the register addresses 5001 to 5016.

Scan list		
No.	MODBUS configuration Register address (data type = Integer)	Configuration via local operation / configuration program (BASIC FUNCTION → MODBUS RS485 →)
1	5001	SCAN LIST REG. 1
2	5002	SCAN LIST REG. 2
3	5003	SCAN LIST REG. 3
4	5004	SCAN LIST REG. 4
5	5005	SCAN LIST REG. 5
6	5006	SCAN LIST REG. 6
7	5007	SCAN LIST REG. 7
8	5008	SCAN LIST REG. 8
9	5009	SCAN LIST REG. 9
10	5010	SCAN LIST REG. 10
11	5011	SCAN LIST REG. 11

Scan list		
No.	MODBUS configuration Register address (data type = Integer)	Configuration via local operation / configuration program (BASIC FUNCTION → MODBUS RS485 →)
12	5012	SCAN LIST REG. 12
13	5013	SCAN LIST REG. 13
14	5014	SCAN LIST REG. 14
15	5015	SCAN LIST REG. 15
16	5016	SCAN LIST REG. 16

Access to data via MODBUS

The MODBUS master uses the register addresses 5051 to 5081 to access the data area of the auto–scan buffer. This data area contains the values of the device parameters defined in the scan list. For example, if the register 2007 was entered for mass flow in the scan list by means of the SCAN LIST REG. 1 function, the master can read out the current measured value of the mass flow in register 5051.

Data area				
Parameter value/Measured values		Access via MODBUS register address	Data type *	Access**
Value of scan list entry No. 1	→	5051	Integer / Float	Read/Write
Value of scan list entry No. 2	→	5053	Integer / Float	Read/Write
Value of scan list entry No. 3	→	5055	Integer / Float	Read/Write
Value of scan list entry No. 4	→	5057	Integer / Float	Read/Write
Value of scan list entry No. 5	→	5059	Integer / Float	Read/Write
Value of scan list entry No. 6	→	5061	Integer / Float	Read/Write
Value of scan list entry No. 7	→	5063	Integer / Float	Read/Write
Value of scan list entry No. 8	→	5065	Integer / Float	Read/Write
Value of scan list entry No. 9	→	5067	Integer / Float	Read/Write
Value of scan list entry No. 10	→	5069	Integer / Float	Read/Write
Value of scan list entry No. 11	→	5071	Integer / Float	Read/Write
Value of scan list entry No. 12	→	5073	Integer / Float	Read/Write
Value of scan list entry No. 13	→	5075	Integer / Float	Read/Write
Value of scan list entry No. 14	→	5077	Integer / Float	Read/Write
Value of scan list entry No. 15	→	5079	Integer / Float	Read/Write
Value of scan list entry No. 16	→	5081	Integer / Float	Read/Write
* The data type depends on the device parameter entered in the scan list				
** The data access depends on the device parameter entered in the scan list. If the device parameter entered supports read and write access, the parameter can also be accessed by means of the data area.				

Response time

The response time when accessing the data area (register addresses 5051 to 5081) is typically between 3 and 5 ms.

Note!
It may take longer for a command to be executed in the device. The data is not updated until the command has been executed. Especially write commands are affected by this!

Example

The following device parameters should be grouped via the auto-scan buffer and read out by the master with just one request telegram:
- Mass flow → Register address 2007
- Temperature → Register address 2017
- Totalizer 1 → Register address 2610
- Actual system condition → Register address 6859

1. Configuration of the scan list

- With the local operation
  or a configuration program (via the function matrix):
  BASIC FUNCTION block → MODBUS RS485 function group → SCAN LIST REG. function
  → Entry of the address 2007 under SCAN LIST REG. 1
  → Entry of the address 2017 under SCAN LIST REG. 2
  → Entry of the address 2610 under SCAN LIST REG. 3
  → Entry of the address 6859 under SCAN LIST REG. 4

- Via the MODBUS master (the register addresses of the device parameters are written to the registers 5001 to 5004 via MODBUS):
  1. Write address 2007 (mass flow) to register 5001
  2. Write address 2017 (temperature) to register 5002
  3. Write address 2610 (totalizer 1) to register 5003
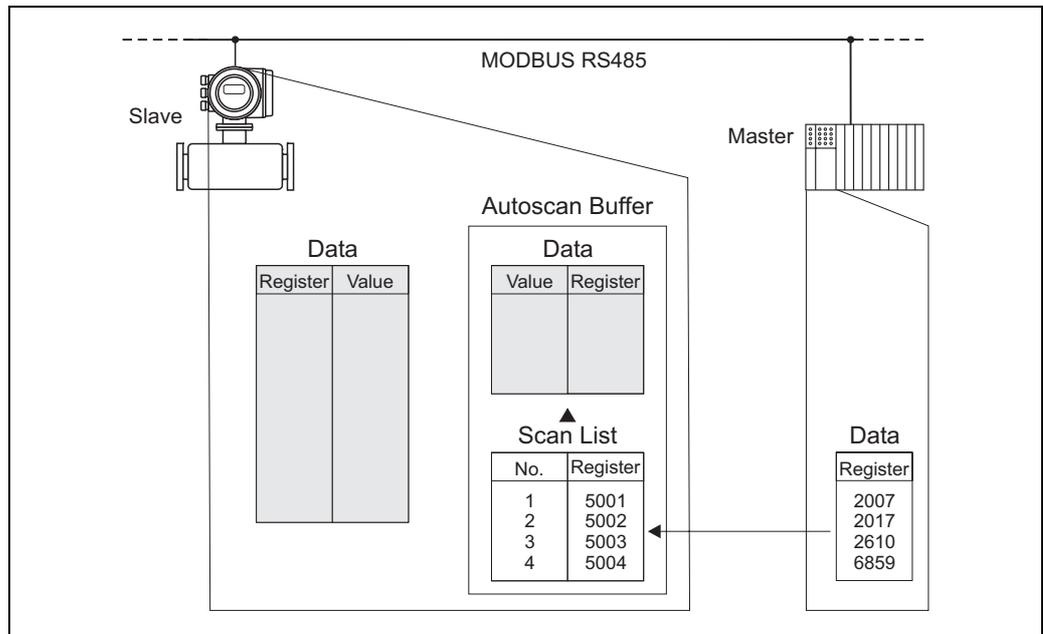 4. Write address 6859 (actual system condition) to register 5004

Fig. 16:   Configuration of the scan list via the MODBUS master

2. Access to data via MODBUS

By specifying the register start address 5051 and the number of registers, the MODBUS master can read out the measured values with just one request telegram.

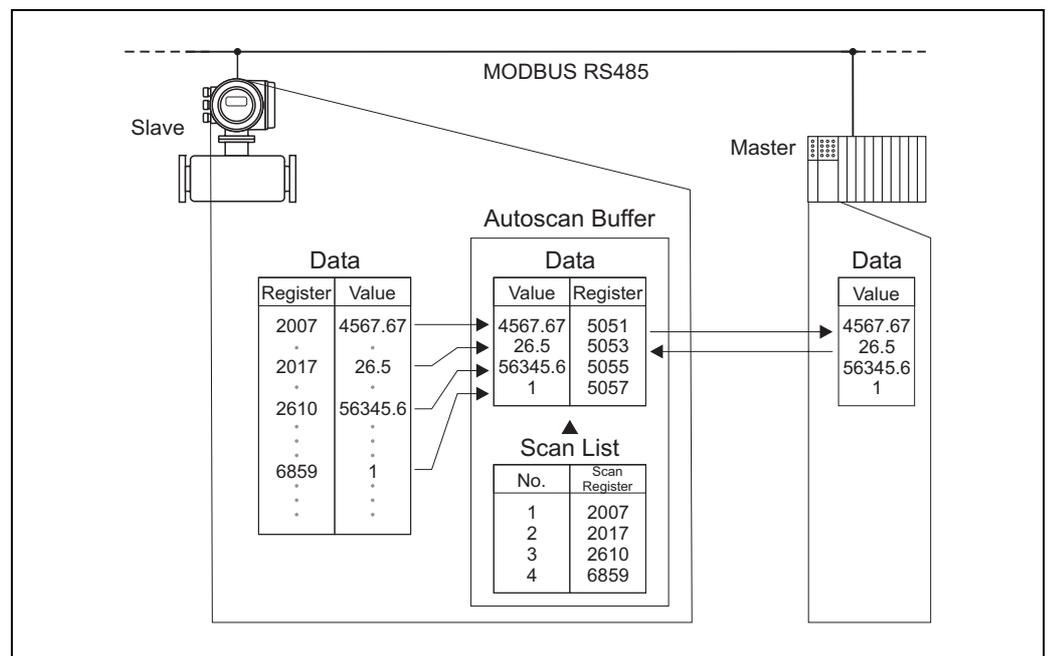| Data area			
Access via MODBUS register address	Measuring values	Data type	Access
5051	Mass flow = 4567.67	Float	Read
5053	Temperature = 26.5	Float	Read
5055	Totalizer 1 = 56345.6	Float	Read
5057	Actual system condition = 1 (system ok)	Integer	Read

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Fig. 17:   With just one request telegram, the MODBUS master reads out the measured values via the auto-scan buffer of the measuring device.

5.3   Operating options

5.3.1   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 service interface or via the service interface FXA291.

5.3.2   Device description files for operating programs

Operation:

Operating program/Device driver:	How to acquire:
FieldCare/ DTM	■ www.endress.com (→ Download → Software → Driver) ■ CD-ROM (Endress+Hauser order number: 56004088)

Tester and simulator:	How to acquire:
Fieldcheck	■ Update by means of FieldCare via flow device FXA193/291 DTM in Fieldflash module

✎ Note!
The Fieldcheck tester/simulator is used for testing flowmeters in the field. When used in conjunction with the FieldCare software package, test results can be imported into a database, printed out and used for official certification. Contact your Endress+Hauser representative for more information.

6   Commissioning

6.1   Function check

Make sure that all the final checks have been completed before commissioning the measuring point:
- Checklist for "Post–installation check" → 📄 14.
- Checklist for "Post–connection check" → 📄 19.

6.2   Switching on the measuring device

Once the installation checks have been successfully completed, it is time to switch on the supply voltage. The device is now operational.
The measuring device performs a number of power on self–tests. Normal measuring mode commences as soon as startup completes.

✎ Note!
If the startup is not successful, depending on the cause, a corresponding message is displayed in the Fieldtool operating program, or the status LED flashes correspondingly (→ 📄 39).

6.3   Zero point adjustment

All measuring devices are calibrated with state–of–the–art technology.
The zero point obtained in this way is printed on the nameplate.
Calibration takes place under reference operating conditions → 📄 49.
Consequently zero point adjustment is generally **not** necessary for Cubemass!

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).

6.3.1   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
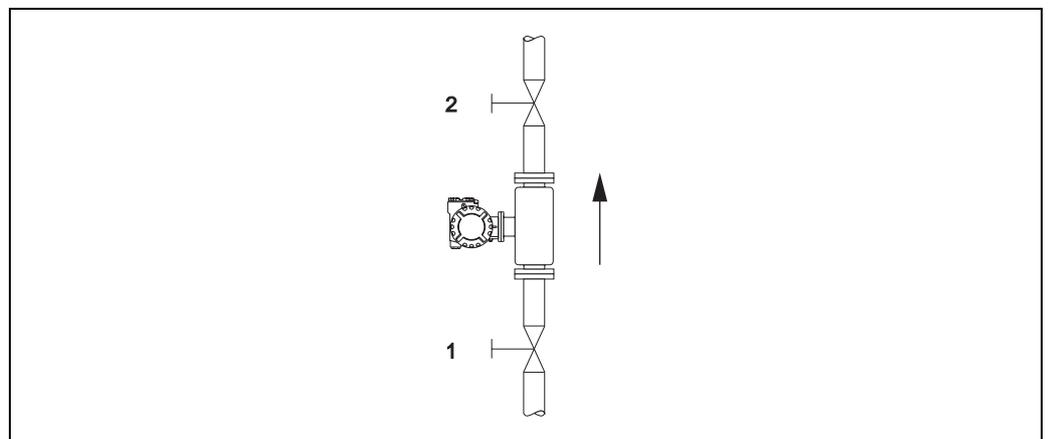 - Zero point adjustment **without** pump pressure → Valve 1 closed / valve 2 open

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Fig. 18:   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).

6.3.2 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. Carry out the alignment using the "ZEROPOINT ADJUST"
   (→ "Description of Device Parameters" manual).

6.4 Rupture element

Sensor housings with an integrated rupture element are optionally available.

Warning!
- Make sure that the function of the rupture element is not impeded by the installation.
  The triggering pressure in the housing is indicated on the information notice.
  Take suitable measures to ensure that no damage can occur if the rupture disk is tripped and
  personal injury is ruled out.
  Triggering pressure in the housing 10 to 15 bar (145 to 217.5 psi)
- Please note that if a rupture disk is used, the housing can no longer assume a secondary
  containment function.
- It is not permitted to open the connections or remove the rupture disk.

Caution!
- The use of rupture elements cannot be combined with the heating jacket which is available as a
  separate element.
- The existing connection nozzles are not designed for a purge or pressure monitoring function.

Note!
- The transportation guard on the rupture disk must be removed prior to commissioning.
- Comply with the information on information notices.

6.5 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 218 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).

6.6 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.

6.6.1 HistoROM/S-DAT (sensor-DAT)

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

7 Maintenance

No special maintenance work is required.

7.1 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.

8 Accessories/Spare parts

Various accessories and spare parts, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Detailed information on the order code in question can be obtained from your Endress+Hauser representative.

8.1 Instrument-specific spare parts

Accessory	Description	Order code
Electronics module	Complete plug-in electronics module	71034464

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting set for the Cubemass sensor	Mounting set for Cubemass, comprising: – 2 process connections – Seals	DK8CS – ****
Mounting plate for the Cubemass sensor	Mounting plate for Cubemass, comprising: – mounting plate – 4 × M5	DK8CS – ****

8.3 Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress +Hauser representative for more information.	DXA80 – *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "FieldCare" software package, test results can be imported into a database, printed out and used for official certification. Contact your Endress +Hauser representative for more information.	50098801
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.	→ Product page on the Endress+Hauser website: www.endress.com
FXA291	Service interface from the measuring device to the PC for operation via FieldCare.	FXA291 – *

9   Troubleshooting

9.1   Self-monitoring

Exceptional states that arise during operation are detected by the flowmeter and corresponding messages are output:

- Via the outputs, depending on the setting ($\rightarrow$ "Description of Device Parameters" manual)
- Via the Modbus interface, depending on the setting ($\rightarrow$ 🖹 27)
- Via error messages in the "FieldCare" operating program ($\rightarrow$ 🖹 40)
- Via the status LED ($\rightarrow$ 🖹 39, visible only when the device is open)

If multiple messages are pending, the one with the highest priority is output.

The message about a status can be assigned to a category as follows:

OFF
- When the status occurs, no message is generated

Error
- The message belongs to the "Errors" category, meaning that the measuring system cannot continue measuring operation.

Note
- The message belongs to the "Notes" category, meaning that the measuring system may be able to continue measuring operation with restrictions.

9.2   Diagnosis using light emitting diode (LED)

There is a Light Emitting Diode (LED) on the meter electronics board that allows simple fault diagnostics at any time:

- If the status output was not configured to output errors or notes.
- If fault diagnostics are no longer possible via the Fieldtool operating program.

Warning!
Risk of explosion! The electronics compartment may not be opened while there is an explosive atmosphere. This type of fault diagnostics can no longer be carried out in Ex–protected areas.

A0013097
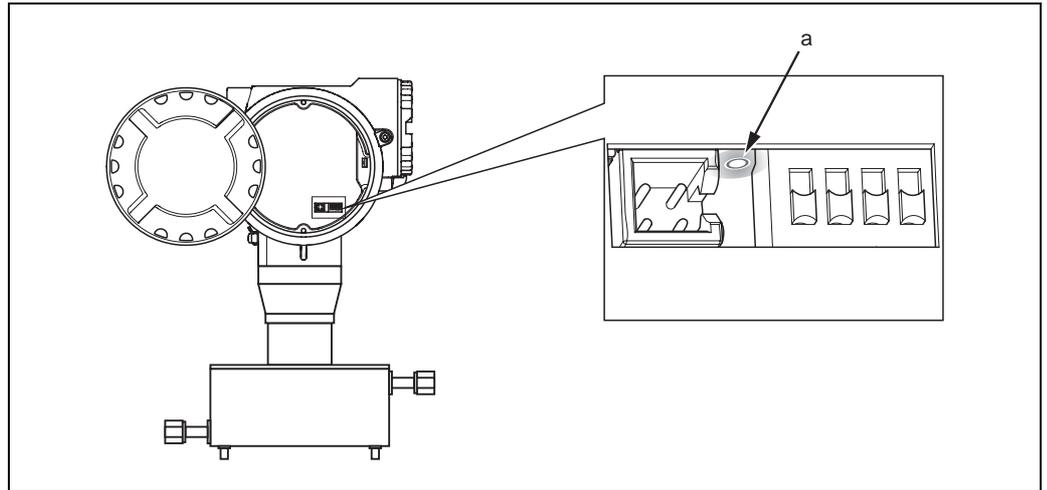
Fig. 19:   Fault diagnostics using light emitting diode (a)

Status of light emitting diode (LED)	Status of measuring system
LED illuminated in green	Measuring system OK, creepage is active
LED flashes green (once per second)	Measuring system OK, operation
LED not illuminated	Measuring system no longer working
LED flashes red (three times per second)	– Operation not possible – Error (fault message) pending
LED flashes red/green (once per second)	– Operation possible, but may be limited by application conditions. – Notice message pending
LED flashes red/green (three times per second)	Zero point adjustment running
LED flashes green/orange (approx. 3 seconds long)	Security switched on
LED flashes red/orange (approx. 3 seconds long)	Security switched off
LED flashes red/(pause)/green (approx. 3 seconds long)	SW update active

9.3 Messages (FieldCare)

No. / error message	Cause	Remedy / spare part
# 001 CRITICAL FAIL		Replace the electronics module (→ 🗐 44). Spare parts: → 🗐 37
# 002 CONFIGURATION FAILURE	Inconsistent parameter configuration	Restore the factory settings.
# 011 AMP HW-EEPROM	Electronics module: Defective EEPROM	Replace the electronics module (→ 🗐 44). Spare parts: → 🗐 37
# 012 AMP SW-EEPROM	Electronics module: Error when accessing the EEPROM	Restore the factory settings.
# 021 HW-FRAM	Electronics module: Faulty FRAM	Replace the electronics module (→ 🗐 44). Spare parts: → 🗐 37
# 022 SW-FRAM	Electronics module: Error when accessing the FRAM	Contact your E+H service organization.
# 031 HW-DAT	Sensor DAT: 1. DAT is defective. 2. DAT is not plugged in or is missing.	1. Replace DAT. Spare parts: → 🗐 37 Check the spare part set number to ensure that the new, replacement DAT is compatible with the meter electronics. 2. Insert the DAT: → 🗐 44
# 032 SW DAT	Sensor: Error when accessing the DAT.	Restore the factory settings.
# 101 STARTUP RUNNING	Measuring instrument is running though the startup procedure.	–
# 355/356 RANGE FRQ.OUT 1/2	Frequency output: The output frequency is out of range.	1. Increase the entered full scale value 2. Reduce flow rate
# 359/360 RANGE PULSE 1/2	Pulse output: Pulse output frequency is out of range.	1. Increase the setting for pulse weighting. 2. Reduce flow rate.
# 379 LOW FREQ.LIM.	The measuring tube oscillation frequency is below the permitted range. Causes: – Measuring tube damaged – Sensor defective or damaged	Contact your E+H service organization.
# 380 UPP.FREQ.LIM.	The measuring tube oscillation frequency is above the permitted range. Causes: – Measuring tube damaged – Sensor defective or damaged	Contact your E+H service organization.
# 381 MEAS. TEMP. CIRC. SHORT	The temperature sensor on the measuring tube is likely defective.	Check whether the connector of the sensor signal cable is correctly plugged into the electronics module before contacting your E+H service organization (→ 🗐 44).
# 382 MEAS. TEMP. CIRC. OPEN		
# 383 CARR. TEMP. CIRC. SHORT	The temperature sensor on the carrier tube is likely defective.	Check whether the connector of the sensor signal cable is correctly plugged into the electronics module before contacting your E+H service organization (→ 🗐 44).
# 384 CARR. TEMP. CIRC. OPEN		
# 387 SEN.ASY.EXCEED	One of the sensor coils (on the inlet or outlet side) is probably defective.	Check whether the connector of the sensor signal cable is correctly plugged into the electronics module before contacting your E+H service organization (→ 🗐 44).

No. / error message	Cause	Remedy / spare part
# 388 ZP-COMP. INSTABILE	External process conditions	Contact your E+H service organization.
# 389 ZP-COMP. LIMIT	–	Contact your E+H service organization.
# 390 COMMUNIC.DSP	–	Replace the electronics module.
# 586 OSC.AMP.LIM	The fluid properties do not allow a continuation of the measurement.	Change or improve process conditions.
# 587 TUBE NOT OSC.	Extreme process conditions exist. The measuring system can therefore not be started. The measuring cell or electronics are defective.	Change or improve process conditions. Replace the electronics module ($\rightarrow$ 📄 44). Spare parts: $\rightarrow$ 📄 37
# 692 SIM. MEASURAND	Simulation of measuring variables (e.g. mass flow)	Switch off simulation
# 700 EMPTY PIPE	The density is below the lower limit value defined for the function "EPD VALUE LOW"	Adapt the "EPD" to the prevailing process conditions.
# 701 EXC.CURR.LIM	The maximum current value for the measuring tube excitation coil has been reached. The instrument continues to work correctly.	This could be caused by liquids contained in the fluid. Change or improve process conditions.
# 702 FLUID INHOM.	The frequency control is not stable because the fluid properties are inhomogenous.	This could be caused by liquids contained in the fluid. Change or improve process conditions.
# 703 FLUID INHOM.	The amplitude control is not stable due to inhomogenous fluid properties.	This could be caused by liquids contained in the fluid. Change or improve process conditions.
# 704 NOISE LIMIT	The failsafe level of the sensor signal is too high.	This could be caused by liquids contained in the fluid. Change or improve process conditions.
# 731 ADJ.ZERO FAIL.	The zero point adjustment is not possible.	Make sure that zero point adjustment is carried out at "zero flow" only (v = 0 m/s) ($\rightarrow$ 📄 33).
# 740 ZEROPOINT ADJ. RUNNING	The zero point adjustment is running.	Wait until the zero point adjustment is finished.
# 801 LOW. PROC. LIMIT TEMP	The temperature has fallen below the lower process limit.	Change the process condition or setting ($\rightarrow$ "Description of Device Parameters" manual).
# 802 UPP. PROC. LIMIT TEMP	The temperature has exceeded the process limit.	Change the process condition or setting ($\rightarrow$ "Description of Device Parameters" manual).
# 803 LOW. PROC. LIMIT DENS.	The density has fallen below the lower process limit.	Change the process condition or setting ($\rightarrow$ "Description of Device Parameters" manual).
# 804 UPP. PROC. LIMIT DENS.	The density has exceeded the upper process limit.	Change the process condition or setting ($\rightarrow$ "Description of Device Parameters" manual).
# 805 LOW. PROC. LIMIT MASSFLOW	The mass flow has fallen below the lower process limit.	Change the process condition or setting ($\rightarrow$ "Description of Device Parameters" manual).
# 806 UPP. PROC. LIMIT MASSFLOW	The mass flow has exceeded the upper process limit.	Change the process condition or setting ($\rightarrow$ "Description of Device Parameters" manual).
# 807 LOW. PROC. LIMIT VOLFLOW	The volume flow has fallen below the lower process limit.	Change the process condition or setting ($\rightarrow$ "Description of Device Parameters" manual).
# 808 UPP. PROC. LIMIT VOLFLOW	The volume flow has exceeded the upper process limit.	Change the process condition or setting ($\rightarrow$ "Description of Device Parameters" manual).

9.4   Errors without messages

Symptoms	Rectification
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 data (→ 🖺 7): order code and serial number **Return the devices to Endress+Hauser** Procedures must be carried out before you return a flowmeter to Endress+Hauser for repair or calibration → 🖺 6. Always enclose a duly completed "Declaration of contamination" form with the flowmeter. You will find a preprinted form at the back of these Operating Instructions. **Replace the transmitter electronics** Electronics module defective → order spare parts → 🖺 37.

9.5   Spare parts

The previous sections contain detailed troubleshooting instructions → 🖺 38.
The measuring device, moreover, provides additional support in the form of continuous self–diagnosis and storage of error messages that arise.
Fault rectification can entail replacing defective components with tested spare parts. For an overview of the spare parts that can be delivered → 🖺 37.

✎ Note!
Spare parts can be ordered directly from your Endress+Hauser representative by providing the serial number printed on the transmitter's nameplate (→ 🖺 7).

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

9.6   Response of outputs to errors

Failsafe mode of the outputs	
Output	Failsafe mode
Frequency output	✎ Note! The failsafe mode of the frequency output can be configured in various ways (→ "Description of Device Parameters" manual): FALLBACK VALUE Signal output → 0 Hz HOLD VALUE Last valid value (preceding occurrence of the fault) is output. HIGH VALUE Signal output → maximum possible frequency
Pulse output	✎ Note! The failsafe mode of the pulse output can be configured in various ways (→ "Description of Device Parameters" manual): FALLBACK VALUE Signal output → no pulses HOLD VALUE Last valid value (preceding occurrence of the fault) is output. HIGH VALUE Signal output → maximum possible pulse rate
Status output	✎ Note! The assignment of the status of the output can be defined (→ "Description of Device Parameters" manual). In the event of fault, note or power supply failure → status output not conductive.
Totalizer	✎ Note! The failsafe mode of the totalizer can be configured in various ways (→ "Description of Device Parameters" manual): STOP The totalizers are paused until the error is rectified. HOLD VALUE The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).
MODBUS RS485	✎ Note! The failsafe mode of the MODBUS RS485 output can be configured in various ways (→ "Description of Device Parameters" manual): STOP In the event of a fault, the value "NaN" (not a number) is transmitted instead of the current measured value. HOLD VALUE Last valid value (preceding occurrence of the fault) is output.

9.7   Removing and installing the meter electronics

⚠ Warning!
- Risk of explosion! The electronics compartment may not be opened while there is an explosive atmosphere.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability.

1. Switch off power supply

2. Unscrew the hexagon socket head cap screw with the Allen screw (1) and dismount the electronics compartment cover (2).

3. Remove the securing screw (3) of the protective cover.

4. Push the side snap hooks (2× item 4) together and pull off the protective cover (5).

5. Unplug the cable connector from the electronics module:
   – Pull off the connector of the sensor signal cable (6) by pulling it forwards.
   – Pull off the connector for the power supply and signal outputs (7) by pulling them upwards.

6. Remove the HistROM/DAT connector (8).

7. Unscrew the Phillips screws (2× item 9) and pull out the electronics module (10).

8. Installation is the reverse of the removal procedure.

   ☝ Caution!
   Use only original Endress+Hauser parts.
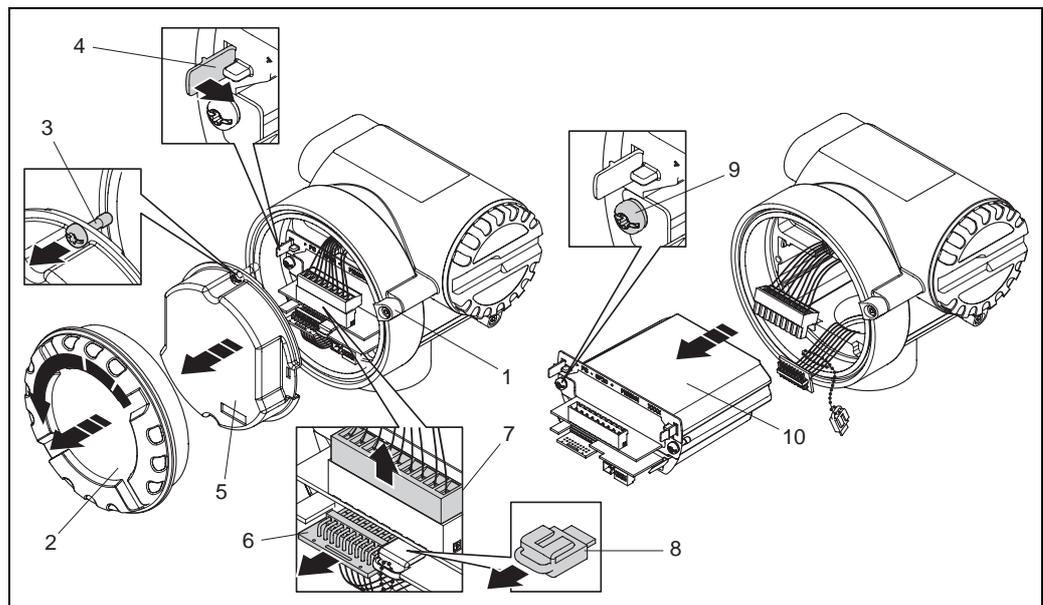
Fig. 20:   Removing and installing the meter electronics

1   Allen screw
2   Electronics compartment cover
3   Securing screw of the protective cover
4   Snap hooks, 2×
5   Protective cover
6   Connector of the sensor signal cable
7   Cable connector for power supply and signal outputs
8   HistoROM/DAT connector
9   Phillips screw, 2×
10   Electronics module

9.8 Return

→ 🗎 6

9.9 Disposal

Observe the regulations applicable in your country.

9.10 Software history

Date	Software version	Changes to software	Operating Instructions
11.2009	3.06.00	Original software	71109491/ 02.10

10 Technical data

10.1 Technical data at a glance

10.1.1 Applications

→ 🗎 5

10.1.2 Function and system design

Measuring principle	Mass flow measurement by the Coriolis principle

Measuring system	→ 🗎 7

10.1.3 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) • Fluid density (proportional to the resonance frequency of the measuring tube) • Fluid temperature (via temperature sensors)/ (not suitable for custody transfer measurement)

Measuring range

Measuring ranges for liquids

DN		Range for full scale values (liquids) $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[inch]	[kg/h]	[lb/min]
1	1/24"	0 to 20	0 to 0.75
2	1/12"	0 to 100	0 to 3.70
4	1/8"	0 to 450	0 to 16.50
6	¼"	0 to 1000	0 to 37.00

Operable flow range	Over 1000 : 1 Flow rates above the preset full scale value do not overload the amplifier, i.e. the totalized flow values are registered correctly.

Input signal	*Status input (auxiliary input)* U = 3 to 30 V DC, R_i = 5 kΩ, galvanically isolated. Configurable for: totalizer reset, positive zero return, error message reset, start zero point adjustment.

10.1.4   Output

Output signal	*Pulse/frequency output*

Pulse/frequency output

- passive
- galvanically isolated
- Open Collector
- max. 30 V DC
- max. 25 mA
- Frequency output: end frequency 100 to 5000 Hz, on/off ratio 1:1, pulse width max. 2 s
- Pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.1 to 1000 ms)

Status output

- passive
- Open Collector
- max. 30 V DC
- max. 25 mA

MODBUS RS485

- MODBUS device type: slave
- Address range: 1 to 247
- Functions codes supported: 03, 04, 06, 08, 16, 23
- Broadcast: supported with the function codes 06, 16, 23
- Physical interface: RS485 in accordance with standard EIA/TIA-485
- Baudrate supported: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- Transmission mode: RTU or ASCII
- Response time: typically 5 ms

Signal on alarm

Pulse/frequency output
De-energized in the event of fault or power supply failure

Status output
De-energized in the event of fault or power supply failure

MODBUS RS485
De-energized in the event of fault or power supply failure

Load   → "Output signal"

Galvanic isolation   All circuits for outputs, and power supply are galvanically isolated from each other.

10.1.5   Power supply

Electrical connections	→ 🖹 17

Supply voltage	24 V DC nominal voltage (20 to 30 V DC) / 24 V AC nominal voltage (20 to 28 V AC)

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

Cable specifications	Each compatible cable, with a temperature specification at least 20°C (68 °F) higher than the ambient temperature prevailing in the application. We recommend using a cable with a temperature specification of +80°C (176 °F). Also refer to → 🖹 15.

Power consumption	AC: < 4.0 VA DC: < 3.2 W *Typical switch-on current at 24 V DC nominal voltage at $R_i = 0.1$ W of the source.*
	t [ms]	I [A]
0	10.0
0.1	8.0
0.2	7.5
0.5	7.0
1.0	6.0
2.0	4.0
5.0	1.5
10.0	0.125 (operating current)

✎ Note!
The internal resistance of the source may not exceed $R_i = 10$ Ω.

Power supply failure	Lasting min. 20 ms: ■ HistoROM/S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point etc.)

Potential equalization	No measures necessary. For explosion-protected equipment → separate Ex-documentation supplied

10.1.6 Performance characteristics

Reference operating conditions	■ Error limits following ISO/DIS 11631 ■ Water, typically 20 to 30 °C (68 to 86 °F); 2 to 4 bar (30 to 60 psi) ■ Data as per the calibration report ±5 °C (±9 °F) and ±2 bar (±30 psi) ■ Data on the measured error based on accredited calibration rigs traced back to ISO 17025
Maximum measured error	The values indicated refer to the pulse/frequency output. The additional measured error for the current output is typically ±5 µA. Basis for calculations → 📄 51. o.r. = of reading *Mass flow and volume flow (liquids)* ■ ±0.10% o.r. (mass flow) ■ ±0.10% o.r. (volume flow) *Density (liquids)* ■ ±0.001 g/cc (after field density calibration or under reference conditions) ■ ±0.002 g/cc (special density calibration (optional) Calibration range: 0.0 to 2.0 g/cc, 5 to 80 °C (41 to 176 °F) Application range: 0.0 to 5.0 g/cc, −50 to 200 °C (−58 to 392 °F) ■ ±0.02 g/cc (standard calibration) *Temperature* $\pm0.5\ °C \pm 0.005 \cdot T\ °C$ $(\pm1.0\ °F \pm 0.003 \cdot (T − 32)\ °F)$ T = Fluid temperature *Zero point stability*

DN		Max. full scale value		Zero point stability	
[mm]	[inch]	[kg/h]	[lb/min]	[kg/h]	[lb/min]
1	1/24"	0 to 20	0 to 0.75	0.0008	0.00003
2	1/12"	0 to 100	0 to 3.7	0.002	0.00007
4	1/8"	0 to 450	0 to 16.5	0.014	0.0005
6	¼"	0 to 1000	0 to 37	0.02	0.0007

Example of maximum measured error
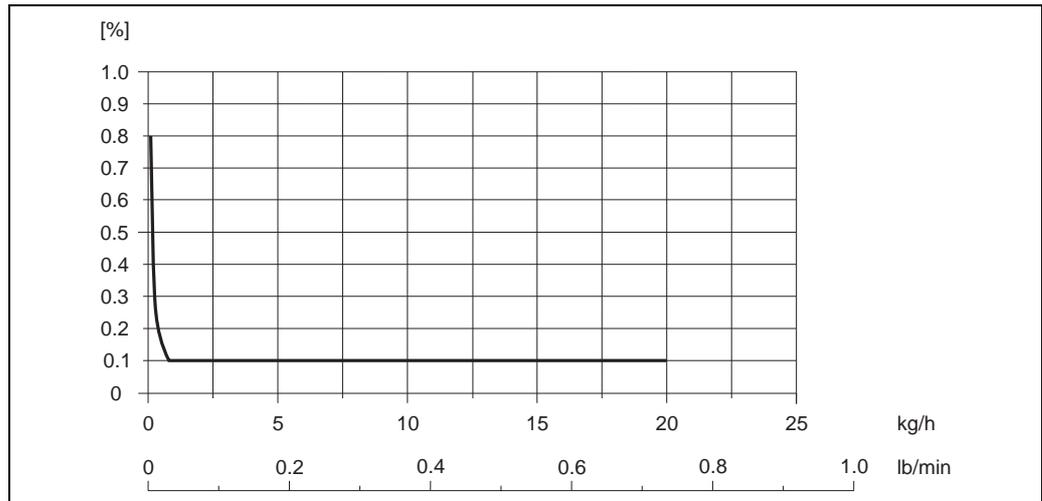
Fig. 21:   Max. measured error in % o.r. (example: Cubemass, DN 1)

Flow values (examples)

Basis for calculations → 📄 51.

Flow rate		Maximum measured error
[kg/h]	[lb/min]	[% o.r.]
0.1	0.0037	0.8
0.7	0.0257	0.114
2.5	0.0919	0.1
15	0.5513	0.1

o.r. = of reading

Repeatability

Basis for calculations → 📄 51.

o.r. = of reading

Mass flow and volume flow (liquids)

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

Density (liquids)

- ±0.0005 g/cc

1 g/cc = 1 kg/l

Temperature

±0.25 °C ± 0.0025 · T °C
(±0.5 °F ± 0.0015 · (T − 32) °F)

T = Fluid temperature

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 / °C (±0.0001% of the full scale value / °F).

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]	[inch]	[% 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	¼"	−0.003	−0.0002

o.r. = of reading

Basis for calculations

Depends on the flow:

- Flow ≥ zero point stability : (basic accuracy : 100)
  – Max. measured error: ±basic accuracy in % o.r.
  – Repeatability: ±½ · basic accuracy in % o.r.

- Flow < zero point stability : (basic accuracy : 100)
  – Max. measured error: ±(zero point stability : measured value) · 100% o.r.
  – Repeatability: ±½ · (zero point stability : measured value) · 100% o.r.

o.r. = of reading

10.1.7 Operating conditions: Installation

Installation instructions

→ 🖹 10

Inlet and outlet runs

There are no installation requirements regarding inlet and outlet runs.

System pressure

→ 🖹 8

10.1.8   Operating conditions: 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.
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 68‑2‑31
Vibration resistance	Acceleration up to 1 g, 10 to 150 Hz, following IEC 68‑2‑6
CIP cleaning	Yes
SIP cleaning	Yes
Electromagnetic compatibility (EMC)	As per IEC/EN 61326 and NAMUR Recommendation NE 21.

10.1.9   Operating conditions: 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)
Limiting medium pressure range (nominal pressure)	The material load diagrams (pressure-temperature diagrams) for the process connections 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 → 🖹 56. *Pressure range of secondary containment* ■ 25 bar (362.5 psi)
Limiting flow	→ 🖹 46, "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 (SI units)	Pressure loss depends on the fluid properties and on the flow rate. The following formulas can be used to approximately calculate the pressure loss:

Reynolds number	$Re = \dfrac{4 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$
	A0003381
Re ≥ 2300[1]	$\Delta p = K \cdot \nu^{0.25} \cdot \dot{m}^{1.75} \cdot \rho^{-0.75}$
	A0003380
Re < 2300	$\Delta p = K1 \cdot \nu \cdot \dot{m}$
	A0003379

Δp = pressure loss [mbar]
ν = kinematic viscosity [m²/s]
ṁ = mass flow [kg/s]
ρ = density [kg/m³]
d = inside diameter of measuring tubes [m]
K, K1 = constants (depending on nominal diameter)

[1] To compute the pressure loss for gases, always use the formula for Re ≥ 2300.

Pressure loss coefficients for Cubemass

DN		d	K	K1
[mm]	[inch]	[m]		
1	1/24"	$1.40 \cdot 10^{-3}$	$7.78 \cdot 10^{10}$	$9.50 \cdot 10^{10}$
2	1/12"	$2.50 \cdot 10^{-3}$	$5.04 \cdot 10^{9}$	$9.51 \cdot 10^{9}$
4	1/8"	$3.90 \cdot 10^{-3}$	$6.31 \cdot 10^{8}$	$1.66 \cdot 10^{9}$
6	¼"	$5.35 \cdot 10^{-3}$	$1.49 \cdot 10^{8}$	$4.97 \cdot 10^{8}$
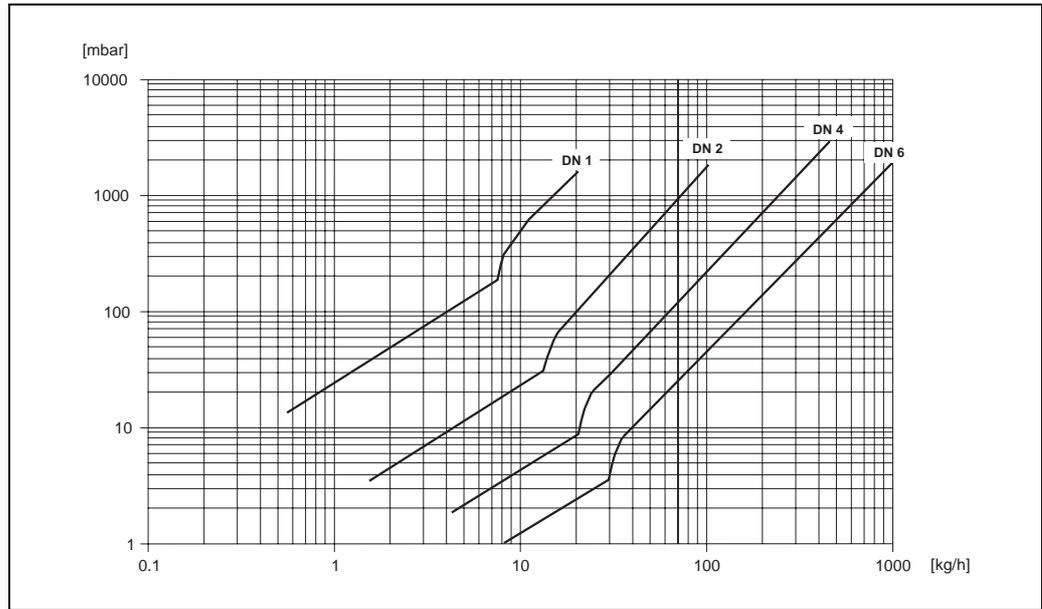
Fig. 22:   Pressure loss diagram for water

Pressure loss (US units)

Pressure loss depends on the nominal diameter and the fluid properties.
The "Applicator" PC software is available from Endress+Hauser and can be used to calculate the pressure loss
in US units. The "Applicator" program contains all the important device data which allows the measuring system arrangement to be optimized.

The software is used for the following calculations:
- Nominal diameter of the sensor with fluid properties such as viscosity, density etc.
- Pressure loss downstream from the measuring point
- Conversion of mass flow to volume flow etc.
- Simultaneous display of variables determined by different measuring devices
- Determining measuring ranges

The Applicator program runs on any IBM–compatible PC with Windows.

10.1.10 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 → 🗎 56.

Weight

Compact version	
[kg]	**[lb]**
5.0	11.0

Material

Transmitter housing

■ Aluminum housing: powder-coated die-cast aluminum

Sensor housing / secondary containment

■ Acid-resistant and alkali-resistant external surface, stainless steel 1.4301/304

Process connections

Process connections	Material
Mounting set for flanges EN 1092-1 (DIN 2501) / ANSI B16.5 / JIS B2238	Stainless steel 1.4539/904L
Loose flanges	Stainless steel 1.4404/316L
VCO coupling	Stainless steel 1.4539/904L
Mounting set for NPT-F (¼", ½")	Stainless steel 1.4539/904L

Measuring tube

■ 1.4539/904L

Seals for mounting set

■ Viton
■ EPDM
■ Silicone
■ Kalrez

Material load diagram	The material load diagrams (pressure-temperature diagrams) for the process connections 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 → 🗎 56.

Process connections	→ 🗎 55, process connections

10.1.11 Human interface

Display elements	Status LED

Remote operation	Operation takes place using the "FieldCare" configuration and service program from Endress+Hauser and the MODBUS RS485, which can be used to configure parameters for functions and read measuring values.

10.1.12 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 → 🖹 56.
Pressure device approval	The measuring devices correspond to Article 3(3) of the EC Directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice.
Functional safety	SIL 2: in accordance with IEC 61508/IEC 61511-1 (FDIS)
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

10.1.13 Ordering information

The Endress +Hauser service organization can provide detailed ordering information and information on the order code.

10.1.14 Accessories/spare parts

→ 🖹 37

10.1.15 Documentation

❑ Flow measurement (FA005D/06)

❑ Description of Device Parameters (GP005D/06)

❑ Technical Information (TI106D/06)

❑ Ex-Supplementary documentation ATEX (II2G): (XA146D/06)

❑ Ex-Supplementary documentation NEC/CEC (Div. 1): (XA147D/06)

❑ Ex-Supplementary documentation NEPSI (Zone 1, Zone 21): (XA148D/06)

Index

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

RA No. ☐☐☐☐☐☐☐☐

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.

Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

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

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

Medium and warnings
Warnhinweise zum Medium

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

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

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

Description of failure / *Fehlerbeschreibung* _____
_____
_____

Company data / *Angaben zum Absender*

Company / *Firma* _____
_____

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

Address / *Adresse* _____
_____

Fax / E-Mail _____

Your order No. / *Ihre Auftragsnr.* _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."

"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."

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

P/SF/Konta XIV

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