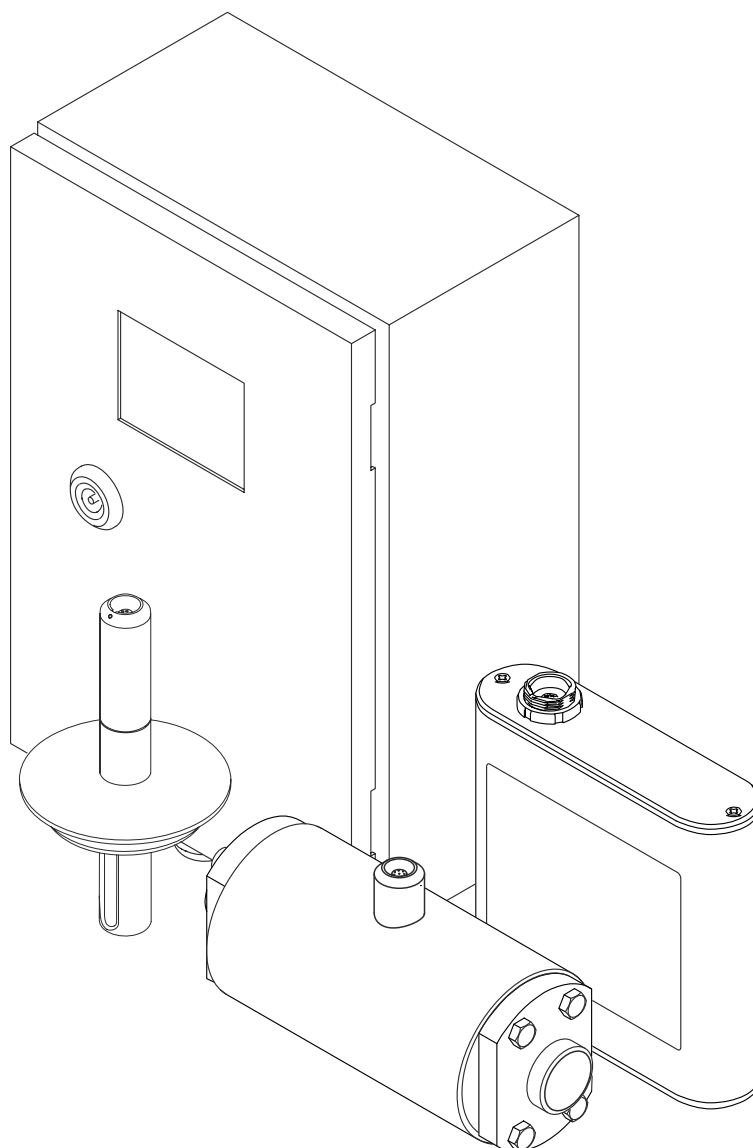


Operating Instructions

Teqwave H

Ultrasonic concentration meter
Modbus TCP



- Make sure the document is stored in a safe place such that it is always available when working on or with the device.
- To avoid danger to individuals or the facility, read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser sales organization will supply you with current information and updates to this manual.

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1 About this document

1.1 Document function

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

1.2 Symbols

1.2.1 Safety symbols

DANGER

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

WARNING

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

CAUTION

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

NOTICE

This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.2.2 Electrical symbols

Symbol	Meaning
	Direct current
	Alternating current
	Direct current and alternating current
	Ground connection A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	Protective earth (PE) Ground terminals that must be connected to ground prior to establishing any other connections. The ground terminals are located on the interior and exterior of the device: ■ Interior ground terminal: protective earth is connected to the mains supply. ■ Exterior ground terminal: device is connected to the plant grounding system.

1.2.3 Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.

Symbol	Meaning
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection

1.2.4 Symbols in graphics

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

1.3 Documentation

 For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the product configuration:

Document type	Purpose and content of the document
Technical Information (TI)	Planning aid This document contains all the technical data on the product and provides an overview of everything that can be ordered with the product.
Brief Operating Instructions (KA)	Quick guide to obtaining the first measured value The Operating Instructions contain all the essential information about the product from incoming acceptance to initial commissioning.

Document type	Purpose and content of the document
Operating Instructions (BA)	Reference The Operating Instructions contain the information that is required in the various phases of the life cycle of the product: From product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	Reference for parameters The document contains detailed explanations of readable or configurable parameters in the product. The description is aimed at those who work with the product over its entire life cycle and perform specific configurations.
Safety Instructions (XA)	Safety Instructions for electrical equipment in hazardous areas are supplied with the product depending on the approval. These are an integral part of the Operating Instructions.  The nameplate indicates the Safety Instructions (XA) that are relevant to the product.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the product documentation.

1.4 Registered trademarks

Modbus®

Registered trademark of SCHNEIDER AUTOMATION, INC.

TRI-CLAMP®

Registered trademark of Ladish & Co., Inc., Kenosha, USA

VARIVENT®

Registered trademark of GEA Tuchenhausen GmbH, Büchen, Germany

2 Safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- ▶ Trained, qualified specialists must have a relevant qualification for this specific function and task.
- ▶ Are authorized by the plant owner/operator.
- ▶ Are familiar with federal/national regulations.
- ▶ Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- ▶ Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- ▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

2.2 Intended use

Application and media

- The measuring instrument is intended only for the measurement of liquids or their analysis.
- Only operate the measuring instrument within the limits specified in the technical data and for the fluid profile in question.

To ensure that the measuring instrument remains in proper condition during the operating time:

- ▶ Only use the measuring instrument in full compliance with the data on the nameplate and the general conditions listed in the manual and supplementary documentation.
- ▶ Using the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area (e.g. explosion protection, pressure vessel safety).
- ▶ Use the measuring instrument only for media to which the process-wetted materials are sufficiently resistant.
- ▶ Keep within the specified pressure and temperature range.
- ▶ Keep within the specified ambient temperature range.
- ▶ Protect the measuring instrument permanently against corrosion from environmental influences.

Incorrect use

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

WARNING

Danger of breakage due to corrosive or abrasive fluids and ambient conditions!

- ▶ Verify the compatibility of the process fluid with the sensor material.
- ▶ Ensure the resistance of all wetted materials during the process.
- ▶ Keep within the specified pressure and temperature range.

WARNING

Risk of injury if the process connection and sensor gland are opened under pressure.

- ▶ The process connection should be opened only when in an unpressurized state.

Residual risks

Risk of hot or cold burns! Hot or cold surfaces on the device may occur due to the process medium or ambient temperature.

- ▶ Mount suitable touch protection.

2.3 Workplace safety

For work on and with the device:

- ▶ Wear the required personal protective equipment according to federal/national regulations.

2.4 Operational safety

Damage to the device!

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

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!

- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:

- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

2.5 Product safety

This state-of-the-art device is designed and tested in accordance with good engineering practice to meet operational safety standards. It left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU declaration of conformity. The manufacturer confirms this by affixing the CE mark.

2.6 IT security

The manufacturer warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

3 Product description

The measuring system consists of a sensor and a transmitter. The sensor and transmitter are mounted in physically separate locations. A connecting cable with a push-pull connector interconnects the sensor and transmitter.

The measuring system uses fluid profiles, which are individually tailored to the specific measuring task and encoded to work only with the serial number of a specific transmitter.

3.1 Product design

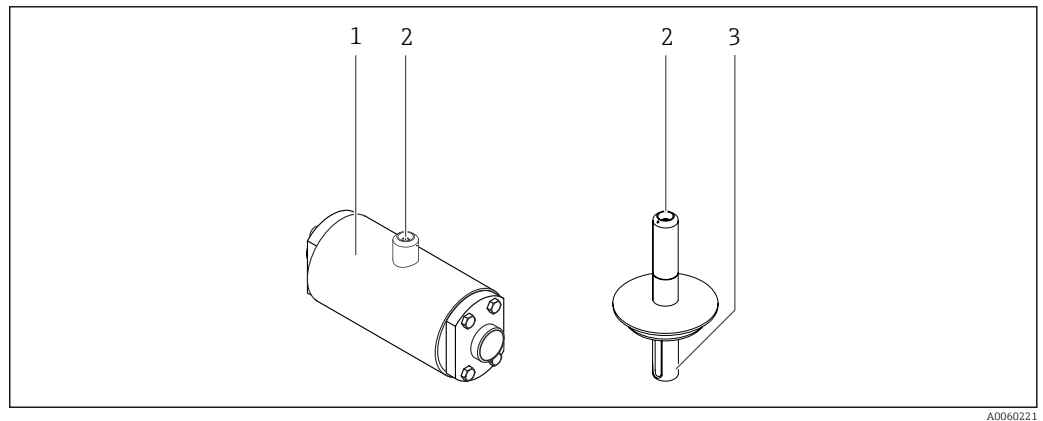
Two sensor versions are available:

- Inline sensor
- Insertion sensor

Two transmitter versions are available:

- Transmitter with aluminum housing
- Transmitter with stainless steel housing

3.1.1 Sensor



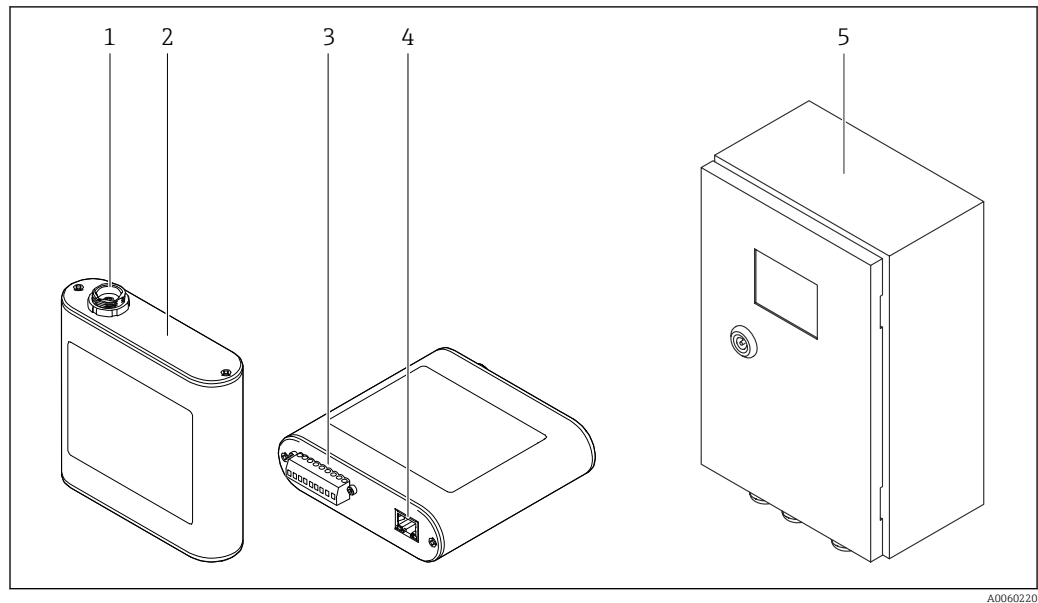
A0060221

1 Sensor versions

- 1 Inline sensor
- 2 Push-pull connection for connecting to the transmitter
- 3 Insertion sensor

 Only use the connecting cable supplied. The connecting cable can be ordered subsequently as an accessory →  85.

3.1.2 Transmitter



2 Transmitter versions

- 1 Push-pull connection for connecting to the sensor
- 2 Transmitter with aluminum housing and with a touchscreen
- 3 Terminal strip with supply voltage, analog output, switch output and digital input
- 4 Ethernet interface for digital signal transmission ("Teqwave Viewer" operating tool and Modbus protocol)
- 5 Transmitter with stainless steel housing

i Only use the connecting cable supplied. The connecting cable can be ordered subsequently as an accessory → 85.

3.2 Fluid profiles

Endress+Hauser makes individually configured fluid profiles available for each fluid. A fluid profile contains the characteristics of the speed of sound in a defined temperature range. These values are needed to calculate the concentration of a liquid. Each fluid profile is uniquely identified by a five-digit number (#MA-xxxxx).

The data sheet belonging to a fluid profile contains information on the medium, analysis parameters, permitted measuring ranges, compensation values and accuracy of the concentration measurement.

When individual fluid profiles are ordered, they are pre-installed on the transmitter and can be used immediately. When ordering an application, only common fluid profiles are initially installed on the transmitter. All the ordered fluid profiles are always available via *Netilion*.

i The order options available for fluid profiles and analysis parameters are listed in the "Application options" section of the "Technical Information" document. More information, e.g. about measuring ranges, is available in the *Applicator* (→ 87) or from your *Endress+Hauser* sales organization.

Apart from the preconfigured fluid profiles which are available by default, Endress+Hauser also creates individual fluid profiles specifically for your application.

i Your Endress+Hauser sales organization can provide detailed information on this service.

3.3 Recipes

With the "Teqwave Viewer" operating tool, it is also possible to customize a fluid profile to specific customer requirements and save the changes as a recipe.

When creating a recipe, an offset (zero adjustment) can be defined. This adjustment with a reference system is recommended during commissioning in order to optimize measurement accuracy.

In addition, other measured values can be read in or entered manually to compensate for cross-interferences of certain fluid profiles (e.g. for acids that influence concentration measurement).

Each transmitter can manage a maximum of 50 files (fluid profiles and recipes), including a maximum of 25 fluid profiles.



- To enable storage space for creating recipes, unused fluid profiles can be removed from the transmitter.
- For details on creating recipes, see →  61.

3.4 Application options

The measuring instrument offers application-specific options for selecting and ordering appropriate measured variables and fluid profiles.

Available measured variables: →  88

For information about the options available, see the "Measuring system" section of the "Technical Information" document.



- A selection of common fluid profiles for this area of application is already pre-installed upon delivery.
- To enable storage space for creating recipes, unused fluid profiles can be removed from the transmitter.
- All the fluid profiles of an ordered application are always available via *Netilion* and can be added to the transmitter.

4 Incoming acceptance and product identification

4.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
 - ↳ Report all damage immediately to the manufacturer.
Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.



If one of the conditions is not satisfied, contact the manufacturer.

4.2 Product identification

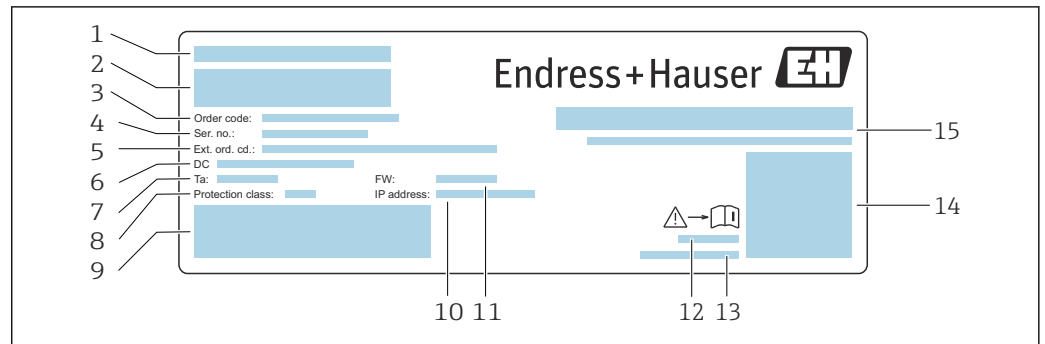
The device can be identified in the following ways:

- Nameplate
- Order code with details of the device features on the delivery note
- Enter the serial numbers from the nameplates in the *Device Viewer* (www.endress.com/deviceviewer): all the information about the device is displayed.
- Enter the serial numbers from the nameplates into the *Endress+Hauser Operations app* or scan the DataMatrix code on the nameplate with the *Endress+Hauser Operations app*: all the information about the device is displayed.

For an overview of the scope of the associated Technical Documentation, refer to the following:

- The "Additional standard device documentation" and "Supplementary device-dependent documentation" sections
- The *Device Viewer*: Enter the serial number from the nameplate (www.endress.com/deviceviewer)
- The *Endress+Hauser Operations app*: Enter the serial number from the nameplate or scan the DataMatrix code on the nameplate.

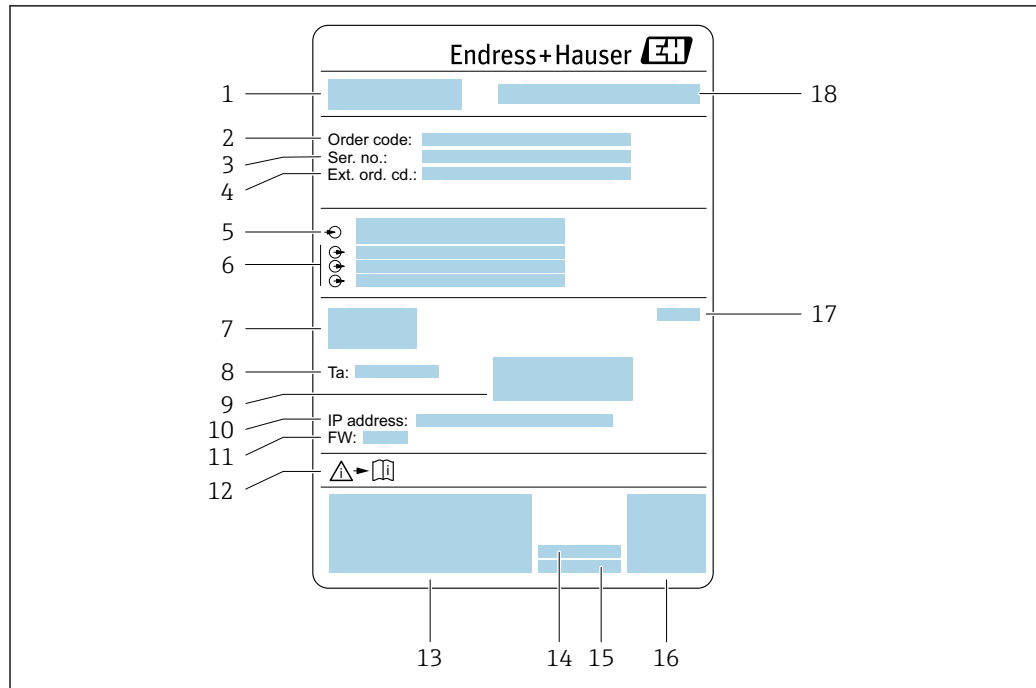
4.2.1 Transmitter nameplate



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 3 Example of a nameplate for a transmitter with an aluminum housing

- 1 Manufacturer address/certificate holder
- 2 Name of the measuring instrument
- 3 Order code
- 4 Serial number (ser. no.)
- 5 Extended order code (Ext. ord. cd.)
- 6 Supply voltage/power loss
- 7 Permitted ambient temperature (T_a)
- 8 Degree of protection
- 9 Space for approvals and certificates
- 10 IP address ex works
- 11 Firmware version (FW) from the factory
- 12 Date of manufacture: year-month
- 13 Manufacturing country
- 14 2D matrix code with link to DeviceViewer
- 15 Barcode for internal use

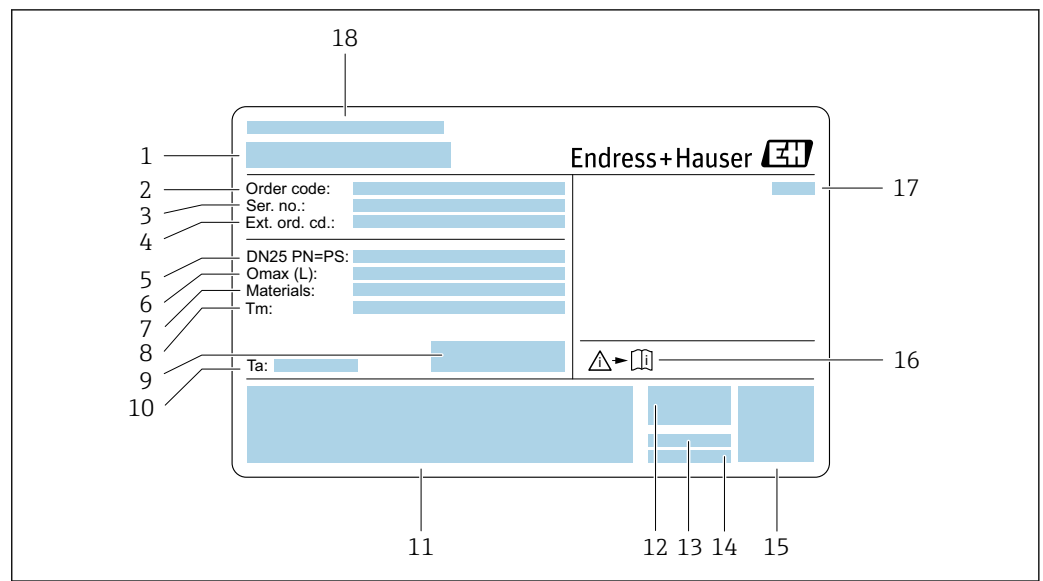


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 4 Example of a nameplate for a transmitter with a stainless steel housing

- 1 Name of the measuring instrument
- 2 Order code
- 3 Serial number (ser. no.)
- 4 Extended order code (Ext. ord. cd.)
- 5 Supply voltage/power loss
- 6 Available inputs and outputs
- 7 Cable gland/bushing (M20x1.5)
- 8 Permitted ambient temperature (T_a)
- 9 Permitted cable ambient temperature
- 10 IP address ex works
- 11 Firmware version (FW) from the factory
- 12 Follow the safety instructions in the documentation
- 13 Space for approvals and certificates, e.g. CE mark
- 14 Date of manufacture: year-month
- 15 Manufacturing country
- 16 2D matrix code with link to DeviceViewer
- 17 Degree of protection
- 18 Manufacturer address/certificate holder

4.2.2 Inline sensor nameplate



A0060224

 5 Example of a nameplate for an inline sensor

- 1 Name of the measuring instrument
- 2 Order code
- 3 Serial number (ser. no.)
- 4 Extended order code (Ext. ord. cd.)
- 5 Nominal diameter of the sensor/pressure rating (PN = PS)
- 6 Max. flow (Qmax)
- 7 Material of measuring tube
- 8 Permitted medium temperature (Tm)
- 9 Permitted cable ambient temperature
- 10 Permitted ambient temperature (Ta)
- 11 Space for approvals and certificates: e.g. CE mark
- 12 Flow direction
- 13 Date of manufacture: year-month
- 14 Manufacturing country
- 15 2D matrix code with link to DeviceViewer
- 16 Refer to device documentation
- 17 Degree of protection
- 18 Manufacturer address/certificate holder



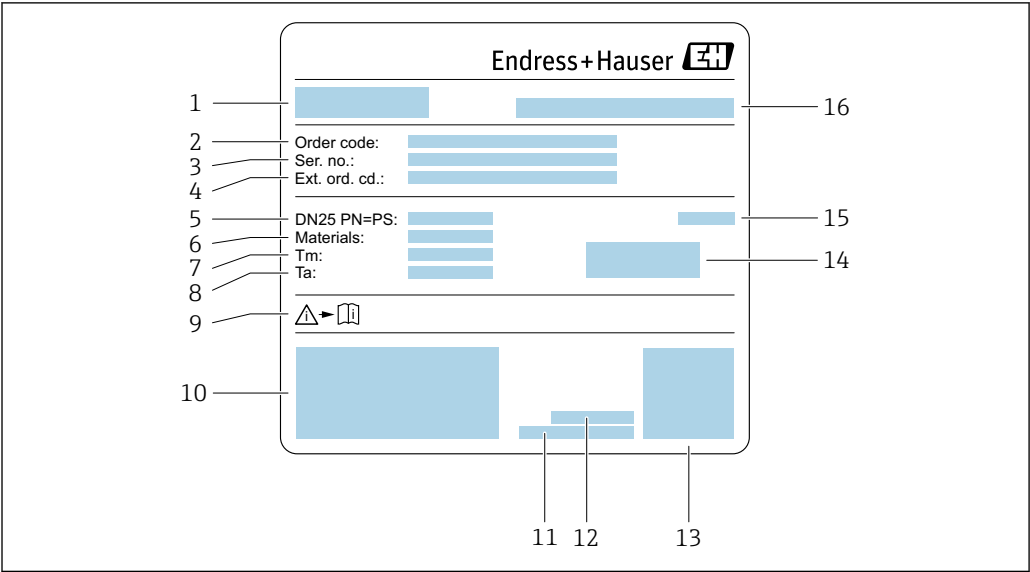
Order code

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. XXXXXX-ABCDE +).

4.2.3 Insertion sensor nameplate



6 Example of a nameplate for the insertion sensor

- 1 Name of the measuring instrument
- 2 Order code
- 3 Serial number (ser. no.)
- 4 Extended order code (Ext. ord. cd.)
- 5 Nominal diameter of the sensor/pressure rating (PN = PS)
- 6 Material of sensor
- 7 Permitted medium temperature (Tm)
- 8 Permitted ambient temperature (Ta)
- 9 Refer to device documentation
- 10 Space for approvals and certificates: e.g. CE mark
- 11 Manufacturing country
- 12 Date of manufacture: year-month
- 13 2D matrix code with link to DeviceViewer
- 14 Permitted cable ambient temperature
- 15 Degree of protection
- 16 Manufacturer address/certificate holder

i Order code
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. XXXXXX-ABCDE +).

4.2.4 Symbols on the device

Symbol	Meaning
	WARNING! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury. Please consult the documentation for the measuring instrument to discover the type of potential danger and measures to avoid it.
	Reference to documentation Refers to the corresponding device documentation.

5 Storage and transport

5.1 Storage conditions

Observe the following notes for storage:

- Store in the original packaging to ensure protection from shock.
- Do not remove protective covers or caps installed on process connections. They prevent mechanical damage to the sealing surfaces and contamination.
- Protect from direct sunlight. Avoid unacceptably high surface temperatures.
- Store in a dry and dust-free place.
- Do not store outdoors.
- Avoid condensation and ice formation.

Storage temperature →  94.

5.2 Transporting the product

- Transport the measuring instrument to the measuring point in the original packaging.
- Do not remove protective covers or caps installed on process connections. They prevent mechanical damage to the sealing surfaces and contamination.

5.3 Packaging disposal

All packaging materials are environmentally friendly and 100 % recyclable: Box in accordance with European Packaging Directive 94/62/EC; if the RESY symbol is affixed, this confirms that it can be recycled.

6 Installation

6.1 Installation requirements

6.1.1 Installation position

NOTICE

Measurement result is not representative

Heterogeneous mixing of the fluid and irregular flow to the medium can distort the measurement results, which are only valid for the layer of liquid in which the sensor is located.

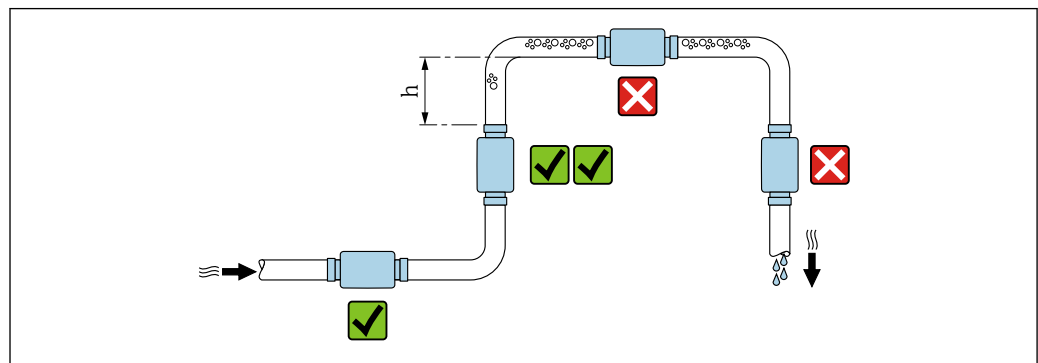
- Ensure homogeneous mixing of the liquid and its continuous flow to the sensor.

Installation location

- Install the sensor in an area that meets the following conditions:
 - Well-mixed medium
 - Bubble-free medium
 - Constantly heated medium, not close to heating coils
- Support the sensor in the event of severe dynamic load. Maximum lateral loading capacity: 75 Nm (55 lbf ft).
- Allow sufficient space for mounting and electrical connection.

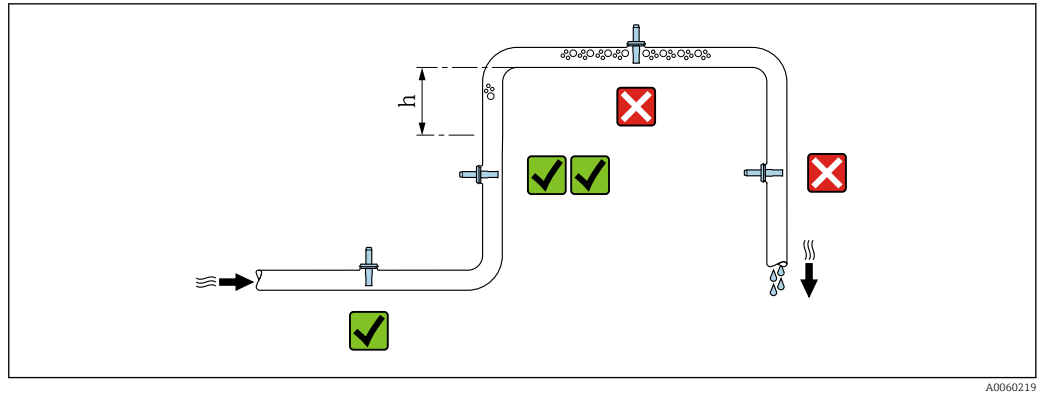
Piping

- Preferably install the sensor in an ascending pipe, and ensure a sufficient distance to the next pipe elbow: $h \geq 5 \times \text{DN}$.
- Do not install the device at the highest point of the pipe.
- Do not install the device upstream from a free pipe outlet in a down pipe.



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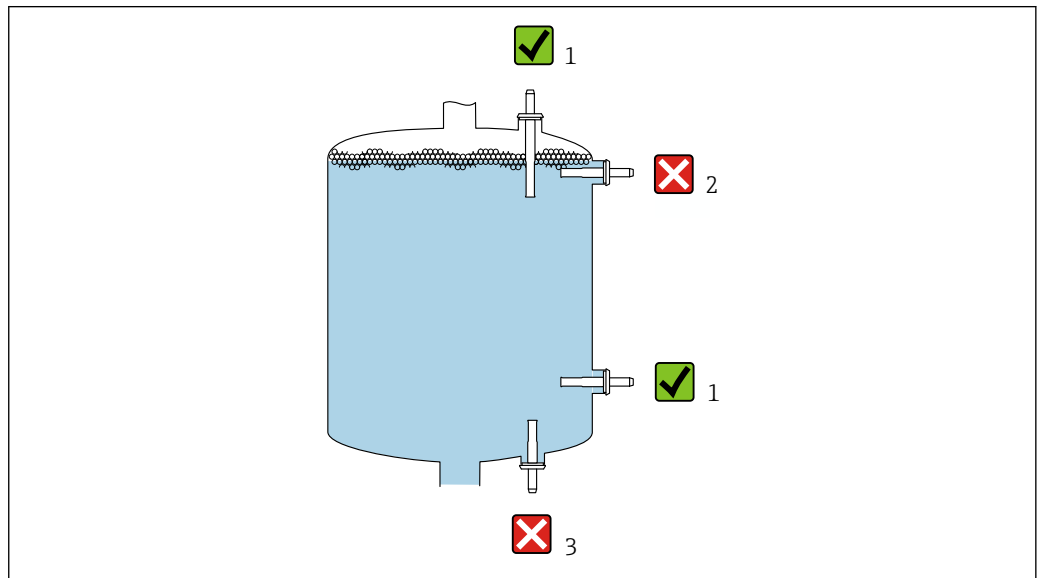
7 Installation location, inline measuring instrument



A0060219

8 Installation location, insertion measuring instrument

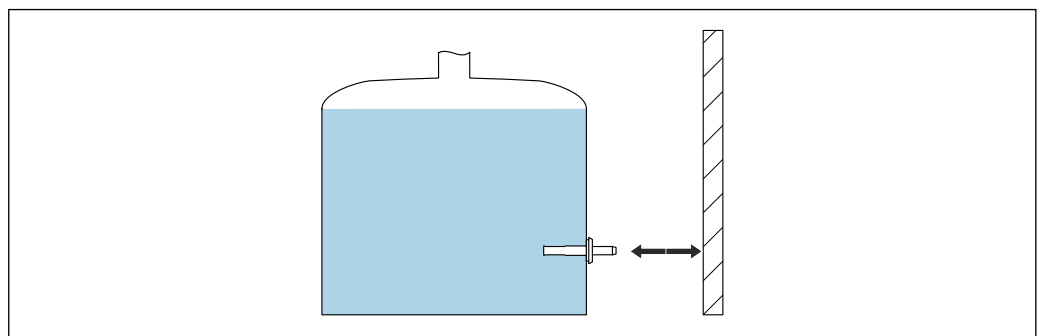
Tank



A0060238

9 Tank installation location, insertion measuring instrument

- 1 Select the installation location such that the sensor opening is completely immersed in the medium.
- 2 Avoid the installation location at the filling limit, as this can lead to increased bubble formation.
- 3 Avoid the installation location at the tank bottom in hygienic applications or if sedimentation is to be expected.



A0060239

10 Take into consideration the spacing, insertion measuring instrument

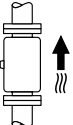
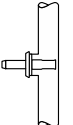
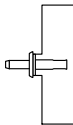
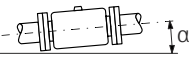
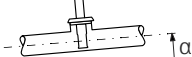
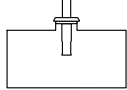
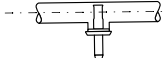
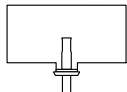
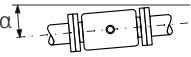
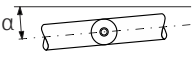
Orientation

NOTICE

Self-drainability must be ensured for hygienic applications and applications with sediment formation.

- Select the installation position and angle so that, during draining, the medium can drain completely by gravity and no residue remains on the sensor.

For the insertion sensor in tanks: To ensure hygienic installation, position the sensor such that all surfaces are directly reachable by spray from a cleaning device.

Orientation			
	Inline sensor	Insertion sensor, pipe installation	Insertion sensor, tank installation
Vertical orientation	 A0060225	 A0060229	 A0060390
Horizontal orientation Push-pull connection at top	 A0060226	 A0060230	 A0060391
Horizontal orientation, Push-pull connection at bottom	 A0060227	 A0060231	 A0060392
Horizontal orientation, Push-pull connection on the side	 A0060228	 A0060232	—

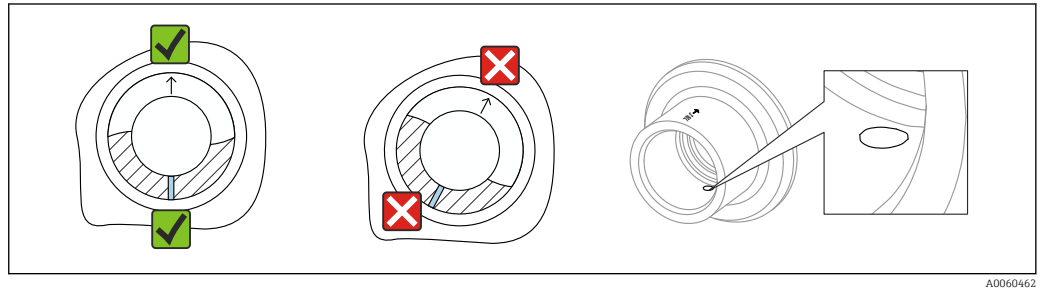
- 1) In hygienic applications and media that tend to cause buildup, install the insertion sensor with an inclination angle of $\geq 3^\circ$, so that no dead legs can form in which the medium can remain. Ensure that the medium can drain completely and that no residue remains on the sensor, weld-in adapter or T-piece.
- 2) The measuring instrument should be self-draining for hygiene applications. A vertical orientation is recommended for this. If only a horizontal orientation is possible, an angle of inclination $\alpha \geq 3^\circ$ is recommended.
- 3) This orientation is not suitable in hygienic applications or media that tend to form buildup. Install the insertion sensor such that no dead space is created in which the medium can remain. Ensure that the medium can drain completely and that no residue remains on the sensor, weld-in adapter or T-piece.
- 4) This orientation is not suitable for media that tend to form buildup on the bearing surface and can thereby affect the measurement result.

Process connections

Installation conditions for weld-in adapter

- For detailed information, see "Technical Information" TI00426F (weld-in adapters, process adapters and flanges).
- For process connection version G1", there is a weld-in adapter as an accessory, → 86.

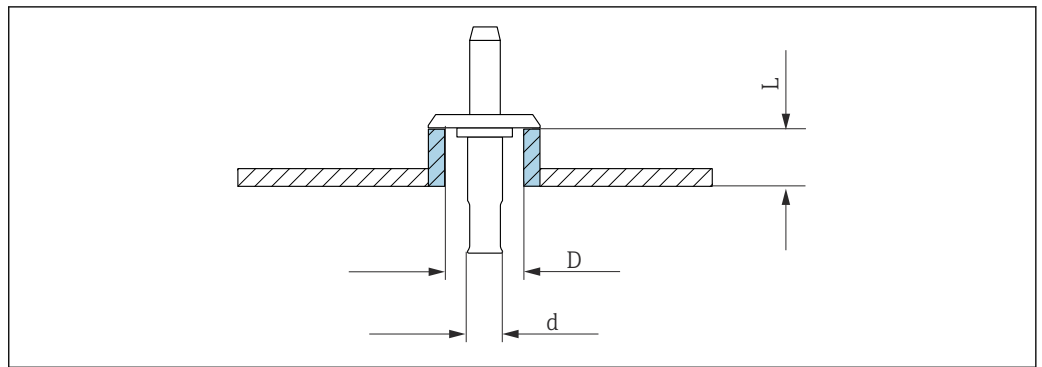
Weld in the weld-in adapter in such a way that the leakage hole is pointing downwards. This enables any leaks to be detected more quickly.



A0060462

Installation conditions for T-piece installation

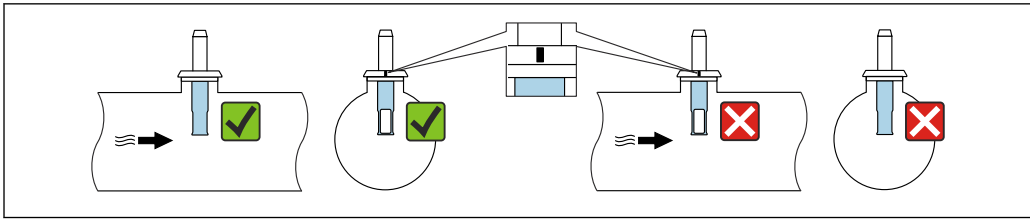
- The sensor opening must be completely wetted with the medium.
- To ensure hygienic installation the dead end of the T-piece should be minimized. See also the "Certificates and approvals/hygienic compatibility" section → 98.
The ratio between the depth of the T-piece (L), diameter D of the T-piece and diameter d of the sensor must comply with:
 - For EHEDG: $L/(D-d) < 1$
 - For 3-A: $L/(D-d) < 2$
- T-piece length:
 - For pipe installation a T-piece with a length of $L = 15 \text{ mm}$ must be used.
 - For tank installation a T-piece with a length of $L \leq 25 \text{ mm}$ must be used.



A0060470

Orientation of the insertion sensor

- If installing in a tank in a horizontal position, the marking on the process connection must point up or down to avoid buildup in the area of the sensor.
- If installing in a pipe, the marking on the process connection must point in the flow direction so that the flow is guided through the sensor opening.

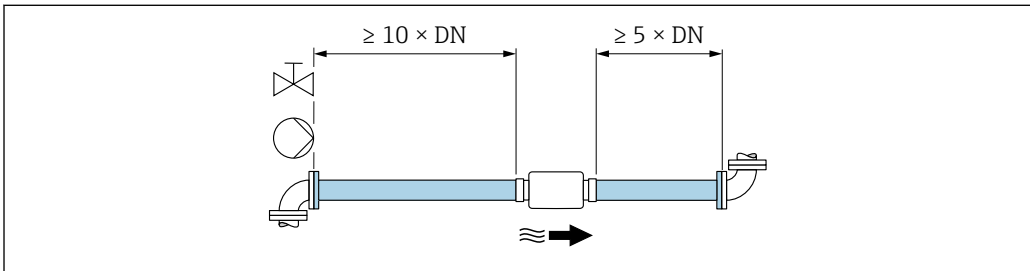


A0060461

11 Align the sensor in the pipe so that there is sufficient flow through the sensor opening and the flow is not significantly impeded. Align the marking on the process connection in the direction of flow for this purpose.

Inlet and outlet runs

Observe the following inlet and outlet runs to comply with accuracy specifications:



A0035458

12 Inlet and outlet runs

6.1.2 Environmental and process requirements

Ambient temperature range

Sensor	0 to +60 °C (+32 to +140 °F)
Transmitter with aluminum housing	0 to +60 °C (+32 to +140 °F)
Transmitter with stainless steel housing	0 to +50 °C (+32 to +122 °F)
Connecting cable supplied	Permanently installed: -40 to +80 °C (-40 to +176 °F) Loosely installed: -20 to +80 °C (-4 to +176 °F)

- If operating outdoors:
- Install the sensor in a shady location.
 - Avoid direct sunlight, particularly in warm climatic regions.
 - Avoid rain, condensation and ice formation.
 - Avoid direct exposure to weather conditions.
 - The transmitter is not designed for operation outdoors.

Vibrations

Installation in event of pipe vibrations

NOTICE

Pipe vibrations can damage the device!

- ▶ Do not expose the device to strong vibrations.
- ▶ Support the pipe and fix it in place.
- ▶ Support the device and fix it in place.

6.1.3 Special installation instructions

Sanitary compatibility

If installing the sensor in hygienic applications:

- Refer to the instructions in the "Certificates and approvals/hygienic compatibility" section →  98.
- Ensure that liquid cannot accumulate on the outside of the measuring instrument.
- If the measuring instrument is installed horizontally, align the connection socket for the connecting cable so it is pointing upward.
- Select the orientation in such that the measuring instrument is self-draining when installed. Installation with an inclination angle of $>3^\circ$ is recommended for this purpose.
- In tanks the sensor must be installed such that all surfaces are directly reachable by spray from a cleaning device.
- Avoid or minimize dead legs .

6.2 Installing the device

6.2.1 Installing the inline sensor

WARNING

Excessive equipotential bonding current between the transmitter and sensor can cause overheating and fire, and impair measurement.

- ▶ Connect the sensor to the ground wire via the piping system.
- ▶ For sensors with a Tri-Clamp connection, only use stainless steel clamps to ensure the electrical connection to the piping system.

WARNING

Danger due to improper process sealing!

- ▶ Ensure that the inside diameters of the gaskets are greater than or equal to that of the process connections and piping.
- ▶ Ensure that the seals and sealing surfaces are clean and undamaged.
- ▶ Use only the process connections, seals, and Endress+Hauser accessories supplied.
- ▶ Secure the seals correctly.

WARNING

Incorrect installation or contaminated connection parts can cause liquid to escape uncontrollably in the event of a seal defect.

- ▶ Keep all connection parts clean.
- ▶ Position the leakage groove in the process connection pointing downward so that liquid can be dissipated specifically.

Mounting the sensor with the threaded adapter in the pipe

- ▶ Mount the sensor in the pipe in full compliance with the installation conditions →  20.

Welding the sensor with the welding socket into the pipe

1. Tack-weld the process connection to secure it in the pipe.
2. Release the screws on the process connections and remove the sensor, along with the seal, from the pipe.
3. Weld the process connection into the pipe.
4. Mount the sensor, along with the seals, back on the process connections. Ensure that all the connection parts are clean and the leakage groove on the process connection is located on the underside of the transmitter.

5. Check whether the process connections and seals are centered when mounted.
6. Tighten the screws in a diagonally opposite sequence with a torque of 7 Nm (5.2 lbf ft).

6.2.2 Installing the insertion sensor

⚠ WARNING

Excessive equipotential bonding current between the transmitter and sensor can cause overheating and fire, and impair measurement.

- ▶ Connect the sensor to the ground wire via the piping system.
- ▶ For sensors with a Tri-Clamp connection, only use stainless steel clamps to ensure the electrical connection to the piping system.

⚠ WARNING

Danger due to improper process sealing!

- ▶ Match the seals to the type and nominal diameter of the process connection.
- ▶ Select the seal material as per the process parameters (such as temperature, pressure, medium, cleaning agent).
- ▶ For the insertion sensor with an ISO228, 1" thread, only use the process connections, seals and Endress+Hauser accessories supplied.
- ▶ Ensure that the seals and sealing surfaces are clean and undamaged.
- ▶ Secure the seals correctly.

Installing the insertion sensor with dairy, Tri-Clamp and Varivent connections

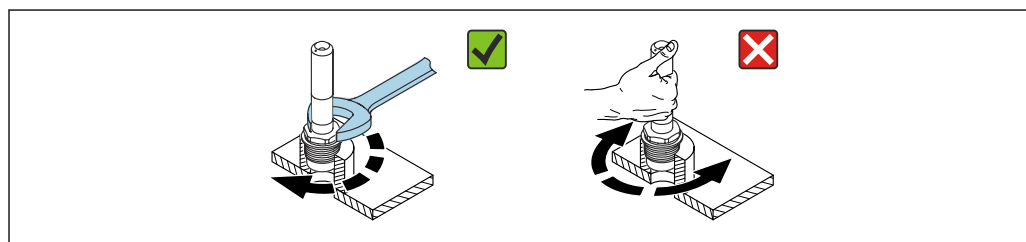
1. Insert the sensor with the seal correctly positioned.
2. Tighten the clamping connection evenly.

Insertion sensor with ISO228, 1" thread

- ▶ Screw the sensor with the correctly positioned seal into the process connection or weld-in adapter.

Note the following when screwing in the sensor:

- Only turn by the hexagon, 15 to 30 Nm (11 to 22 lbf ft).
- Do not turn at the housing.



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6.2.3 Mounting the transmitter

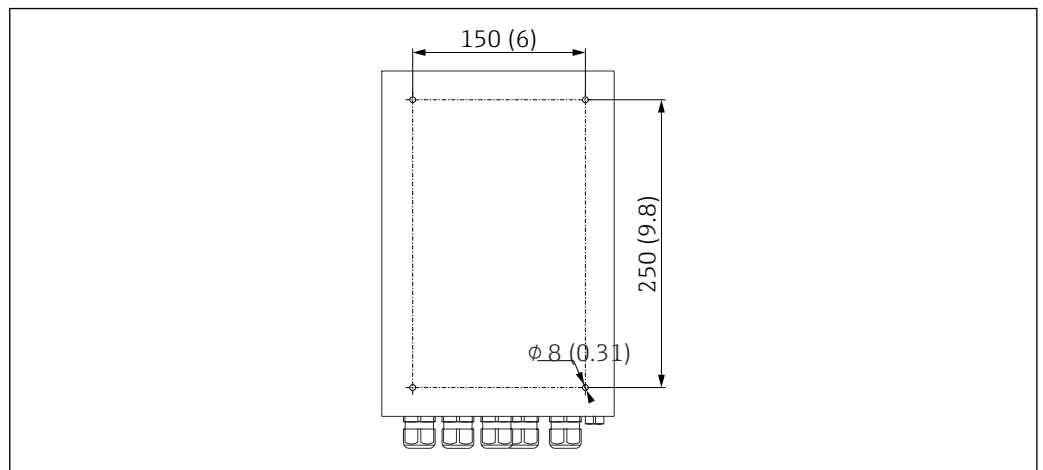
Transmitter with aluminum housing

- ▶ Mount the transmitter on the DIN rail DIN EN 60715 TH 35 using the DIN rail holder.

Transmitter with stainless steel housing

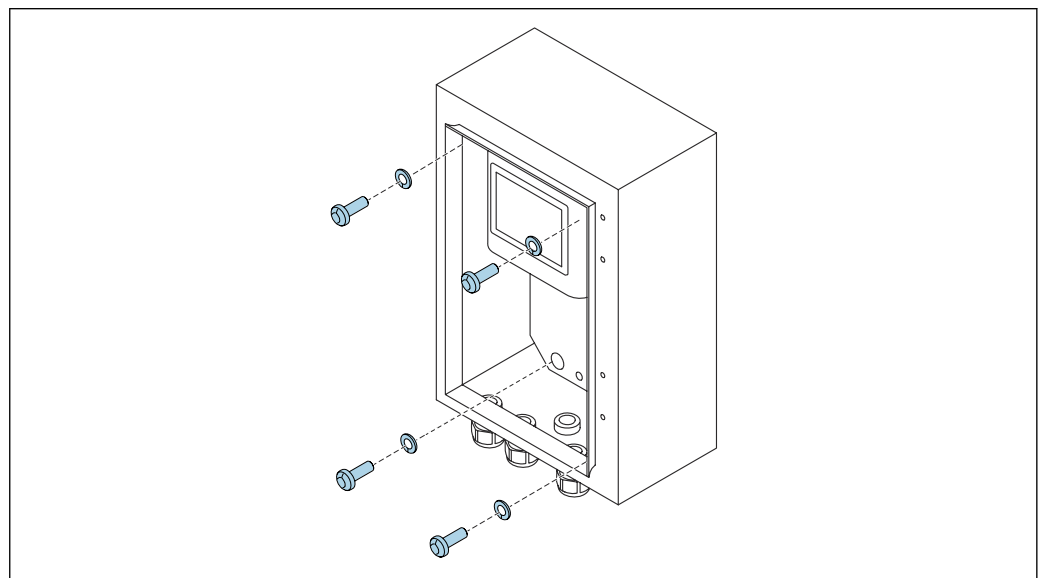
The transmitter can be mounted in the following ways:

- Wall mounting: Mounting over the mounting holes
- Post mounting: Mounting with transmitter holder (accessory)

Preparing for mounting

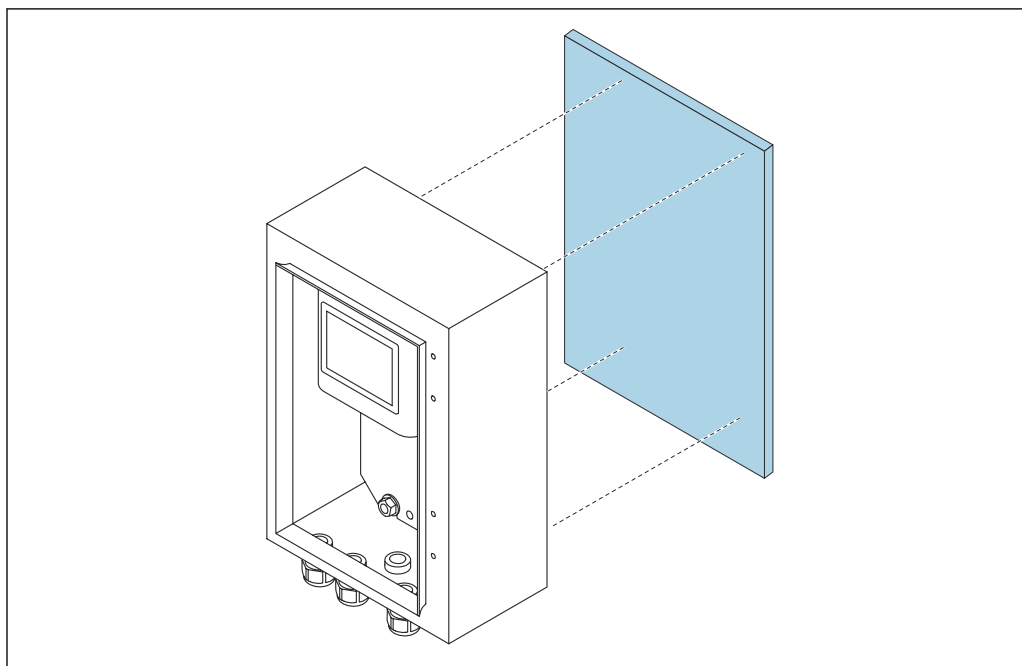
A0061031

13 Mounting holes, engineering unit mm (in)



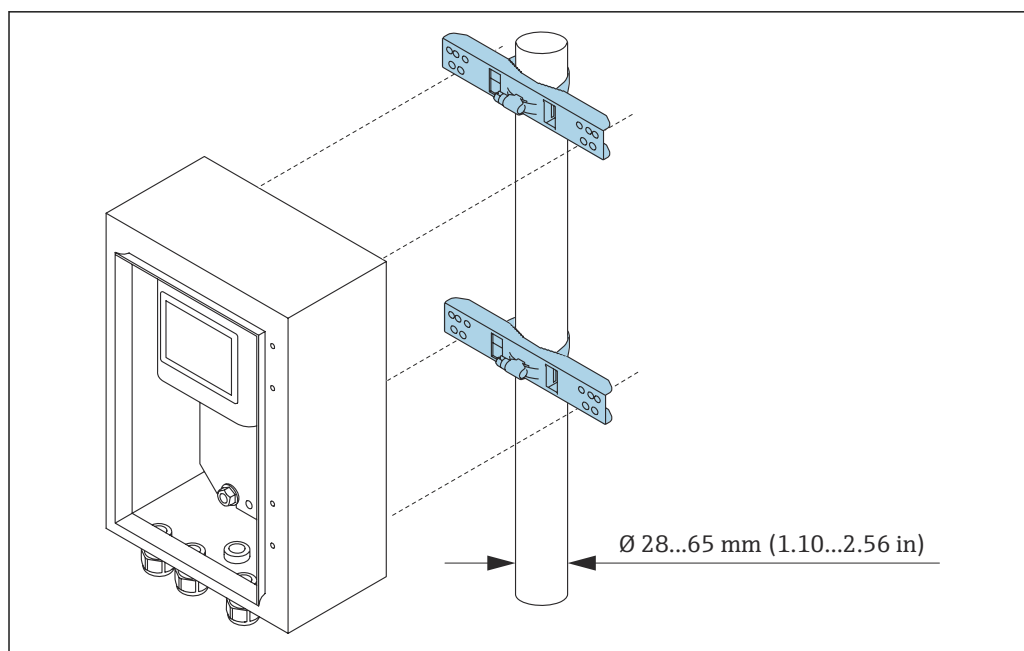
14 Carry out M8 screws with copper washers through the mounting bores from the inside.

1. Prepare the wall or bracket based on the dimensions of the mounting bores.
2. Open the housing cover.
3. Guide four M8 screws with copper washers from the inside of the housing through the mounting bores provided.

*Securing the transmitter**Wall mounting*

A0061959

- Secure the transmitter to the wall with the screws previously used and tighten to 18 Nm (13.2 lbf ft).

Post mounting

A0061032

1. Secure the transmitter holder to a post with the clamps and tighten to 1.6 Nm (1.18 lbf ft).
2. Secure the transmitter to the transmitter holder with the screws previously used and tighten to 18 Nm (13.2 lbf ft).

6.3 Post-installation check

Is the device undamaged (visual inspection)?	☐
Does the measuring instrument correspond to the measuring point specifications? For example: ■ Ambient temperature → 24 ■ Nominal pressure → 94 ■ Measuring range → 88	☐
Correct installation location and alignment of sensor selected? → 20	☐
Have the correct seals and process connections been selected and the process sealing been ensured?	☐
Are the specifications for the inlet run observed (inlet run $\geq 10 \times \text{DN}$)?	☐
Are the specifications for the outlet run observed (outlet run $\geq 5 \times \text{DN}$)?	☐
Is the device sufficiently protected from precipitation and direct sunlight?	☐

7 Electrical connection

 The measuring instrument does not have an internal circuit breaker. For this reason, assign the measuring instrument a switch or power-circuit breaker that allows the power supply line to be easily disconnected from the mains.

7.1 Connecting requirements

7.1.1 Requirements for connecting cable

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

Electrical safety

In accordance with applicable national regulations.

Connecting cable between the sensor and transmitter

Only use the cable supplied.

Permitted temperature range

- The installation guidelines that apply in the country of installation must be observed.
- The cables must be suitable for the minimum and maximum temperatures to be expected.
- A temperature increase of up to +20K above the ambient temperature must be expected in stainless steel housings.

Protective ground for protective ground terminal

Transmitter with aluminum housing

Conductor cross-section	0.129 to 1.31 mm ² (16 to 26 AWG)
Grounding impedance	< 2 Ω

Transmitter with stainless steel housing

Connection type	Via cable lug, suitable for M6 bolts
Grounding impedance	< 2 Ω
Cable diameter	4 to 6.5 mm (0.16 to 0.25 in)

Modbus Ethernet cable

Cable type	100 Base-TX
Cable category	Min. CAT5
Plug type	RJ-45 (8P8C)
Shielding	S/FTP, F/FTP, SF/FTP, S/UTP, F/UTP or SF/UTP
Cable length	Max. 30 m (98 ft)
Cable diameter	4 to 6.5 mm (0.16 to 0.25 in)

Power supply and signal cables

Cable type	Strand or solid wire
Conductor cross-section	0.129 to 1.31 mm ² (16 to 26 AWG)
Cable length	Max. 30 m (98 ft)
Cable diameter	7 to 10 mm (0.28 to 0.39 in)
Power supply cable	Standard installation cable is sufficient.
Analog output	Standard installation cable is sufficient.
Digital input	Standard installation cable is sufficient.
Switch output (alarm)	Standard installation cable is sufficient.

7.1.2 Terminal assignment

Terminal	Assignment	Description
V+	V_{in} DC 24 V	Supply voltage
V-		
+	out 0 to 10 V; 4 to 20 mA	Analog output
-		
0	output selection	Digital input
1		Digital input ground
		
	alarm Max. 50 VDC/30 VAC, 1 A	Switch output
		

7.1.3 Requirements for the supply unit

Supply voltage	DC 19.2 to 28.8 V
Version	Touch-safe circuit according to EN 61010-1, as terminal V- is electrically connected to the transmitter housing.
Power unit	The power unit must be safety-approved (PELV), as the measuring instrument is Class III equipment.
Overvoltage category	The measuring instrument is designed for operation on the secondary side of power units in overvoltage category I.

7.2 Connecting the device: Transmitter with aluminum housing

WARNING

Live parts.

Incorrect work performed on the electrical connections can result in an electric shock.

- ▶ Only properly trained specialist staff may perform electrical connection work.
- ▶ Refer to applicable federal/national installation codes and regulations.
- ▶ Comply with local workplace safety regulations.

7.2.1 Connecting the signal and supply voltage cables

1. Connect the protective ground to terminal V-, ensure potential equalization → 32, terminal assignment → 31.
2. Ground the transmitter housing via the mounted DIN rail.
3. Connect the signal and supply voltage cables to the transmitter via screw terminals, terminal assignment → 31.
4. For transmission via Modbus protocol or connection to the "Tegwave Viewer" operating tool, connect the Ethernet cable to the Ethernet port of the transmitter and the Ethernet port of the computer or network. To establish the connection to the operating tool, see the → 42.

7.2.2 Connecting the connecting cable

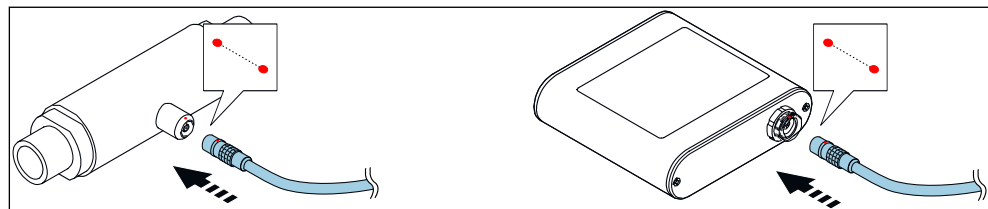
Connect the sensor to the transmitter only using the connecting cable supplied. This is important because the cable length influences the measuring signal and is taken into account in the calibration.

NOTICE

Measuring instrument malfunction

Damaged cables can impact the functional integrity of the measuring instrument.

- ▶ Do not route the connecting cables along the piping system as the maximum permitted temperature can be exceeded.
- ▶ Avoid strain when laying the connecting cable.
- ▶ Do not bend or shorten the connecting cable.
- ▶ Do not remove the plug of the connecting cable.
- ▶ Replace damaged or broken cables immediately.
- ▶ Route connecting cables separate from cables that carry very large electrical current (e.g. converter and motor connecting cables).



15 Connecting the connecting cable

i Red dots on the connectors indicate the position.

- ▶ Insert the push-pull connectors of the connecting cable into the sockets at the position indicated until they engage with a click.

7.2.3 Ensuring potential equalization

Due to their function, sensors and transmitters are connected via a common ground potential. Potential equalization currents can be avoided with the following measures.

⚠ WARNING

Excessive equipotential bonding current between the transmitter and sensor can cause overheating and fire, and impair measurement.

- ▶ Connect the sensor to the ground wire via the piping system.

Checking the protective ground connection

- ▶ Ensure that the protective ground is connected to terminal V- of the transmitter.

Checking for the absence of current

1. Unplug the connecting cable from the sensor and leave it attached to the transmitter.
2. Measure the absence of current between the grounding point of the sensor and the unplugged metal plug of the cable (cable shield).

7.3 Connecting the device: Transmitter with stainless steel housing

⚠ WARNING

Live parts.

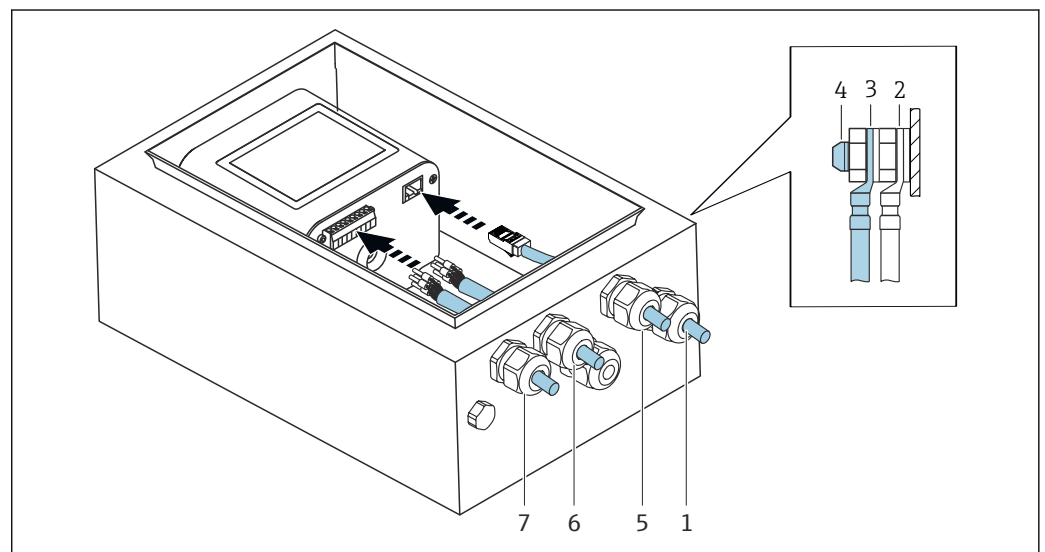
Incorrect work performed on the electrical connections can result in an electric shock.

- ▶ Only properly trained specialist staff may perform electrical connection work.
- ▶ Refer to applicable federal/national installation codes and regulations.
- ▶ Comply with local workplace safety regulations.

7.3.1 Opening the housing cover

- ▶ Open the housing cover using the control cabinet key.

7.3.2 Connecting the signal and supply voltage cables



A0060065

NOTICE

The degree of protection is guaranteed only when the seals are mounted correctly

- ▶ Cable glands (1) and (5): Equipped with slotted seal. Prior to installation, insert the seal over the cable and mount it together with the cable.
- ▶ Cable glands (6) and (7): Equipped with sealing rings. Do not remove the sealing rings.

NOTICE

Missing or insufficient grounding may impair functionality and lead to incorrect measurement results

- ▶ Properly ground the measurement device.

1. Guide the protective grounding cable through the cable gland (1) and connect it to the pre-installed internal grounding (2) on the M6 bolt (4) inside the housing using a cable lug (3). Prior to installation, insert the slotted seal over the cable and mount it together with the cable in the cable gland in order to ensure that there are no leaks.

2. If necessary, guide the Ethernet cable through the cable gland (5). Prior to installation, insert the slotted seal over the cable and mount it together with the cable in the cable gland in order to ensure that there are no leaks.
3. Feed the signal and supply voltage cables through the cable glands (6) and (7). To ensure tight sealing, do not remove the sealing rings from the cable glands.
4. Connect the signal and supply voltage cables to the transmitter via screw terminals, terminal assignment → 31.
5. For transmission via Modbus protocol or connection to the "Tegwave Viewer" operating tool, connect the Ethernet cable to the Ethernet port of the transmitter and the Ethernet port of the computer or network. To establish the connection to the operating tool, see the → 42.
6. Tighten the cable glands to 2.5 Nm (1.84 lbf ft).

7.3.3 Connecting the connecting cable

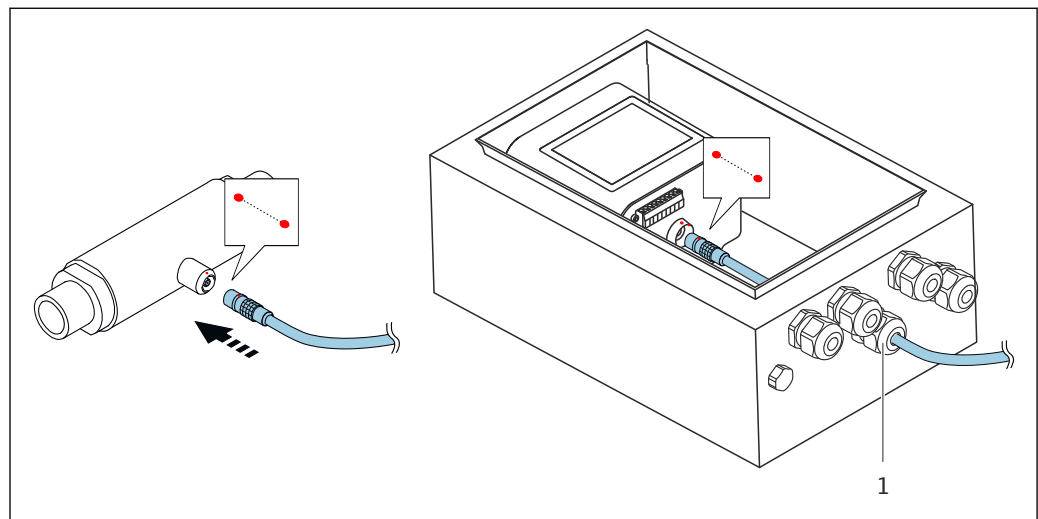
Connect the sensor to the transmitter only using the connecting cable supplied. This is important because the cable length influences the measuring signal and is taken into account in the calibration.

NOTICE

Measuring instrument malfunction

Damaged cables can impact the functional integrity of the measuring instrument.

- ▶ Avoid strain when laying the connecting cable.
- ▶ Do not bend or shorten the connecting cable.
- ▶ Do not remove the plug of the connecting cable.
- ▶ Replace damaged or broken cables immediately.
- ▶ Route connecting cables separate from cables that carry very large electrical current (e.g. converter and motor connecting cables).



A0060245

i Red dots on the connectors indicate the position.

NOTICE

The degree of protection is guaranteed only when the seals are mounted correctly

- ▶ Cable glands (1): Equipped with slotted seal. Prior to installation, insert the seal over the cable and mount it together with the cable.
1. Push the connecting cable through the cable gland (1). Prior to installation, insert the slotted seal over the cable and mount it together with the cable in the cable gland in order to ensure that there are no leaks.

2. Insert the push-pull connectors of the connecting cable into the sockets at the position indicated until they engage with a click. Red dots on the connectors indicate the position.
3. Tighten the cable glands to 2.5 Nm (1.84 lbf ft).

7.3.4 Ensuring potential equalization

Due to their function, sensors and transmitters are connected via a common ground potential. Potential equalization currents can be avoided with the following measures.

WARNING

Excessive equipotential bonding current between the transmitter and sensor can cause overheating and fire, and impair measurement.

- Connect the sensor to the ground wire via the piping system.

Checking the protective ground connection

- Ensure that the protective ground is connected to terminal V- of the transmitter.

Checking for the absence of current

1. Unplug the connecting cable from the sensor and leave it attached to the transmitter.
2. Measure the absence of current between the grounding point of the sensor and the unplugged metal plug of the cable (cable shield).

7.3.5 Closing the housing cover

- Close the housing cover using the control cabinet key.

7.3.6 Ensuring the degree of protection

Degree of protection: IP66

The transmitter with stainless steel housing fulfills all the requirements for the degree of protection IP66.

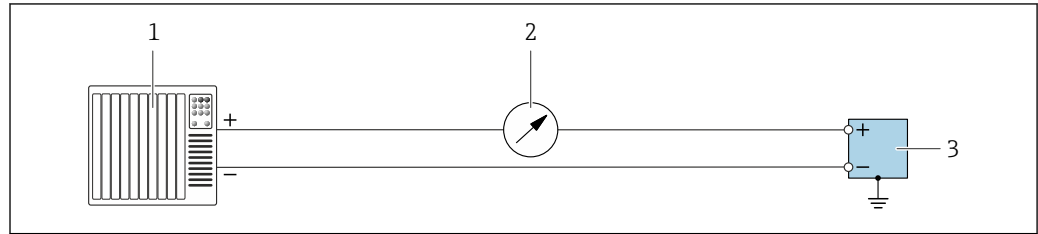
To ensure degree of protection IP66, carry out the following steps after making the electrical connection:

1. Check that the housing seals are clean and fitted correctly.
2. Dry, clean or replace the seals if necessary.
3. Tighten all housing screws and screw covers.
4. Tighten the cable glands to 2.5 Nm (1.84 lbf ft).
5. Unused cable glands must be closed with the dummy plugs supplied to guarantee the degree of protection of the transmitter.

7.4 Special connection instructions

7.4.1 Connection examples

Current output 4 to 20 mA (without HART)

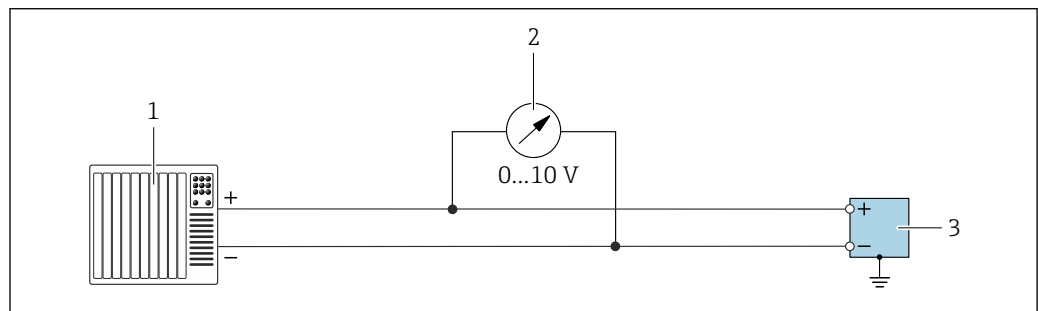


A0055851

16 Connection example for 4 to 20 mA current output (active)

- 1 Automation system with current input (e.g. PLC)
- 2 Optional additional display unit: Observe maximum load
- 3 Transmitter with current output (active)

Voltage output 0 to 10 V

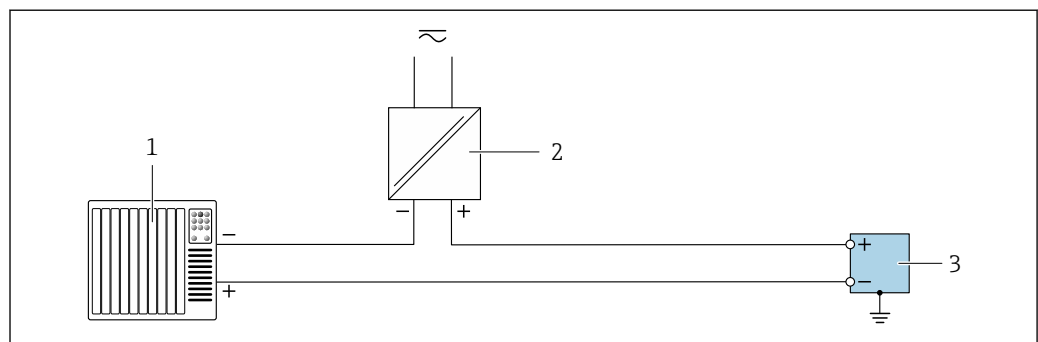


A0056212

17 Connection example for voltage output, active, 0 to 10 V

- 1 Automation system with voltage input (e.g. PLC)
- 2 Analog display unit for voltage: Observe minimum load
- 3 Transmitter with voltage output

Relay output



A0055859

18 Connection example for relay output

- 1 Automation system with switch input (e.g. PLC)
- 2 Power supply
- 3 Transmitter with relay output

Digital input (elective inputs)

The digital input controls which measured variable is active at the analog output. A total of up to four measured variables can be configured.

Configuration options:

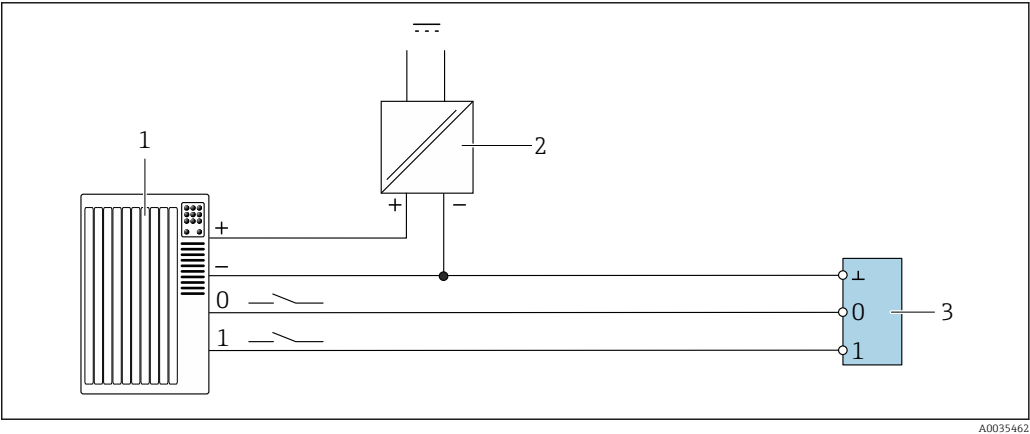
Active analog output	Digital input "0"	Digital input "1"
Channel 1	Open	Open
Channel 2	Ground (digital input ⊥)	Open
Channel 3	Open	Ground (digital input ⊥)
Channel 4	Ground (digital input ⊥)	Ground (digital input ⊥)

NOTICE

Interference at the digital input

If the measuring instrument is connected incorrectly, this can impact the functional integrity of the device.

- Switch the digital input only against the digital input ground (⊥).



19 Connection example for the digital input

- 1 Automation system with switch output (e.g. PLC)
- 2 Power supply
- 3 Transmitter

i If the transmitter is connected as illustrated in the example, the outputs are no longer galvanically isolated.

7.5 Post-connection check

Are the device and cable undamaged (visual inspection)?	☐
Do the cables used meet the requirements?	☐
Are the mounted cables strain relieved?	☐
Are all the connectors firmly seated?	☐
Is the terminal assignment correct?	☐
Are all the screw terminals firmly tightened?	☐
Is terminal V- connected to the protective earth?	☐
Has the protective earthing of the transmitter housing been established correctly?	☐
Is the potential equalization between the transmitter and sensor correctly established?	☐

For a transmitter with stainless steel housing: ■ Are dummy plugs inserted in unused cable glands? ■ Are all cable glands installed, securely tightened and leak-tight?	☐
If supply voltage is present: Is the device operational and do values appear on the display module?	☐

8 Operation options

8.1 Overview of the operation options

The measuring device can be operated in the following ways:

- Operation via the local display (transmitter with touch screen)
- Operation via the "Tegwave Viewer" operating tool supplied

8.2 Access to the measuring instrument via the local display

The device can be operated via the transmitter touchscreen and via the "Tegwave Viewer" operating tool.

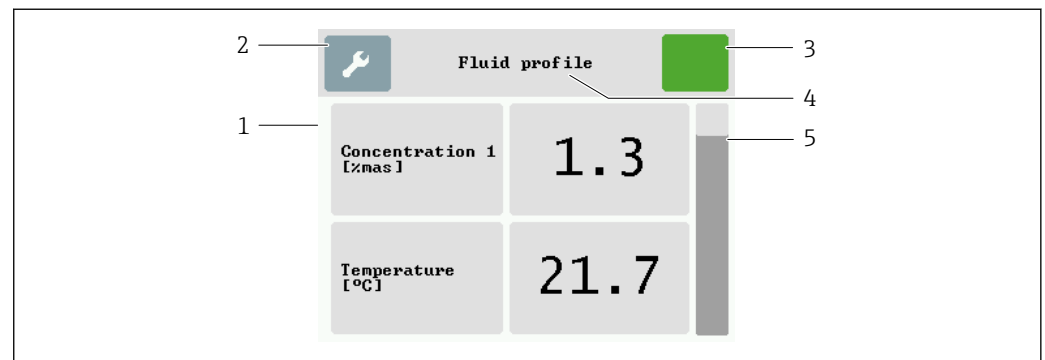
 For the transmitter with a stainless steel housing, the housing cover must be opened to gain access to the touchscreen.

Functions supported when operating via the transmitter:

- Real-time display of the measured values in list and graph formats
- Selection of a fluid profile or a recipe
- Device configurations

8.2.1 Transmitter operational display

The operational display is used to view the measured values and the sensor status, and use the touchscreen to access the Settings menu.



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 20 Operational display

- 1 Measured value display
- 2 Settings menu
- 3 Status indicator
- 4 Name of the fluid profile or the recipe
- 5 Scroll bar

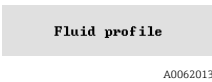
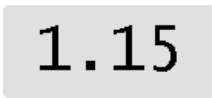
Measured value display

The list display shows exactly one active measured variable in each line. The display shows the name of the measured variable, its physical unit and the associated measured value.

There are three display modes available in the list display. Two, four or five measured values are displayed simultaneously depending on the mode. If more measured values are available than can be displayed in the selected display mode, the other measured variables can be viewed via the scroll bar on the right edge. When a measured variable is selected, the menu for offset configuration of the active fluid profile or recipe is changed.

In addition, a display mode is available in which a single measured value is displayed in the form of a graph. The list and graph format and can be changed with the **View** parameter, see →  56.

Functions of the display and operating elements

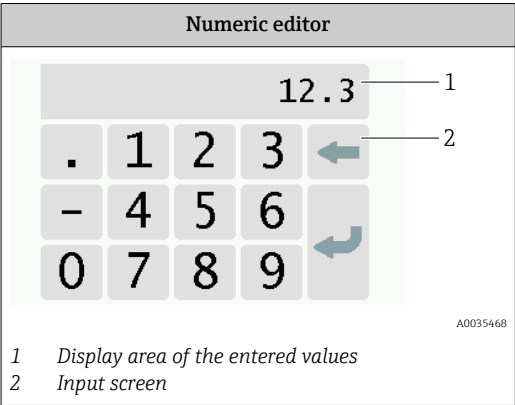
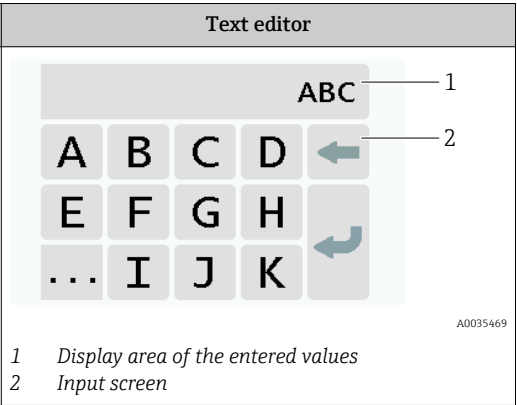
Button	Description
	Settings menu Opens the settings.
	Navigation Navigate between the menus or submenus.
	Status indicator Displays the current status, and navigation to more detailed diagnostic messages in text format.
	Fluid profile name Displays the name of the fluid profile and navigation to the operational display.
	Measured variable display Displays the measured variable and its unit, and navigation to the offset setting.
	Measured value display Displays the measured value and navigation to the offset setting.
	Scroll bar For scrolling up and down.

States of functions and parameters

Tap a parameter or function to open the related submenu or to activate a function.

Button	Description
	Blue background Parameter is selected or function is activated.
	Gray background Parameter is not selected or function is deactivated.

Editing elements

Numeric editor	Text editor
 1 Display area of the entered values 2 Input screen	 1 Display area of the entered values 2 Input screen

Input screen

The following input symbols are available in the input screen of the numeric and text editor:

Input and operating symbols in the editors

Symbol	Meaning
	Selection of letters from A to Z.
	Selection of numbers from 0 to 9 and special characters.
	Inserts decimal separator at the cursor position.
	Inserts minus sign at the cursor position.
	Confirms selection.
	Clears the last character entered.

8.3 Access to the measuring instrument via the "Teqwave Viewer" operating tool

The device can be operated via the transmitter touchscreen and via the "Teqwave Viewer" operating tool.

Supported functions when operating via the "Teqwave Viewer" operating tool:

- Real-time display of the measured values in list and graph formats
- Save graph
- Management of fluid profiles and recipes on the transmitter
- Device configurations
- Switch between multiple transmitters
- Self-test

- Read saved measured values
- Offline analysis with graphing of the measured values
- Measured data logging and export function

8.3.1 System requirements

Computer hardware

Interface	The computer must have an Ethernet RJ45 interface.
Connection	Standard Ethernet cable with RJ45 connector.
Screen	Recommended screen resolution: min. 1024 x 768 pixel.

Computer software

Recommended operating system	Microsoft Windows 10 or higher.
------------------------------	---------------------------------

Computer settings

User rights	Appropriate user rights (e.g. administrator rights) for TCP/IP and proxy server settings are necessary (for changing the IP address or subnet mask).
Network connections	Only use active network connections to the measuring instrument. Switch off all other network connections such as WLAN.

8.3.2 Software installation

The "Tegwave Viewer" operating tool is available to download at www.software-products.endress.com. You need to register in the Endress+Hauser software portal to download the application.

Installing the "Tegwave Viewer" operating tool

1. Download the "Tegwave Viewer" operating tool under www.software-products.endress.com and save it locally.
2. Close all applications.
3. Double-click the "setup.exe" file to start the installation.
4. Follow the instructions in the installation window.

8.3.3 Establishing a connection between the transmitter and the "Tegwave Viewer" operating tool

The connection between the transmitter and the "Tegwave Viewer" operating tool is established via the Internet protocol. The Internet protocol and the network settings of the computer must be configured for this purpose.

Configuring the Internet protocol of the computer

1. Switch on the measuring instrument.
2. Connect it to the computer using the Ethernet cable.
3. If a second network card is not used: Close all the applications on the computer that need the Internet or a network (e.g. e-mail, SAP, Internet Explorer).
4. Configure the properties of the Internet protocol (TCP/IP) as defined in the network settings of the transmitter with a static IP address in the same address range.
Example: Transmitter IP address: 192.168.1.212 → PC IP address: 192.168.1.2

Viewing and configuring the network settings

Navigation on the transmitter

1. Settings menu → "Network settings" → "Network status"
2. Settings menu → "Network settings" → "System name"
3. Settings menu → "Network settings" → "MAC address"
4. Settings menu → "Network settings" → "IP address"
5. Settings menu → "Network settings" → "Subnet mask"
6. Settings menu → "Network settings" → "Gateway"
7. Settings menu → "Network settings" → "DHCP"

Navigation via the "Teqwave Viewer" operating tool

1. Menu "Teqwave Transmitter" → "Network settings" → "IP address"
2. Menu "Teqwave Transmitter" → "Network settings" → "System name"
3. Menu "Help" → "Version" → "MAC address"
4. Menu "Teqwave Transmitter" → "Network settings" → "Subnet mask"
5. Menu "Teqwave Transmitter" → "Network settings" → "Gateway"
6. Menu "Teqwave Transmitter" → "Network settings" → "Switch DHCP status"



The operating tool sends the settings to the transmitter once the "Send (parameters)" button is clicked.

Parameter overview with brief description

Parameter	Description	Selection/entry/display	Factory setting
Network status ¹⁾	Displays the current connection status.	■ Static IP address ■ DHCP ■ Not connected	-
System name	Enter the name or system name of the transmitter under which it can be reached in the network.	Sequence of letters and characters, no special characters, max. 15 characters.	[Serial number]
MAC address	Displays the physical network address of the device.	Byte-wise notation, colon-separated	Depends on the transmitter
IP address	Enter the IPv4 address. ■ The transmitter IP address assigned at the factory is indicated on the transmitter nameplate. ■ The network settings of the computer must be configured with a static IP address in the same address range.	Group of four: 0 to 255 (in the specific group) 0.0.0.0, 127.0.0.1 and 255.255.255.255 are not allowed.	192.168.1.212
Subnet mask	Enter one of the predefined values, or a new value, for the subnet mask.	■ 255.255.255.0 ■ 255.255.0.0 ■ 255.0.0.0 ■ Group of four: 0 to 255 (in the specific group)	255.255.255.0

Parameter	Description	Selection/entry/display	Factory setting
Gateway	Enter the IP address for a gateway in the local network.	Group of four: 0 to 255 (in the specific group)	0.0.0.0
DHCP Change DHCP status	Enable DHCP to allow the DHCP server in the network to automatically assign the IP address for the transmitter.  This function is only available if the transmitter has a "system name". Otherwise, the "Tegwave Viewer" operating tool cannot find the transmitter in the network. The system name is preconfigured when the device is delivered.	Enable or disable the function	The function is disabled

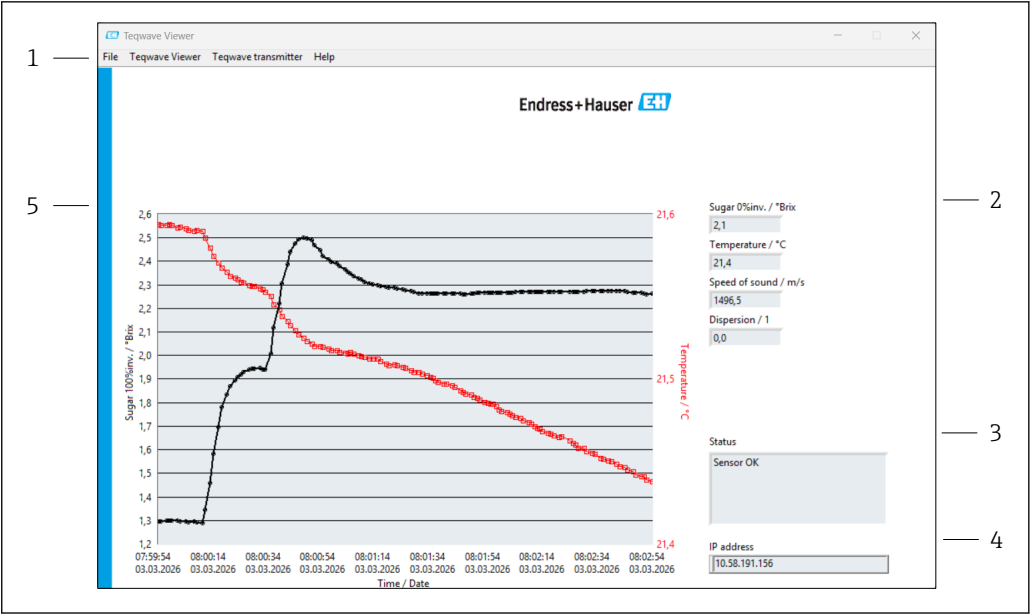
1) Only displayed via the transmitter

Establishing a connection with the transmitter

1. Start the "Tegwave Viewer" operating tool.
2. Under "Tegwave Transmitter" → "Change transmitter": enter the IP address or system name (Net-BIOS name) of the transmitter.
 - ↳ The measured values are displayed on the right of the graph and on the graphic display.

8.3.4 User interface

The central element on the start screen is a graph that displays the selected measured variables over the time period. To the right of the graph, the user interface also shows all the measured variables, the sensor status and the IP address of the transmitter.



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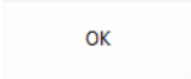
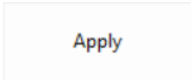
21 User interface

- 1 Menu bar
- 2 Measured variable display (with scroll bar if more than six measured variables)
- 3 Status indicator
- 4 IP address displayed
- 5 Graph

Menu bar

Menu	Description
File	File Functions to start and stop measured value transmission and to save the graph.
Teqwave Viewer	Teqwave Viewer Functions that are required to configure the operating tool.
Teqwave Transmitter	Teqwave Transmitter Functions that are required to configure the transmitter and function for accessing another transmitter.
Help	Help Information about the system and Operating Instructions.

8.3.5 General control and operating elements

Button	Description
 A0062131-EN	OK button Confirm or exit the function.
 A0062132-EN	Apply button Accept entries or send entries to transmitter.

Button		Description
Cancel A0062143	Cancel button Cancel the operation.	
Close A0062144	Close button Exit the function.	
☒ A0062135-EN	Active check box Enable function or parameter. Active functions and parameters are indicated by a check mark.	
☐ A0062136-EN	Inactive checkbox Disable function or parameter. Inactive functions and parameters are displayed without a tick.	

9 System integration

9.1 Overview of device description files

Current version data for the device

Firmware version	2.4.zz	▪ On the title page of the manual ▪ On the nameplate ▪ On the local display: Settings ▪ Via the "Teqwave Viewer" operating tool: Help → Version
Release date of firmware version	06.2026	
License key		Read via the "Teqwave Viewer" operating tool: Help → Version.

 For an overview of the different firmware versions for the device →  78.

9.2 Modbus TCP information

For detailed information on system integration for the device, see: Special Documentation for the “Modbus TCP system integration”→  99.

10 Commissioning

NOTICE

Damage to the touchscreen

Sharp objects, electrostatic discharge, water and the use of pens not designed for touchscreens, such as standard pencils, can cause a malfunction of the transmitter or damage the touch screen.

- ▶ Do not use sharp objects to operate the touchscreen.
- ▶ To avoid electrostatic discharge, make sure the touchscreen does not come into contact with other devices.
- ▶ Make sure the touch screen does not come into contact with water.
- ▶ Only use your finger or a specially designed stylus pen to operate the touchscreen.

 For the transmitter with a stainless steel housing, the housing cover must be opened to gain access to the touchscreen.

10.1 Post-installation and post-connection check

Before commissioning the device:

- ▶ Make sure that the post-installation and post-connection checks have been performed successfully.
- Checklist for "Post-installation" check→  29
- Checklist for "Post-connection" check→  37

10.2 Switching on the measuring device

After a successful function check, switch on the measuring device.

After a successful startup, the local display switches automatically from the start screen to the measured value display.

 If nothing appears on the local display or an error message is displayed, perform diagnostics and troubleshooting →  72.

10.3 Configuring the operating language

The transmitter operating language is configured via the local display.

 For the transmitter with stainless steel housing, the housing cover must be removed to gain access to the local display.

 The language of the "Teqwave Viewer" operating tool is selected via the menu "Teqwave Viewer" → "Language settings". The options available correspond to those of the transmitter.

Navigation on the transmitter

Settings menu → "Language settings"

 Once the language has been selected, the operating tool transmits the language setting to the transmitter, where it is saved.

Parameter	Procedure	Selection/input	Factory setting
Language setting	Tap to select the language	■ German ■ English ■ French ■ Spanish ■ Italian	English

10.4 Configuring the device

The device can be configured either via the transmitter or via the "Tegwave Viewer" operating tool.

 If using areas of application: For information on the fluid profiles contained in the areas of application and the associated measuring ranges, see the "Technical Information" document, "Measuring ranges" section.

10.4.1 Activating the fluid profile

A fluid profile is always active. The name of the fluid profile currently active is shown on the transmitter in the operating display. If the displayed fluid profile does not match the fluid profile provided for the application, activate the desired fluid profile.

Navigation on the transmitter

Operational display → Fluid profile name

Navigation via the "Tegwave Viewer" operating tool

Menu "Tegwave Transmitter" → "Manage fluid profiles/recipes"

Parameter overview with brief description

Parameter/function	Procedure	Selection/input	Factory setting
Select fluid profile (transmitter) Managing fluid profiles/recipes ("Tegwave Viewer" operating tool)	Transmitter Tap the desired fluid profile to select it. "Tegwave Viewer" operating tool Select the desired fluid profile by selecting it from the list. If the selected fluid profile is inactive, tap the Activate button to activate it.  If the necessary fluid profile is not displayed, it must first be added →  70	Fluid profile 1...n	Fluid profile 1

10.4.2 Configuring the measuring unit

All the measured values of a fluid profile are configured via the **Measuring unit** (transmitter) menu or via the **Display settings** ("Tegwave Viewer" operating tool) menu. The desired fluid profile must be active →  49.

 ■ The measured value is automatically converted if the unit is changed.
■ The unit of the speed of sound and of Delta cF H2O is set permanently to m/s and cannot be changed.

Navigation on the transmitter

- Settings menu → "Application parameter" → "Measuring unit" → "Analysis parameter 1...n"
- Settings menu → "Application parameter" → "Measuring unit" → "Temperature"
- Settings menu → "Application parameter" → "Measuring unit" → "Density"

Navigation via the "Tegwave Viewer" operating tool

- Menu "Tegwave Transmitter" → "Display settings" → "Analysis parameter 1...n"
- Menu "Tegwave Transmitter" → "View settings" → "Temperature"
- Menu "Tegwave Transmitter" → "View settings" → "Density"

 The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Analysis parameter 1...n	Select the unit for analysis parameter.	Depends on the selected fluid profile	Depends on the selected fluid profile
Temperature	Select the unit for temperature.	■ °C ■ °F ■ K	°C
Density	Select the unit for density.	■ g/cm³ ■ kg/m³ ■ g/l	kg/m ³

10.4.3 Configuring the analog output

The **Application parameters** menu contains the parameters for the configuration of the analog output.

Navigation on the transmitter

1. Settings menu → "Application parameters" → "Analog output" → "Analog channel 1...4"
2. Settings menu → "Application parameters" → "Analog output" → "Current/Voltage"
3. Settings menu → "Application parameters" → "Analog output" → "Output settings"
4. Settings menu → "Application parameters" → "Analog output" → "Output settings" → "Suspend time (s)"
5. Settings menu → "Application parameters" → "Analog output" → "Test signal"

Navigation via the "Teqwave Viewer" operating tool

1. Menu "Teqwave Transmitter" → "Application parameters" → "Analog channel 1...4"
2. Menu "Teqwave Transmitter" → "Application parameters" → "Current/Voltage"
3. Menu "Teqwave Transmitter" → "Application parameters" → "Output settings"
4. Menu "Teqwave Transmitter" → "Application parameters" → "Suspend time"
5. Menu "Teqwave Transmitter" → "Application parameters" → "Test signal"



The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Analog channel 1...4	Select the measured variable or special function to be output at the analog output.  ■ If Deactivate analog output is selected, the analog interface is set to 0 V or 2 mA. The indication on the display continues to run normally. ■ If Suspend measurement is selected, the measuring instrument stops and all the measured values and the system status freeze. If necessary, the Suspend time function can be used to specify a delay for switching the function on and off.	■ Analysis parameter 1...n ■ Speed of sound ■ Temperature ■ Dispersion ■ Delta cF H2O ■ Density ■ Deactivate analog output ■ Suspend measurement	Analysis parameter 1
Current/Voltage	Select the type of signal of the analog interface.	■ Current (4 to 20 mA) ■ Voltage (0 to 10 V)	Current (4 to 20 mA)
Output settings	Behavior of the interface if the measuring and calibration range is breached (value over-range/under-range).  ■ If 0 V/2 mA exceeding limits is selected, a failure value is displayed. ■ If Min/Max exceeding limits is selected, the value output is limited to the specified limit value →  52.	■ 0 V/2 mA exceeding limits ■ Min/Max exceeding limits	0 V/2 mA exceeding limits
Suspend time (s)	Enter the suspend time in seconds until the measured values are recorded if the Suspend measurement function is active.  If a suspend time (s) is entered and the Suspend measurement function is selected simultaneously in the Analog channel 1...4 parameter and activation is via the digital input, the Suspend measurement function is delayed by the configured time.	Positive integer 0 to 10000 s	0 s
Test signal	Transmitter Enter the current or voltage value for simulation. Output the test signal with Enable/Disable "Teqwave Viewer" operating tool A new window appears as soon as the Test signal button is pressed. Enter the current or voltage value for simulation. Output the test signal with the Test signal button.  The Test signal function allows users to simulate different process variables and the device alarm behavior without a real-life measuring situation.	■ Current (4 to 20 mA) ■ Voltage (0 to 10 V)	0.0

10.4.4 Displaying calibration ranges

The calibration ranges for the temperature and the concentration and compensation values can be viewed via the **Select fluid profile** menu (transmitter with touch screen). The calibration ranges are also specified on the data sheet of a fluid profile.

Navigation using transmitter with touch screen

- ▶ Settings menu → "Select fluid profile" → "Calibration range" → Select temperature, concentration or compensation value

10.4.5 Configuring the measuring range

The **Measuring range** menu contains parameters for configuring the measuring range.

-  The settings configured in this menu also apply for the functions of the analog output, where they define the minimum (0 V/4 mA) and the maximum (10 V/20 mA).
- A valid measuring range must be set for the selected fluid profile to ensure correct operation. For measured variables that are relevant for calibration of the fluid profile (e.g. temperature or concentration), the calibration range is also specified. The measuring instrument takes this calibration range from the fluid profile file. It cannot be modified.

Navigation on the transmitter

1. Settings menu → "Application parameters" → "Measuring range" → "Select measured variable" → "Measuring range Max"
2. Settings menu → "Application parameters" → "Measuring range" → "Select measured variable" → "Measuring range Min"
3. Settings menu → "Application parameters" → "Measuring range" → Select measured variable → "Decimal places"

Navigation via the "Teqwave Viewer" operating tool

1. Menu "Teqwave Transmitter" → "Measuring range" → "Select measured variable" → "Measuring range Max"
2. Menu "Teqwave Transmitter" → "Measuring range" → "Select measured variable" → "Measuring range Min"
3. Menu "Teqwave Transmitter" → "View settings" → "Select measured variable" → "Decimal places"

-  The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Measuring range Max	Enter the upper limit for the selected measured variable or 20 mA current/10 V voltage, paying attention to measuring range limits → 88 and fluid profile data sheet.	Positive decimal or floating point number with sign	■ Analysis parameter 1...n: Depends on the selected fluid profile ■ Temperature: 120.0 ■ Speed of sound: 2000.00 ■ Density: 1500.00 ■ Delta cF H2O: +450.0 :
Measuring range Min	Enter the lower limit for the selected measured variable or 4 mA current/0 V V voltage, paying attention to measuring range limits → 88 and fluid profile data sheet.	Positive decimal or floating point number with sign	■ Analysis parameter 1...n: Depends on the selected fluid profile ■ Temperature: 0.0 ■ Speed of sound: 600.00 ■ Density: 700.00 ■ Delta cF H2O: -450.0 :
Decimal places	Select the number of decimal places for the value of the measuring range.	■ 0 ■ 1 ■ 1 ±0.5 ■ 2 ■ 2 ±0.5 ■ 3 ■ 3 ±0.5 ■ 4	■ Analysis parameter 1...n: 2 ■ Temperature: 1 ■ Speed of sound: 2 ■ Density: 1 ±0.5 ■ Delta cF H2O: 1

10.4.6 Configuring the switch output

The **Relay output** menu contains all the parameters for configuring the relay output.

Navigation on the transmitter

1. Settings menu → "Application parameters" → "Relay output" → "Settings" → "Select measured value" → "Output mode"
2. Settings menu → "Application parameters" → "Relay output" → "Settings" → "Select measured value" → "Switch point Max"/"Switch point Min" or "Switch point"
3. Settings menu → "Application parameters" → "Relay output" → "Settings" → "Hysteresis"
4. Settings menu → "Application parameters" → "Relay output" → "Settings" → "NC contact/NO contact"
5. Settings menu → "Application parameters" → "Relay output" → "Output"

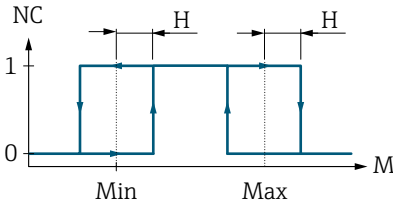
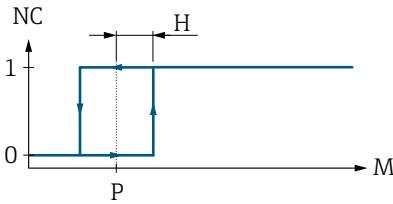
Navigation via the "Teqwave Viewer" operating tool

1. Menu "Teqwave Transmitter" → "Relay output" → "Select measured variable" → "Output mode"
2. Menu "Teqwave Transmitter" → "Relay output" → "Select measured variable" → "Switch point Max"/"Switch point Min" or "Switch point"
3. Menu "Teqwave Transmitter" → "Relay output" → "Select measured variable" → "Hysteresis"
4. Menu "Teqwave Transmitter" → "Relay output" → "Select measured variable" → "NC contact/NO contact"
5. Menu "Teqwave Transmitter" → "Relay output" → "Output"



The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Output mode	Select the mode for the switch point definition. i If Range mode is selected, enter the upper and lower limit to define the switch points.  22 Example: Relay output configured in the range mode as an NC contact NC Normally closed 0 Closed relay 1 Open relay M Measured value Min Switch point Min Max Switch point Max H Hysteresis i If Trigger mode is selected, enter the value to define the switch point  23 Example: Relay output configured in the trigger mode as an NC contact NC Normally closed 0 Closed relay 1 Open relay M Measured value P Switch point H Hysteresis	- Range mode - Trigger mode	Range mode
Switch point	Prerequisite: Trigger mode is selected in the Output mode parameter. Set the value at which the relay changes its switch status, paying attention to measuring range limits → 88 and fluid profile data sheet.	Positive decimal or floating point number with sign	- Analysis parameter 1...n: Depends on the selected fluid profile - Temperature: 60.00 - Speed of sound: 1500.00 - Density: 1000.00 - Delta cF H2O: 0
Switch point Max	Prerequisite: Range mode is selected in the Output mode parameter. Set the upper limit at which the relay changes its switch status, paying attention to measuring range limits → 88 and fluid profile data sheet.	Positive decimal or floating point number with sign	- Analysis parameter 1...n: Depends on the selected fluid profile - Temperature: 120.00 - Speed of sound: 2000.00 - Density: 1500.00 - Delta cF H2O: +450.0

Parameter	Procedure	Selection/input	Factory setting
Switch point Min	<i>Prerequisite:</i> Range mode is selected in the Output mode parameter. Set the lower limit at which the relay changes its switch status, paying attention to the measuring range limits → 88 and fluid profile data sheet.	Positive decimal or floating point number with sign	- Analysis parameter 1...n: Depends on the selected fluid profile - Temperature: 0.00 - Speed of sound: 500.00 - Density: 500.00 - Delta cF H2O: -450.0
Hysteresis	Enter the tolerance value for the switch points.  Entering a hysteresis prevents the relay from switching back and forth around the upper and lower limits. The unit for the hysteresis is identical to the unit of the measured variable.	Positive decimal	0.00
NC contact/NO contact	Select the switching behavior of the relay.	- NC contact - NO contact	NC contact
Output	Select the measured variable to which the relay output should react.	- Analysis parameter 1...n - Temperature - Speed of sound - Density - Delta cF H2O - Dispersion - Deactivate relay output (can only be selected via the transmitter)	Temperature

10.4.7 Specifying the storage interval

The **Read memory** function can be used to retrieve measured data stored in the device memory. It is also possible to save the measured data and physical units to a .csv file. This file can then be imported into a database.

 For more information on retrieving measured data → 69.

A storage interval of 10 to 7 200 s can be defined for data storage. The storage interval refers to the frequency at which the data are saved to the device memory.

There are 2 GB of space available on the internal memory. With a storage interval of 60 s, there is enough space in the memory for approx. 7.5 years.

NOTICE

The available storage space is largely occupied.

The device displays a warning message when the remaining storage capacity reaches 500 MB. Data logging is stopped automatically if there is a remaining storage capacity of 100 MB. The current remaining memory location can be viewed via the "Free memory space" parameter in the "Application parameters" menu.

► Enable storage by removing existing data to enable data logging.

Navigation on the transmitter

Settings menu → "Application parameters" → "Storage interval (s)"

Navigation via the "Teqwave Viewer" operating tool

Menu "Teqwave Transmitter" → "Storage interval"

 The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Storage interval (s)	Select the time interval in which the measured values are written to the internal memory.  The function only applies if the application package with interface for data download is installed.	Positive integer 10 to 7200 s	60 s

10.4.8 Configuring the measured value display

The measured value display is configured via various menus in the transmitter and via the "Tegwave Viewer" operating tool.

Navigation on the transmitter

1. Settings menu → "View settings"
2. Settings menu → "View settings" → "View"
3. Settings menu → "Application parameters" → "Averaging" → Select measured variable
4. Settings menu → "Application parameters" → "Averaging" → Select the "Temperature" measured variable → "Kalman filter"

Navigation via the "Tegwave Viewer" operating tool

1. Menu "Tegwave Transmitter" → "View settings"
2. Menu "Tegwave Transmitter" → "Averaging" → Select measured variable
3. Menu "Tegwave Transmitter" → "Averaging" → Select the "Temperature" measured variable → "Kalman filter"

 The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Display settings	Transmitter Tap the measured variable to show or hide it on the transmitter's operational display. "Tegwave Viewer" operating tool Under Display , use the options Yes or No to choose which transmitter measured variables are displayed or not.	■ Analysis parameter 1...n ■ Temperature ■ Speed of sound ■ Delta cF H2O ■ Density ■ Dispersion	All the measured variables are displayed, with the exception of Delta cF H2O.
View (transmitter)	Select the number of measured variables or activate the graphic view of the operational display.	■ 2 measured variables ■ 4 measured variables ■ 5 measured variables ■ Graph	2 measured variables

Parameter	Procedure	Selection/input	Factory setting
Averaging	Select averaging over a defined period for the selected measured variable. Example of averaging for the "Density" measured variable ■ User entry: 5 ■ Output: Averaging across 5 s.  The analysis parameters are still calculated using the non-averaged measured values.	Positive integer 1 to 1000 s	For all measured variables 3 s.
Kalman filter	Apply the Kalman filter for displaying the temperature by activating the function.  When the Kalman filter is enabled, the measuring instrument uses surface wave information, in addition to the measured value of the integrated temperature chip, for temperature measurement. This allows the sensor to follow variations in temperature more quickly. However, the sensor then needs more time to reach the stationary full scale value.	Enable/disable the function	The function is disabled.

10.4.9 Configuring the touchscreen

The touchscreen is configured via the local display. The **User settings** menu contains all the parameters for configuring the display.

 For the transmitter with a stainless steel housing, the housing cover must be removed to gain access to the touchscreen.

Navigation using transmitter with touch screen

1. Settings menu → "User settings" → "Brightness"
2. Settings menu → "User settings" → "Time settings" → "User time"
3. Settings menu → "User settings" → "Time settings" → "User date"
4. Settings menu → "User settings" → "Screensaver" → "Switched off"
5. Settings menu → "User settings" → "Screensaver" → "Reduce brightness" → "Brightness"
6. Settings menu → "User settings" → "Screensaver" → "Reduce brightness" and "Display turn off" → "Time settings" → "Start after"
7. Settings menu → "User settings" → "Screensaver" → "Reduce brightness" and "Display turn off" → "Time settings" → "Time unit"
8. Settings menu → "User settings" → "Screensaver" → "Reduce brightness" and "Display turn off" → "Lock display"
9. Settings menu → "User settings" → "Screensaver" → "Reduce brightness" and "Display turn off" → "Unlock password"
10. Settings menu → "User settings" → "Password protection" → "Fluid profile"
11. Settings menu → "User settings" → "Password protection" → "Settings"

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Brightness	Enter screen brightness.  If the screensaver is enabled, the value entered here must be greater than the minimum value for the screensaver.	20 to 100 %	100%
User time	Enter the current, local time.  The user time is used in the graph format and to save the measured values.	Entry format HH:MM:SS	The current time is set
User date	Enter the current date.	Entry format DD.MM.YY	The current date is set.
Switched off	Tap the option to activate/deactivate the screensaver.  The display is unlocked by entering the unlock password. This function protects the entire measuring instrument from unauthorized access or modification. To only protect settings, select Settings → User settings → Unlock password → Settings.	Enable/disable the function	The function is disabled.
Brightness	Enter the brightness for the background lighting after the screensaver has been activated.  The value must be less than the value specified for normal screen brightness.	20 to 100 %	100%
Start after	Set the time that passes until the display reduces the brightness or the display lock is activated.	Depends on the time unit selected ■ 30 to 7 200 s or ■ 1 to 120 min or ■ 1 to 2 h	60 s
Time unit	Set the time unit.  The value is automatically converted if the unit is changed.	■ Seconds ■ Minute(s) ■ Hour(s)	Seconds
Lock display	Enable or disable the display lock.	Enable/disable the function	The function is disabled.
Unlock password	Enter the unlock password to unlock the display.	4-digit character string or numerical sequence	LSC2

Parameter	Procedure	Selection/input	Factory setting
Fluid profile	To prevent an unauthorized fluid profile change, enter the password and enable the function. When you tap the Password button, the text editor opens where you can enter the password. Tap the Activate / Deactivate button to activate or deactivate the password.  To protect the entire system from being used and modified, activate the display lock under Settings → User settings → Screensaver → Display turn off → Lock display.	4-digit character string or numerical sequence - Enable/disable the function	LSC2
Settings	To protect access to the settings (apart from the Select fluid profile function), enter the password and enable the function. When you tap the Password button, the text editor opens where you can enter the password. Tap the Activate / Deactivate button to activate or deactivate the password.  To protect the entire system from being used and modified, activate the display lock under Settings → User settings → Screensaver → Display turn off → Lock display.	4-digit character string or numerical sequence - Enable/disable the function	LSC2

10.4.10 Configuring the failsafe mode

The menus **Diagnostics** (transmitter and **View filter** ("Tegwave Viewer" operating tool) contain functions to define how the device behaves when limit values are breached (under/over range). In addition, they also contain settings for the evaluation of the measurement results that are shown on the transmitter display.

Navigation on the transmitter

1. Settings menu → "Application parameters" → "Diagnostics" → "View options"
2. Settings menu → "Application parameters" → "Diagnostics" → "Change in" → Select measured variable
3. Settings menu → "Application parameters" → "Diagnostics" → "Process disturbance" → "Switch point"

Navigation via the "Tegwave Viewer" operating tool

1. Menu "Tegwave Transmitter" → View filter" → "Filter options" and "Filter arrangements"
2. Menu "Tegwave Transmitter" → "View filter" → "Change in" → Select measured variable
3. Menu "Tegwave Transmitter" → "View filter" → "Process disturbance" → "Switch point"

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Display options (transmitter) Filter options/filter arrangements ("Tegwave Viewer" operating tool)	Select filter options and arrangements to enable or disable them.	Filter options: ■ Measuring range limits ■ Calibration range limits ■ Stationarity Filter arrangements: ■ Hide measured value ■ Background coloring ■ Hold measured value	The "Measuring range limits" and "Calibration range limits" options are enabled. The "Stationarity" option is disabled.
Change in analysis parameter 1...n [unit]	Specify the limit value for the maximum permissible speed at which the analysis parameter can change. Enable or disable the function using the button.  If the unit is changed, the unit is changed according to the "change in" setting, but the value entered is not converted.	>0.01 [unit]	100 [unit] The function is disabled.
Change in temperature °C/min ("F/min; °K/min)	Specify the limit value for the maximum permissible speed at which the temperature can change. Enable or disable the function using the button.  If the measuring instrument is changed, the unit is changed according to the "change in" setting, and the value entered is converted.	0.01 to 100 °C/min (K/min) or 0.018 to 180 °F/min	1.5 °C/min The function is enabled.
Change in speed of sound (m/s)/s	Enter the limit value for the maximum permissible speed at which the speed of sound can change. Enable or disable the function using the button.	0.01 to 100 (m/s)/s	100 (m/s)/s The function is enabled.
Change in density [unit]	Enter the limit value for the maximum permissible speed at which the density can change. Enable or disable the function using the button.  If the measuring instrument is changed, the unit is changed according to the "change in" setting, and the value entered is converted.	0.01 to 100 (kg/m ³)/s or (g/l)/s 0.00001 to 0.10 (g/cm ³)/s	100 (kg/m ³)/s The function is enabled.
Change in dispersion 0.01 to 100 m/s	Enter the limit value for the maximum permissible speed at which the dispersion can change. Enable or disable the function using the button.	0.01 to 100 1/s	100 1/s The function is disabled.

Parameter	Procedure	Selection/input	Factory setting
Rate of increase delta cFH ₂ O (m/s)/s	Enter the limit value for the maximum permissible rate of change of the speed of sound deviation compared to the speed of sound of water. Enable or disable the function using the button.	0.01 to 100 (m/s)/s	100 (m/s)/s The function is disabled.
Switch point	Set the trigger value for process disturbances (dispersion). Transmitter Enable or disable the function using the Enable / Disable button. "Teqwave Viewer" operating tool Enable or disable the function using the Process disturbance activated button.  ▪ If the speed of sound and temperature are used for concentration measurement, do not exceed the value of 1. If the density is used, use a switch point of 0.25. ▪ If the measured dispersion is greater than the configured switch point, the measuring instrument no longer displays an analysis parameter.	0.01 ... 1	0.3 The function is disabled.

10.5 Advanced settings

Offset adjustments and compensations can be performed to increase the measurement accuracy. In addition, recipe management can be used to save combinations of settings as an initial setting or recipe for every fluid profile.

10.5.1 Recipe management

The recipe management contained in the "Teqwave Viewer" operating tool makes it possible to permanently assign default settings to an analysis parameter and from compensation values to a fluid profile. Default settings include the unit, measuring range and offset as well as the channel selection of the analog interface via which the analysis parameter is output.

The default settings are saved as a recipe in RCP format in the working directory of the "Teqwave Viewer" operating tool. After saving, a recipe can be added to the transmitter such that the default setting is available there.

Any number of recipes can be created for each fluid profile. However, only a maximum of 25 fluid profiles or 50 fluid profiles and recipes can be used in combination.

 To ensure recipes can be created for a fluid profile, it must be saved in the working directory of the "Teqwave Viewer" operating tool.

Creating a recipe

1. Select the menu "Teqwave Viewer" → "Manage recipes".
↳ The "Manage recipes" window appears.
2. Click the Plus icon to create a new recipe.
↳ The "Create recipe" window appears.
3. Enter a unique name for the recipe in the "Recipe name" field. The name may contain a maximum of 64 characters, and can consist of any string of letters and numbers.

4. In the "Fluid profile" drop-down menu, select the fluid profile for which a recipe is to be created.
5. Record default settings.
Under "Analysis parameter", set the analysis parameter →  62;
set the compensation values →  62.
6. Use the "Save" button to save the recipe.
 - ↳ The RCP file is saved in the working directory of the "Tegwave Viewer" operating tool.
When saving a new recipe, the recipe name is used as a default file name.
When a processed recipe is saved, the existing RCP file is overwritten in the working directory. The file name remains unchanged.

Configuring analysis parameters

For the analysis parameters calculated in a fluid profile, the unit, measuring range and offset can be preset and saved permanently via recipe management.

1. In the "Create recipe" window under "Analysis parameter" in the drop-down menu select the required analysis parameter and configure initial settings; see the Parameter overview with brief description .
2. If necessary, use the Plus icon to add additional analysis parameters and configure initial settings for these.

Parameter overview with brief description

Parameter/function	Procedure	Selection/input	Factory setting
Unit	Select the unit for analysis parameters via the drop-down menu.	Depends on the selected fluid profile.	Depends on the selected fluid profile.
Offset	Enter the offset value of the analysis parameter.	Floating point number with sign	0.00
Advanced diagnostics settings	Clicking the button opens another configuration window in which the measuring range limits as well as the channel for the analog output can be configured. By pressing "OK", the settings in the transmitter are accepted and overwritten.  The changes affect the output of the analog interface.	-	-
Measuring range limits (in the "Advanced diagnostics settings" window)	Set the upper and lower measuring range limit using the slider or entry field.	The minimum and maximum values are specified by the calibration range limits saved in the fluid profile.	Calibration range limits
Analog output to channel (in the "Advanced diagnostics settings" window)	Specify the channel on which the analysis parameter is output. If no channel is selected, the measured variable is not output and existing settings on the transmitter are not overwritten.	■ 1 ■ 2 ■ 3 ■ 4	No channel selected.

Setting the compensation values

To increase measurement accuracy, predefined compensation values can be used for the compensation of the speed of sound depending on the application. The compensation values can be read into a recipe from external measuring instruments via Modbus TCP or entered as constant measured values.

Typical compensation values are:

- CO₂ concentration
- Acid content



The compensation values are only available if they were provided in the data record of the fluid profile upon delivery.

- Set the compensation values in the "Compensation values" section of the recipe management, see the Parameter overview with brief description.

Parameter overview with brief description

Parameter/function	Procedure	Selection/input	Factory setting
Compensation value K1...K4	Enter the compensation value as a constant value: In the drop-down menu, select the "Fixed value" option and enter the value for the compensation value. Observe the calibration range limits → 52. Read the compensation value into the measuring instrument via Modbus TCP: Select the "Modbus [register address]" option in the selection field.	Input depends on the measured variable selected: Positive decimal or Floating point number with sign Selection: ■ "Disabled": Compensation value is not taken into consideration. ■ "Fixed value": the compensation value entered is used. ■ "Modbus [register address]": the compensation value received via Modbus TCP is taken into consideration.	User entry: 0.00 Selection: Disabled

Saving a comment

A comment can be added to a recipe. The comment is only visible in the "Tegwave Viewer" operating tool, not on the transmitter local display and is limited to 512 characters.

Adding a recipe to the transmitter

The recipes created by the customer can be added to or removed from the transmitter via the "Manage fluid profile/recipes" function.

- Manage fluid profile. → 70.

10.5.2 Setting the compensation values

The compensation values available for a fluid profile can be set manually using the **Select fluid profile** (transmitter) menu. To use compensation values permanently in a recipe and for further information on the compensation values, see the recipe management → 61.

Navigation on the transmitter

Settings menu → "Select fluid profile" → Select fluid profile or recipe → "Compensation values" → Select compensation value



- The **Compensation value** function can only be accessed if the fluid profile has been activated beforehand.
- The compensation values are only available if they were provided in the data record of the fluid profile upon delivery.
- The compensation value is rejected when the fluid profile is changed. The value can only be retained via a recipe.

Parameter overview with brief description

Parameter/function	Procedure	Selection/input	Factory setting
Compensation value 1...4	Enter the compensation value as a constant value: In the "Compensation" selection field, select the "Fixed value" option and enter the value for the compensation value. Observe the calibration range limits → 52. Read the compensation value into the measuring instrument via Modbus TCP: Select the "Modbus" option in the "Compensation" selection field. Modbus register information .  Access to the compensation values is only possible for the active fluid profile. However, the settings are retained if the fluid profile is changed.	User entry: Positive decimal Selection: ■ "Disabled": Compensation value is not taken into consideration. ■ "Fixed value": The compensation value entered is taken into consideration. ■ "Modbus": The compensation value received via Modbus TCP is taken into consideration.	User entry: 0.00 Selection: Disabled

10.5.3 Set the offset for the analysis parameter

The **Fluid profile settings** (transmitter) and **analysis parameter offset** ("Teqwave Viewer" operating tool) menus are used to configure the manual offsets for the calculated analysis parameters. This allows users to adapt the measuring technology to different process conditions (e.g. foreign substances/admixtures).

Navigation on the transmitter

Operational display → Fluid profile name → "Fluid profile settings" → "Analysis parameter 1...n offset"

Navigation via the "Teqwave Viewer" operating tool

Menu "Teqwave Transmitter" → "Analysis parameter offset" → "Offset"

 The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.

Parameter overview with brief description

Parameter/function	Procedure	Selection/entry/display	Factory setting
Analysis parameter 1...n (transmitter)	Displays the selected designation of the analysis parameter.	Depends on the analysis parameter selected	Depends on the analysis parameter selected
Actual value (transmitter)	Displays the current measured value. The measured value is not updated during offset configuration.	Floating point number with sign	Depends on the current measured value
Offset (transmitter) Analysis parameter 1...n/[unit] ("Teqwave Viewer" operating tool)	Displays the offset for the selected analysis parameter. The offset is calculated from the input of the target value.	Floating point number with sign	0.00
Target value (transmitter)	Enter the target value. Once the target value has been entered, the offset for the selected analysis parameter is calculated automatically.  Access to the target value setting is only possible for the active fluid profile or the active recipe. However, the settings are retained if the fluid profile is changed.	Floating point number with sign	Current measured value

11 Operation

11.1 Changing the operating language

Operating language settings →  48.

11.2 Configuring the local display

Local display settings →  57.

11.3 Measured value display via local display

11.3.1 Reading off measured values

All the current measured values can be read via the transmitter's **operational display**. The display can be selected in a list or graph format. The list format can be used to display 2, 4 or 5 measured variables simultaneously on one screen. The graph format shows a selected measured variable over time. The graph format can be customized. The list and graph format can be changed with the **View** parameter, see →  56.

11.3.2 Adjusting the graph display format

Navigation on the transmitter

1. Graph format → Settings (symbol, bottom left) → "Measured variable"
2. Graph format → Settings (symbol, bottom left) → "Timeline"
3. Graph format → Settings (symbol, bottom left) → "Y-axis" → "Maximum value [unit]"
4. Graph format → Settings (symbol, bottom left) → "Y-axis" → "Minimum value [unit]"
5. Graph format → Settings (symbol, bottom left) → "Y-axis" → "Auto scale"

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Measured variable	Select the measured variable to be displayed in the graph format.  Only measured variables that are active in the display settings can be selected.	■ Analysis parameter 1..n ■ Speed of sound ■ Temperature ■ Density ■ Dispersion ■ Delta cF H2O ■ External measured values 1...n	Temperature
Timeline	Select the period shown on the X-axis.	■ 1 minute ■ 10 minutes ■ 1 hour ■ 4 hours ■ 12 hours ■ 1 day ■ 1 week ■ 1 month ■ 3 months	1 minute
Maximum value [unit]	Enter the maximum value to be displayed on the Y-axis.	Floating point number with sign	■ Analysis parameter: Depends on the selected fluid profile. ■ Temperature: 120 °C ■ Speed of sound: 2000 m/s ■ Density: 1500 kg/m³ ■ Dispersion: 1 ■ Delta cF H2O: +450.0 m/s

Parameter	Procedure	Selection/input	Factory setting
Minimum value [unit]	Enter the minimum value to be displayed on the Y-axis.	Floating point number with sign	■ Analysis parameter: Depends on the selected fluid profile. ■ Temperature: 0 °C ■ Speed of sound: 500 m/s ■ Density: 500 kg/m³ ■ Dispersion: 0 ■ Delta cF H2O: -450.0 m/s
Auto scale	Select to enable or disable auto scaling of the graph.	Enable/disable the function	The function is enabled.

11.3.3 Graph tools

Button	Description
	Settings Navigate to the graph settings.
	Cursor position Select the cursor position in the graph for the desired measured value display.
	Delete Clears the graph. The graph representation then resumes.

11.4 Measured value display via the "Teqwave Viewer" operating tool

11.4.1 Reading off measured values

On the home page, the "Teqwave Viewer" operating tool displays measured data in both the list and graph formats. Once the transmitter is connected, **Live Viewer** mode is activated automatically.

 Via the menu "Teqwave Viewer" → "Live Viewer", you can switch to the Live View after an offline analysis.

11.4.2 Adjusting the graph display format

Navigation via the "Teqwave Viewer" operating tool

1. Menu "Teqwave Viewer" → "Graph settings" → "Y-axis 1"
2. Menu "Teqwave Viewer" → "Graph settings" → "Y-axis 2"
3. Menu "Teqwave Viewer" → "Graph settings" → "Time axis"
4. Menu "Teqwave Viewer" → "Graph settings" → "Time interval in s"

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Timeline	Select the period shown on the X-axis.	■ 1 minute ■ 3 minutes ■ 5 minutes ■ 10 minutes ■ 30 minutes ■ 1 hour ■ 6 hours ■ 12 hours ■ 1 day ■ 7 days ■ 30 days ■ 90 days	5 minutes
Y-axis 1	Select measured variables to be displayed on the left-side axis.	Depends on the measured variables enabled and the selected fluid profiles: ■ Analysis parameter 1...n ■ Temperature ■ Speed of sound ■ Density ■ Dispersion ■ Delta cF H2O	Analysis parameter 1
Y-axis 2	Select measured variables to be displayed on the right-side axis.	■ Analysis parameter 1...n ■ Temperature ■ Speed of sound ■ Density ■ Dispersion ■ Delta cF H2O	Temperature
Time interval in s	Specify the display rate (in seconds) for retrieving the values from the transmitter.	Positive decimal	1 s

11.4.3 Graph tools

In the "Tegwave Viewer" operating tool, the view can be adjusted by zooming and moving the Y axis position using the graph tool above the graph.



The graph tools only work when "auto scale" is switched off → 68.

Button	Description
 A0035501	Cursor position Only for the "Read memory" function: select the cursor position in the graph for the desired measured value display.
 A0035502	Select the zoom function Open and use options to zoom in (enlarge view) and zoom out (reduce view) of the chart. ▪ Rectangle zoom: Press and hold the left mouse button and drag the rectangle over the area you wish to zoom into. ▪ X-axis zoom: Press and hold the left mouse button and drag over the desired area of the X-axis. ▪ Y-axis zoom: Press and hold the left mouse button and drag over the desired area of the Y-axis. ▪ Adjust automatically: Click the icon to automatically adjust the graph. ▪ Magnify: Click the desired point to zoom into the graph. ▪ Reduce: Click the desired point to zoom out of the graph.
 A0035508	Y-axis position function Move the position of the Y-axis up or down.

11.4.4 Switching auto scale on and off

- Switch the "Auto scale" function on and off by right-clicking on the Y-axis.

11.4.5 Clearing the graph

- Select the menu "Tegwave Viewer" → "Clear graph".
 - ↳ The graph display starts again with the "Auto scale" function switched on.

11.5 Accessing measured data via the "Tegwave Viewer" operating tool

The "Tegwave Viewer" operating tool records measured data and offers functions to retrieve measured data.

11.5.1 Saving the current measuring point to a .csv file

1. Select the menu "Tegwave Viewer" → "Single measurement".
 - ↳ The "Enter path of file(s)" window appears.
2. Select the file where the measuring point is to be saved. To save the measuring point, either create a new .csv file on the computer or select an existing .csv file on the computer.
 - ↳ The new measuring points are appended to the end of the file. Existing values are retained.

11.5.2 Recording measuring points

1. Select the menu "Tegwave Viewer" → "Start recording".
 - ↳ The "Enter path of file(s)" window appears.

2. Select the file where the measuring points are to be saved. You have the following options: Create a new .csv file on the computer - the measuring points will be saved to this file. Select an existing .csv file on the computer - the measuring points will be saved to this file.
 - ↳ A green indicator appears above the measured values on the start screen. The new measuring points are appended to the end of the file. Existing values are retained.

11.5.3 Stop recording

- ▶ Select the menu "Tegwave Viewer" → "Stop recording".
 - ↳ The system stops recording the measuring points. The green indicator on the start screen disappears.

11.6 Opening measured data in the Graph View

The "Tegwave Viewer" operating tool allows users to retrieve measured data saved earlier with the **Load data** function. These can be measured data that was retrieved from the transmitter or recorded by the operating tool.

11.6.1 Loading the measured data

1. Select the menu "Tegwave Viewer" → "Open data".
 - ↳ The "Enter path of file(s)" window appears.
2. Select the desired file and click "OK" to confirm.
 - ↳ The Viewer interrupts the Live View and displays the selected data.

 The display format of the data displayed offline can be adjusted in the same way as in the Live Viewer. In this mode it is not possible to record additional data simultaneously with the Viewer.

11.7 Reading the device memory and saving measured data

 If the volume of data is large, data readout takes some time. For this reason, it is advisable to regularly call up the data on the data memory and save the data externally.

The "Tegwave Viewer" operating tool can be used to read out and delete measured data recorded during the operation of the transmitter using the **Read memory** function. The operating tool saves the data via the **Save read data** function.

11.7.1 Reading measured data from the transmitter

1. Select the menu "Tegwave Transmitter" → "Read memory".
 - ↳ The "Saved data" window opens.
2. In the dropdown menu, select Fluid profile for reading out the data.
 - ↳ One file is saved on the transmitter per fluid profile.
3. Click the "Read" button.
 - ↳ As soon as the download process is finished, the progress bar closes automatically and the operating tool displays the measured data in the graph format.
Following an offline analysis of the data, the "Tegwave Viewer" → "Live Viewer" menu allows users to switch to the Live View.

11.7.2 Saving the read measured data to a .csv file

 To be able to save the measured data permanently, the data must first be read out from the transmitter.

1. Select the menu "Teqwave Transmitter" → "Save read data".
 - ↳ The "Enter path of file(s)" window appears.
2. Select the path and file name for saving the measured data.
3. Click the "OK" button to confirm.
 - ↳ The "Teqwave Viewer" operating tool saves measured data in a .csv file.

11.7.3 Deleting saved measured data from the transmitter

NOTICE

Lost data

Once data are deleted, they cannot be restored.

► Read out and save data before deleting them.

1. Select the menu "Teqwave Transmitter" → "Read memory".
 - ↳ The "Saved data" window opens.
2. In the dropdown menu, select the Fluid profile with the data to be deleted.
3. Click the "Delete" button.
 - ↳ The message "Do you really want to delete the data?" appears on the screen.
4. Select "Yes" to confirm.
 - ↳ The "Teqwave Viewer" operating tool deletes the measured data of the selected fluid profile from the transmitter's memory.

11.8 Managing fluid profiles

The "Teqwave Viewer" operating tool can manage fluid recipes in the connected transmitter via the **Manage fluid profiles/recipes**. It is possible to get an overview of all the fluid profiles on the transmitter, load new fluid profiles onto the transmitter and activate them, and remove any fluid profiles that are no longer needed from the transmitter.

 The fluid profiles, known as recipes, preset by the customer in recipe management, can also be added to or removed from the transmitter with the **Manage fluid profiles/recipes** function. For more information on recipe management, see →  61.

11.8.1 Adding a fluid profile to the transmitter

 Fluid profiles are individually adapted to a specific measuring instrument and are intended only for use with that particular measuring instrument. The system uses a serial number saved in the fluid profile file to automatically check whether there is authorization to enable the fluid profile on the connected transmitter.

1. Call up the menu "Teqwave Transmitter" → "Manage fluid profiles/recipes".
 - ↳ A new window appears.
2. Click the Plus icon ("+").
 - ↳ The "Enter path of file(s)" window appears.
3. Select the fluid profile file. Fluid profile files are in the lmf format. Fluid profiles preset by the customer, known as recipes, are in the rcp format.
4. Click "OK" to add a new fluid profile or recipe to the transmitter.

11.8.2 Deleting the fluid profile from the transmitter

 After deleting an active fluid profile, a new fluid profile must then be activated. Otherwise, the calculations of the analysis parameters are stopped.

1. Call up the menu "Teqwave Transmitter" → "Manage fluid profiles/recipes".
↳ A new window appears.
2. Select the fluid profile to be deleted in the "Fluid profiles" list.
3. Click the Trash can icon.
↳ The message "Do you really want to delete the data?" appears on the screen.
4. Select "Yes" to confirm.
↳ The Viewer removes the fluid profile from the transmitter.

11.9 Establish a connection to another transmitter

The connection must be established again when connecting to another transmitter
→  42.

11.10 Update firmware

The firmware must be updated via the Viewer. The firmware is available in the Download Area of the Endress+Hauser website: www.endress.com → Downloads.

Specify the following details:

- Search area: "Software"
- Software type: "Device driver" and "Firmware Flash File"

Navigation

Menu "Teqwave Transmitter" → "Update Transmitter"

Update firmware

NOTICE

Damage to the measuring instrument

Disconnecting the transmitter from the power supply or the computer during the update process can damage the transmitter.

- ▶ Do not disconnect the transmitter power supply and the connection to the computer.
- ▶ Establish a direct network connection between the transmitter and the computer running the Viewer.

1. Open the menu "Teqwave Transmitter" → "Update Transmitter".
↳ The "Enter path of file(s)" window appears.
2. Select the .lcu file.
3. Click "OK" to run the update.
↳ The transmitter runs the update.
When the update is complete, the touchscreen displays the operational display.

12 Diagnostics and troubleshooting

12.1 General troubleshooting

12.1.1 For local display

Fault	Possible causes	Remedial action
Local display dark and no output signals.	Supply voltage does not match the voltage specified on the nameplate.	Apply the correct supply voltage.
Local display is dark, but signal output is within the valid range.	Display is set too bright or too dark.	Set the display brighter or darker via the "Teqwave Viewer" operating tool using the "Brightness" parameter.
	Display module is faulty.	Contact Endress+Hauser Service.

12.1.2 For output signals

Fault	Possible causes	Remedial action
Signal output outside the valid range.	Incorrect configuration.	1. Check the configuration and correct if necessary. 2. Stay within the specifications of the outputs indicated in the "Technical data". 3. Observe the failsafe mode of the outputs as indicated under "Failure signal" in the "Technical data" section.
Measuring instrument shows correct value on the local display but the signal output is incorrect, though in the valid range.	Configuration error.	Check the configuration and correct if necessary.
Measured value not stable	Operation outside the range of application.	1. Ensure homogeneous mixing of the liquid and its continuous flow to the sensor. 2. Remove air bubbles and/or particles. 3. Ensure the temperature value is stable.
	Unstable process conditions.	Check the configuration of the "Averaging" parameter. Increase averaging if necessary.
The measuring instrument measures incorrectly or the value of the analysis parameter is zero.	Incorrect use of fluid profile app.	Check the selected fluid profile and change the fluid profile if necessary.
	Communication error.	Restart the transmitter. In doing so, disconnect the device from the supply voltage for at least 30 seconds.
	Operation outside the range of application.	1. Ensure homogeneous mixing of the liquid and its continuous flow to the sensor. 2. Remove air bubbles and/or particles. 3. Ensure the temperature value is stable.
	Sensor is dirty.	Ensure that the sensor is free from dirt and deposit buildup.
	Sensor is faulty.	1. Check the sensor with the "Check sensor" function. 2. Contact Endress+ Hauser-Service if the limit value is exceeded.

12.1.3 For access via the "Tegwave Viewer" operating tool

Problem	Possible causes	Remedial action
Not possible to connect to the "Tegwave Viewer" operating tool.	Cable is not connected.	Connect the network cable to the transmitter.
	Cable too long.	Check the cable length (max. 30 m) and correct if necessary.
	Internet protocol configured incorrectly.	Check the configuration of the Internet protocol and correct if necessary.
The permanent connection to the "Tegwave Viewer" operating tool disconnected after a few days.	Internet protocol has been changed. Check the configuration of the Internet protocol.	Check the configuration of the Internet protocol and correct if necessary.
	Measuring instrument is connected to several operating tools.	Only establish a single link to maintain a permanent connection.
Error message when running the "Read memory" function.	Network connection has been interrupted.	Ensure that the network connection is uninterrupted.
Measured values from 1904 appear in the graph after reading the memory.	Communication error or device memory faulty.	1. Restart the transmitter. In doing so, disconnect the device from the supply voltage for at least 30 seconds. 2. Read the memory again. 3. If the error persists, contact Endress+Hauser Service.
All measured values appear with the value zero after reading the memory.	Communication error or device memory faulty.	1. Restart the transmitter. In doing so, disconnect the device from the supply voltage for at least 30 seconds. 2. Read the memory again. 3. If the error persists, contact Endress+Hauser Service.

12.2 Diagnostic information on local display and in operating tool

The transmitter with a touch screen and the "Tegwave Viewer" operating tool indicate errors and malfunctions by green, yellow and red indicators. Tap this sensor status to display the current messages in text format.

Signal color	Diagnostic message	Description	Measures
Green	"Sensor Status OK"	-	-
Yellow	"Change in temperature > [limit value]"	Temperature of liquid changes too quickly and configured limit value is exceeded. The calculated measured value may be incorrect.	Ensure a stable medium temperature.
	"Change in analysis parameter > [limit value]"	Analysis parameter of liquid changes too quickly and configured limit value is exceeded. The calculated measured value may be incorrect.	Ensure that the analysis parameter has a stable value.
	"Process disturbance detected, dispersion > [limit value]"	The measured dispersion is greater than the configured switch point.	1. Remove air bubbles and/or particles. 2. Take the recommended mounting position into consideration → 20.
	"Stationarity"	The value of the liquid analysis parameter changes too quickly and the measured value changes more frequently within 20 s than allowed by the statistical uncertainty considered in the measuring instrument. Settling processes can occur. The calculated measured value may be incorrect.	Ensure that the analysis parameter has a stable value.

Signal color	Diagnostic message	Description	Measures
	"Measuring range [measured variable] < ; [measured variable] >"	The measured value is above or below the specified measuring range.	Select a measured value that is within the measuring range.
	"Calibration [measured variable] < ; [measured variable] >"	The measured value for the displayed measured variable is above or below the calibration range of the liquid and may therefore be incorrect.	Select a measured value that is within the calibration range.
	"Clock and storage faulty"	Buffer battery is not charged.	1. Supply power to the transmitter for a few hours. 2. Then restart the transmitter. 3. If the error persists, contact Endress+Hauser Service.
	"Compensation not possible: Modbus communication faulty"	Missing compensation value.	1. Check the functional integrity of the external measuring instruments. 2. Check and guarantee Modbus communication with external measuring instruments.
	"Analog interface disabled"	The analog interface is disabled.	Enable the interface by selecting a measured variable in the Analog channel 1...4 parameter.
	"Compensation value is incorrect"	Compensation calculation is not possible. Missing compensation value.	Enter the compensation value in the Compensation value K1...K4 parameter.
Red	"No liquid present"	No liquid is present.	Ensure that there is sufficient liquid in the sensor.
		Sensor is dirty.	Ensure that the sensor is free from dirt and deposit buildup.
		Air bubbles or particles in the liquid.	Remove air bubbles and/or particles.
		Communication error	Restart the transmitter. In doing so, disconnect the device from the supply voltage for at least 30 seconds.
	"No sensor connected"	The sensor is not connected.	Make sure that the sensor is connected to the transmitter via the connecting cable.
		Connecting cable or connections are damaged.	Check the connecting cable and connections for damage.
		Communication error	Restart the transmitter. In doing so, disconnect the device from the supply voltage for at least 30 seconds.
	"Temperature chip is faulty"	Sensor is faulty.	Contact Endress+Hauser Service.
	"Temperature chip is faulty"	Sensor is faulty.	Contact Endress+Hauser Service.
	"Sensor memory faulty"	Measuring instrument is initializing.	Contact Endress+Hauser Service.
	"Process disturbance"	The value measured for the dispersion is greater than 1.	1. Remove air bubbles and/or particles. 2. Take the recommended mounting position →  20 into consideration. 3. If the error persists, contact Endress+Hauser Service.
	"Sensor configuration failed"	Missing calibration.	Contact Endress+Hauser Service.
	"System error"	Communication error between internal processors.	1. Restart the transmitter. 2. If the error persists, contact Endress+Hauser Service.
	"Compensation value is incorrect"	Compensation calculation is not possible. Missing compensation value.	Enter the compensation value in the Compensation value K1...K4 parameter.

12.3 Diagnostic information via dispersion indicator

The dispersion indicates a disturbance in the liquid caused by the dispersion of gas bubbles or particles. This causes a widening in the group and phase speed of sound.

The measuring instrument displays a standardized factor. If this value is less than 1, this indicates that the speed of sound determined for the undisturbed fluid can still be

determined with the specified measurement error. On the other hand, the density measurement error can already be greater than the measurement error specified under reference conditions at values over 0.25.

If the measured dispersion is greater than the configured switch point, the measuring instrument no longer displays an analysis parameter. The configured switch point can be viewed as follows:

Navigation on the transmitter

- ▶ Settings → "Application parameters" → "Diagnostics" → "Process disturbance" → "Switch point"

Navigation via the "Tegwave Viewer" operating tool

- ▶ Menu "Tegwave Transmitter" → "View filter" → "Process disturbance" → "Switch point"

12.4 Checking the sensor

The **Sensor testing** function in the Viewer allows users to test the accuracy of the sensor. A test report is created for documentation purposes.

Navigation using the Viewer

Menu "Tegwave Transmitter" → "Sensor testing"

NOTICE

Incorrect test result

The use of tap water and the presence of air bubbles or variable environmental conditions (e.g. variations in temperature or flow) can corrupt the test result.

- ▶ Clean the sensor before performing the test.
- ▶ Only use distilled or fully deionized water (conductivity < 20 µS/cm) to test the sensor.
- ▶ Boil the liquid for several minutes to prevent air bubbles occurring.
- ▶ Ensure constant environmental conditions.

1. Open the menu "Tegwave Transmitter" → "Sensor testing".
 - ↳ A message appears with information on the preparatory steps.
2. Fill the sensor completely with distilled or completely deionized water.
3. Click "OK" to confirm the message.
 - ↳ View in the Viewer changes to the Test View.
If the temperature of the liquid and sensor is stable, the message "The temperature is steady. Start sensor testing?" appears after approx. three minutes.
4. Click "OK" to confirm the message.
 - ↳ The sensor test begins.
The test result appears in the form of a test report after a few seconds.
5. Click "OK" to save the test report as an image file (.bmp) on the computer.
 - ↳ The "Enter path of file(s)" window appears.
6. Select the path and file name for saving the .bmp file.
7. Click the "OK" button to confirm.
 - ↳ The Viewer saves the test report.
8. Check the test report. If the test values are outside the tolerance range, the sensor may need to be adjusted. In such cases, please contact your Endress+Hauser sales organization. Permitted deviations: speed of sound: $\pm \leq 0.5$ m/s and density: $\pm \leq 3.0$ kg/m³.

12.5 Resetting the device to the factory setting

The entire device configuration can be reset to the as-delivered state with the **Restore factory settings** function.

 Fluid profiles, recipes and application packages are not affected by the reset to the factory settings.

12.5.1 Restoring factory settings via transmitter with touch screen

1. Select Settings menu → "Application parameters".
2. Tap the "Factory settings" function. If the "Factory settings" menu item is not visible on the touch screen, scroll down using the scroll bar.
 - ↳ Screen starts counting down from 10 to 0. At the end of the countdown, user-specific device settings are reset to the factory settings.

12.5.2 Restoring factory settings via the Viewer

1. Open the menu "Tegwave Transmitter" → "Restore factory settings".
 - ↳ A message is displayed.
2. Click "OK" to confirm the message.
 - ↳ The Viewer resets the user-specific device settings to the factory settings.

12.6 Device information

The nameplate contains device information. The **Settings** menu on the local display (transmitter with touch screen) and the **Version** function in the "Tegwave Viewer" operating tool contain additional information.

Navigation using transmitter with touch screen

1. Settings menu → "Version"
2. Settings menu → "Network settings" → "Status"
3. Settings menu → "Network settings" → "MAC address"

Navigation using the Viewer

Menu "Help" → "Version" → "Show device information"

Parameter overview with brief description

Parameter	Description	Display
Tegwave Viewer ¹⁾	Displays the current version of the Tegwave Viewer.	Character string with the format: v.x.y.z
Firmware or version	Displays the installed firmware version of the transmitter.	Character string with the format: v.x.y.z or x.y.z
Hardware	Displays the hardware version of the transmitter.	Character string with the format: x.y.z
Serial number ²⁾	Displays the serial number of the measuring device.	Max. 16-digit numerical sequence
Sensor ID	Displays the ID of the sensor.	Max. 11-digit numerical sequence
Transmitter ID	Displays the ID of the transmitter.	Max. 12-digit numerical sequence
MAC address	Displays the MAC address of the transmitter.	Byte-wise notation, colon-separated.

Parameter	Description	Display
License key ¹⁾	Displays the license key currently used.	32-digit numerical sequence, consisting of 4 groups, separated by a hyphen.
Status	Displays the device status coded for the Service Department.	Max. 5-digit character string

- 1) This information is only visible in the Viewer.
2) This information can be found in the Viewer and on the nameplates.

12.7 Firmware history

Date	Firmware version	Order code for "Firmware version"	Changes	Documentation type	Documentation
02.2021	2.3.zz (transmitter)	Firmware version 2.3.zz included in the delivery. Firmware version 2.2.zz available with option 77. This corresponds to the firmware version of Teqwave F and I.	Original firmware	Operating Instructions	BA02084D/06/EN/02.21 BA02084D/06/EN/01.21

Date	Firmware version	Order code for "Firmware version"	Changes	Documentation type	Documentation
06.2026	2.4.zz (transmitter)	Option 75 Firmware version 2.3.zz available for Teqwave H DN25 with option 76.	New - Supporting the insertion sensor types - New measured variable: Delta cF H₂O - Extended recipe functions: - Additional configuration options for creating recipes: Visibility settings for analysis parameters and configuration of the analog interface - Comment function for recipes Adjustments - Improved temperature measurement for insertion sensors: - Measurement up to 10 times faster - Higher resolution - Reduced quantization of the concentration - Adjusted averaging behavior: The averaging is no longer reset when the calibration ranges are exited, but only if there is a deviation of $\pm 20\%$ above or below the calibration range limit. - Extended memory: - Up to 25 fluid profiles - Up to 50 fluid profiles/recipes - Optimized navigation for fluid profile and recipe selection - Offset input adjusted: Input via difference between setpoint/actual value - Extended measured value logging: Logging of the current offset value for all analysis parameters - Behavior of analog interface adapted when exiting calibration ranges: - Setting 0 V/2 mA: Behavior as previously, error value output - Min/max setting: Leaving the calibration range is ignored, no adjustment of the analog value - Graph format as an additional alternative to list format - General adaptations to UI and navigation - Field calibration function removed Troubleshooting - More reliable detection of defective signal paths - Improved initialization behavior, in particular in connection with "No liquid present" error - Improved behavior in the event of short-term measurement or process malfunctions: Errors are temporarily tolerated before an error condition is triggered	Operating Instructions	BA02574D/06/EN/01.25

Date	Firmware version	Order code for "Firmware version"	Changes	Documentation type	Documentation
06.2026	2.4.02 ("Teqwave Viewer" operating tool)		New ▪ Recipe management added ▪ Configuration of the analog interface via recipes ▪ Comment function for recipes ▪ Working directory for recipes and fluid profiles introduced ▪ Import function for fluid profiles and recipes Adjustments ▪ General adaptations to UI ▪ Offset input adjusted: Input via difference between setpoint/actual value		

 It is possible to flash the firmware to the current version or the previous version using the "Teqwave Viewer" operating tool →  71.

13 Maintenance

13.1 Maintenance tasks

No special maintenance work is required. Each part and accessory can be cleaned. This may require disassembly.

13.1.1 Cleaning

Cleaning of surfaces not in contact with the medium

1. Recommendation: Use a lint-free cloth that is either dry or slightly dampened using water.
2. Do not use sharp objects or aggressive cleaning agents that could damage surfaces (e.g. displays, housing) and seals.
3. Do not use high-pressure steam.
4. Ensure compliance with the protection class of the device.

NOTICE

Cleaning agents can damage the surfaces!

Incorrect cleaning agents can damage the surfaces!

- Do not use cleaning agents containing concentrated mineral acids, alkalis or organic solvents e.g. benzyl alcohol, methylene chloride, xylene, concentrated glycerol cleaners or acetone.

Cleaning of surfaces in contact with the medium

NOTICE

Damage to the sensor

Unsuitable devices or cleaning agents as well as large and particularly rapid temperature increases can damage the sensor.

- Use an oil-free cleaning agent that does not form a film to clean the sensor.
- Never use cleaning agents that can corrode the material.
- Gently clean the surface using a soft brush.
- Ensure that the immediate temperature increase of the medium does not exceed 55 °C/s (99 °F/s).

Permitted cleaning processes

■ Inline sensor:

The measuring instrument is designed for cleaning in place (CIP) in accordance with EHEDG Doc. 2 (maximum temperature of 120 °C).

■ Insertion sensor:

The measuring instrument is designed for sterilization in place cleaning according to EHEDG Doc. 5 (maximum temperature of 145 °C for a maximum of 30 minutes) and cleaning in place (CIP) in accordance with EHEDG Doc. 2.

- The inspection and cleaning intervals depend on the field of application.

13.1.2 Replacing seals

The sensor's seals (particularly aseptic molded seals) must be replaced periodically.

The interval between changes depends on the frequency of the cleaning cycles, the cleaning temperature and the medium temperature.

Replacement seals (accessory) →  85

Refer to the disassembly instructions →  84

13.2 Maintenance services

Endress+Hauser offers a wide variety of services for maintenance such as recalibration, maintenance service or device tests.



Your Endress+Hauser Sales Center can provide detailed information on the services.

14 Repair

14.1 General notes

14.1.1 Repair and conversion concept

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

- The measuring devices have a modular design.
- Spare parts are grouped into logical kits with the associated Installation Instructions.
- Repairs are carried out by Endress+Hauser Service or by appropriately trained customers.
- Certified devices can only be converted to other certified devices by Endress+Hauser Service or at the factory.

14.1.2 Notes for repair and conversion

For repair and conversion of a measuring device, observe the following notes:

- ▶ Use only original Endress+Hauser spare parts.
- ▶ Carry out the repair according to the Installation Instructions.
- ▶ Observe the applicable standards, federal/national regulations, Ex documentation (XA) and certificates.
- ▶ Document all repairs and conversions and enter the details in Netilion Analytics.

14.2 Spare parts

Device Viewer (www.endress.com/deviceviewer):

All the spare parts for the measuring device, along with the order code, are listed here and can be ordered. If available, users can also download the associated Installation Instructions.

 Measuring device serial number:
Is located on the nameplate of the device.

14.3 Repair services

Endress+Hauser offers a wide range of services.

 Your Endress+Hauser Sales Center can provide detailed information on the services.

14.4 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the web page for information: <https://www.endress.com>
2. If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

14.5 Disposal



If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

14.5.1 Removing the measuring instrument

1. Switch off the device.

WARNING

Danger to persons from process conditions!

- Beware of hazardous process conditions such as pressure in the measuring instrument, high temperatures or aggressive media.

2. Carry out the installation and connection steps from the "Installing the device" and "Connecting the device" sections in reverse order. Observe the safety instructions.

14.5.2 Disposing of the measuring instrument

WARNING

Danger to personnel and environment from fluids that are hazardous to health.

- Ensure that the measuring device and all cavities are free of fluid residues that are hazardous to health or the environment, e.g. substances that have permeated into crevices or diffused through plastic.

Observe the following notes during disposal:

- Observe valid federal/national regulations.
- Ensure proper separation and reuse of the device components.

15 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.

15.1 Device-specific accessories

15.1.1 For the transmitter

Accessories	Description
Transmitter	Transmitter for replacement. The serial number of the current transmitter must be specified when ordering. On the basis of the serial number, device-specific data in the replaced device can also be used in the new transmitter. This also includes the existing analysis parameters. Can be ordered separately: Order number DK9BXX.
Transmitter holder (pipe mounting)	Transmitter holder for stainless steel housing for mounting on a post. - Order code for "Accessory enclosed": Option PC - Can be ordered separately: Order number DK9503.
Sensor/transmitter connecting cable	Connecting cable between sensor and transmitter, available in various lengths. Order code for "Cable, remote version": - Option D: 2 m (6 ft) - Option E: 5 m (15 ft) - Option F: 10 m (30 ft) Can be ordered separately: Order number XPD0047.

15.1.2 For the inline sensor

Accessory	Description
Mounting kit	Mounting kit consisting of: 2 process connections 8 screws - Seals (optional) Can be ordered separately: Order number DK9H
Seal set	For regularly replacing seals for the sensor. Seal set consisting of two seals. Can be ordered separately: Order number DK9H

15.1.3 For the insertion sensor

Accessory	Description
Weld-in adapter	Welding socket made of stainless steel 1.4435/316 L for insertion sensor with external thread ISO 228, 1". Surface roughness $R_a \leq 0.76 \mu\text{m}$ (30 μin) Enclosed seals: 1x silicone O-ring 1x EPDM O-ring (EHEDG-compliant) Order code for "Accessory enclosed": - G1", d=53, pipe-mounting: - Option PG "Welding socket, G1", d=53, without inspection certificate" - Option PH "Welding socket, G1", d = 53, with inspection certificate" - G1G1", d=60, tank-mounting - Option PE "Welding socket, G1", d=60, without inspection certificate" - Option PF "Welding socket, G1", d=60, with inspection certificate" Can be ordered separately: - G1", d=53, pipe-mounting: - Welding socket without inspection certificate, order number: 71258358 - Welding socket with inspection certificate, order number: 71093129 - G1", d=60, tank-mounting: - Welding socket without inspection certificate, order number: 52001051 - Welding socket with inspection certificate, order number: 52011896  For detailed information, see "Technical Information" TI00426F (weld-in adapters, process adapters and flanges), available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads).
Replacement seal set	Replacement seal set for insertion sensor with ISO 228, 1" external thread. Can be ordered separately: - O-ring 28.17x3.53 silicone (VMQ,) FDA, 5 pcs, order number: 52014472 - O-ring 28.17x3.53 EPDM, FDA, USP, 3 pcs, order number: 71140668  For detailed information, see "Technical Information" TI00426F (weld-in adapters, process adapters and flanges), available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads).

15.1.4 General

Accessories	Description
Analysis parameters and packages of analysis parameters sorted by application	Fluid profile for the integration of new media. Available fluid profiles and analysis parameters, as well as their measuring ranges, are listed in the Applicator →  87. If a desired fluid profile is not available in the Applicator, Endress+Hauser requires a sample of the medium to create the fluid profile. Endress+Hauser provides the fluid profile as a file in lmf format. Each transmitter can use a maximum of 25 fluid profiles (or a maximum of 50 fluid profiles and recipes in combination). Fluid profiles are individually adapted to a specific measuring instrument and are intended only for use with that particular measuring instrument. Order number: DK9500

15.2 Service-specific accessories

Accessories	Description
Applicator/Product Guide	Software for selecting and sizing Endress+Hauser measuring instruments: ▪ Overview and selection of fluid profiles. ▪ Choice of measuring instruments for industrial requirements. ▪ Calculation of all the necessary data for identifying the optimum measuring instrument: e.g. nominal diameter and measurement accuracy. ▪ Graphic display of the calculation results. ▪ Determine the partial and complete order code, provision of design documents. The Applicator is available via https://portal.endress.com/webapp/applicator.  The Applicator will be replaced by the end of 2026. From this point onwards, the relevant information and functions will be available in the new Product Guide app. The Product Guide is available via https://www.endress.com/en/field-instruments-overview/product-guide.
Engineering platform	Endress+Hauser's engineering platform enables you to optimize project execution, ensure consistent data processing, and improve collaboration among all stakeholders. Building on decades of experience in process automation and project services, Endress+Hauser offers the process industry a platform that integrates engineering data across the entire life cycle of your plant. This seamless data flow supports efficient project planning, smooth handover and reliable operations, resulting in faster execution, higher quality and reduced costs.
Netilion	IIoT ecosystem: Unlock knowledge With the Netilion IIoT ecosystem, Endress+Hauser allows you to optimize your plant performance, digitize workflows, share knowledge, and enhance collaboration. Drawing upon decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem that helps you turn data into actionable insights. These insights allow process optimization, leading to increased plant availability, efficiency, and reliability – ultimately resulting in a more profitable plant. www.netilion.endress.com

16 Technical data

16.1 Application

The measuring device is intended only for the measurement or analysis of liquids.

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

16.2 Function and system design

Measuring principle	Concentration measurement using ultrasonic waves.
Measuring system	For information on the structure of the device, see "Product description" →  11.

16.3 Input

Measured variables	Measured variables ▪ Speed of sound ▪ Temperature ▪ Dispersion (relative indicator for disturbance) ▪ Delta cF H2O (deviation of the speed of sound compared to the speed of sound of demineralized water) (hidden by default) ▪ Density (acoustic density) (hidden by default) Analysis parameters available for order ▪ Concentration ▪ Concentration ratio (ratio between two concentrations)
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Measuring ranges	Speed of sound	600 to 2 000 m/s
	Temperature	0 to 120 °C (32 to 248 °F)
	Delta cF H2O	-450 to +450 m/s (-1 476 to +1 476 ft/s)
	Acoustic density	0.7 to 1.5 g/cm ³
	Analysis parameter	According to the data sheet of the fluid profile

Input signal	Digital input <table border="1"> <tr> <td>Function</td><td>Select analog channel 1 to 4; The digital inputs "0" and "1" may only be connected to the signal ground.</td></tr> <tr> <td>Version</td><td>Open and ground digital input Do not connect external voltage to these terminals.</td></tr> </table>	Function	Select analog channel 1 to 4; The digital inputs "0" and "1" may only be connected to the signal ground.	Version	Open and ground digital input Do not connect external voltage to these terminals.
Function	Select analog channel 1 to 4; The digital inputs "0" and "1" may only be connected to the signal ground.				
Version	Open and ground digital input Do not connect external voltage to these terminals.				

External measured values

To increase the measurement accuracy, the automation system can write a variety of compensation values to the measuring instrument:

- CO₂ concentration
- Acid content

The datasheet of the fluid profile and the Applicator contain detailed information about compensation options.

 The signal input for the measured values that are read in must be configured with the "Tegwave Viewer" operating tool within a recipe using the recipe management function →  61. If it is not possible to read measured values into the measuring instrument using external sensors, the values can be saved as constant values within a recipe.

Digital communication

The measured values are written by the automation system via Modbus TCP.

16.4 Output

Output signal

Ethernet (Modbus protocol)

Physical interface	RJ-45 (8P8C)
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Current output 4 to 20 mA/voltage output 0 to 10 V

Function	Can be configured as a current output or voltage output, as required
Version	Galvanically isolated, protection class III as per IEC 61140
Open-circuit voltage	DC 15.5 V
Assignable functions	■ Analysis parameter 1...n ■ Speed of sound ■ Temperature ■ Dispersion ■ Delta cF H₂O (optional) ■ Density (optional) ■ Suspend measurement ■ Deactivate analog output
Current output	4 to 20 mA
Maximum output value	20 mA
Load	0 to 500 Ω
Resolution	1.5 µA
Voltage output	0 to 10 V
Maximum output value	10 V
Load	> 750 Ω
Resolution	1 mV
Maximum cable length	30 m (90 ft)

Switch output

Function	Switch output
Version	Relay output, galvanically isolated
Maximum switching capacity	Ambient temperature 0 to 55 °C: 50 V _{DC} or 30 V _{AC} , 1 A Ambient temperature > 55 °C: 50 V _{DC} or 30 V _{AC} , 0.8 A
Switching behavior	■ NC contact ■ NO contact
Assignable functions	Limit value (can be configured as a range or threshold, as required): ■ Analysis parameter 1...n ■ Speed of sound ■ Temperature ■ Dispersion ■ Delta cF H₂O (optional) ■ Density (optional)
Maximum cable length	30 m (90 ft)

Failure signal

Breakdown information and failure mode of the outputs are configurable →  59.

Ethernet (Modbus protocol)

Status bit	Diagnostics information via status bits
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Current output 4 to 20 mA / voltage output 0 to 10 V

Failure mode	The breakdown information to be displayed in the event of a breach of the measuring or calibration range (over-range/under-range) can be configured in the Output settings parameter: ■ Failure value for measured variable if the "0 V/2 mA exceeding limits" option is selected: 2 mA or 0 V ■ Limit value for measured variable if the "Min/Max exceeding limits" option is selected: 4 to 20 mA or 0 to 10 V
	■ The breakdown information to be displayed in the event of a breach of the calibration range (over-range/under-range) can be configured in the Output settings parameter: ■ Failure value for measured variable if the "0 V/2 mA exceeding limits" option is selected: 2 mA or 0 V ■ If the measuring instrument exceeds or drops below the calibration range for the temperature, a failure value is also displayed for the concentration or analysis parameter if this is active ■ No failure value and normal output of the current measured value according to the set limits if the "Min/Max exceeding limits" option is selected ■ The breakdown information to be displayed in the event of a breach of the calibration range (over-range/under-range) can be configured in the View filter parameter: Behavior according to the previously described setting in the Output settings parameter for the measured variable if "Calibration limits" is selected
	The breakdown information to be displayed in the event of a non-stationary process (stationarity) can be configured in the View filter parameter: Failure value for the concentration or analysis parameter if the Enable stationarity option is selected: 2 mA or 0 V
	The breakdown information to be displayed if the rate of change exceeds the limit value can be configured in the Change in [measured variable] parameter. If the function is enabled: Failure value for concentration or analysis parameter: 2 mA or 0 V

	In the event of process disturbances (dispersion) above the limit value: Failure value for concentration or analysis parameter: 2 mA or 0 V
	If there is not enough liquid or the sensor is faulty: Failure value for all measured variables: 2 mA or 0 V

Switch output

Failure mode	If the temperature measuring range is exceeded or undershot: For the concentration or analysis parameter: The current status is held.
	If the temperature calibration range is exceeded or undershot: For the concentration or analysis parameter: The current status is held.
	The breakdown information to be displayed in the event of a non-stationary process (stationarity) can be configured in the View filter parameter . If the "Enable stationarity" option is selected: For the concentration or analysis parameter: The current status is held.
	The breakdown information to be displayed if the rate of change exceeds the limit value can be configured in the Change in [measured variable] parameter. If the function is enabled: For the concentration or analysis parameter: The current status is held.
	In the event of process disturbances (dispersion) above the limit value: For the concentration or analysis parameter: The current status is held.
	If there is not enough liquid: Measured value for all measured variables with the exception of temperature: 0 switch status as per the setting for the switching threshold or switch point ("Operating Instructions" document, "Configuring the relay output" section).
	If the sensor is faulty: Measured value for all measured variables: 0 switch status as per the setting for the switching threshold or switch point ("Operating Instructions" document, "Configuring the relay output" section).

Local display

Color encoding	Color field indicates measurement and device error ("Operating Instructions" document, "Diagnostics information on local display and in operating tool" section)
Plain text display	Display alternates between information on the cause and the measured value display

"Tegwave Viewer" operating tool

Color encoding	Color field indicates measurement and device error ("Operating Instructions" document, "Diagnostics information on local display and in operating tool" section)
Plain text display	Information on the cause

Galvanic isolation

The current and relay outputs are galvanically isolated from the rest of the system.

Protocol-specific data

Protocol	Modbus Applications Protocol Specification V1.1
Response times	Typical 10 to 50 ms
Device type	Slave
Function codes	0x04: Read Input Registers 0x10: Write Multiple Registers
Modbus data transmission	Big-endian
Data access	Each measured variable can be accessed via Modbus TCP.

16.5 Power supply

Terminal assignment →  31

Supply voltage

Transmitter	DC 19.2 to 28.8 V
--------------------	-------------------

 The power unit must be tested to ensure it meets safety requirements (PELV).

Power consumption

Transmitter	4 W
--------------------	-----

Current consumption

Transmitter Maximum switch-on current	6 A
---	-----

Power supply failure

The configuration and recorded data are retained in the device memory.

Electrical connection

→  30

Potential equalization

→  32

Terminals

Terminal type	Screw terminals
Conductor cross-section	0.129 to 1.31 mm ² (16 to 26 AWG)

Cable entries

Transmitter with stainless steel housing	Cable glands ■ M20 × 1.5 for cable dia 4 to 6.5 mm (0.16 to 0.25 in) ■ M20 × 1.5 for cable dia 7 to 10 mm (0.28 to 0.39 in)
---	--

Cable specifications

→  30

16.6 Performance characteristics

Reference operating conditions

- Distilled water, degassed (demineralized water) constantly in the range of +15 to +30 °C (+59 to +86 °F)
- Atmospheric pressure constantly in the range of 860 to 1060 mbar (12.47 to 15.37 psi)
- Data as indicated in the calibration certificate

Maximum measurement error

Under reference operating conditions:

Speed of sound	±0.3 m/s (±3.3 ft/s)
Temperature	±0.1 K
Density	±0.01 g/cm ³

Repeatability

Under reference operating conditions:

	Inline measuring instrument	Insertion measuring instrument
Speed of sound	±0.03 m/s (0.10 ft/s)	±0.02 m/s (0.07 ft/s)
Temperature	±0.065 K	±0.01 K
Density	±0.001 g/cm ³	±0.001 g/cm ³

Accuracy

Concentration measurement accuracy

The accuracy depends on the fluid profile. The data sheet for this and the Applicator (→  87) contain detailed accuracy information.

**Compensation of cross-interference**

Depending on the fluid profile, various compensation values can be entered or read into the measuring instrument to compensate for known cross-interference. →  61.

Temperature measurement response time

T90 < 5 s

**Influence of medium temperature**

The response time of the temperature/concentration measurement depends on the transfer of heat from the fluid to the steel. The activation of the Kalman filter can lead to a shorter response time in the event of fast and large temperature changes.

Influence of variations in the medium temperature

If the medium temperature changes quickly (>1.5 °C/min (2.7 °F/min)), the measured error can be greater than specified in the "Maximum measured error" section.

Influence of vibrations

The measured error can be greater than specified in the "Maximum measured error" section as a result of mechanical, acoustic or electrical vibrations in the 0.8 to 2.0 MHz range. We recommend using a dedicated power unit and not the mains power supply.

Influence of ambient temperature

Current/voltage output

Temperature coefficient	100 µV/°C (µV/°F) or ±1 µA/°C (µA/°F)
-------------------------	---------------------------------------

Influence of gas bubbles

Gas bubbles and particles are disturbance factors when measuring with ultrasonic waves. The recommended installation positions and the "Dispersion" diagnostic information largely prevent incorrect measurement results caused by gas bubbles or particles.



In the case of media with a high CO₂ content, there is the danger of CO₂ outgassing. To prevent outgassing, the process pressure must be set in such a way that the CO₂ saturation limit is not exceeded at the specific process temperature.

16.7 Installation

Installation requirements

→  20

16.8 Environment

Ambient temperature range

→  24

Storage temperature The storage temperature corresponds to the operating temperature range of the transmitter and the sensor →  24.

Degree of protection	Sensor	IP66/IP67 with cable plugged in, suitable for Pollution degree 4
	Transmitter with Aluminum housing	IP40, suitable for Pollution degree 2
	Transmitter with Stainless steel housing	IP66, suitable for Pollution degree 2

Relative humidity	Sensor	4 to 95 %
	Transmitter with Aluminum housing	4 to 80 %
	Transmitter with Stainless steel housing	4 to 95 %

Operating altitude According to EN 61010-1
≤ 2 000 m (6 562 ft)

Electromagnetic compatibility (EMC)

- As per IEC/EN 61326
- Maximum deviation under the effect of disturbance: < 2%
- For details, refer to the Declaration of Conformity.

 The device is not designed for use in living areas and cannot guarantee adequate protection of the radio reception in such environments.

16.9 Process

Medium temperature range	Sensor	0 to +120 °C (+32 to +248 °F)
--------------------------	--------	-------------------------------

Temperature increase	Sensor	Max. 55 °C/s (99 °F/s)
----------------------	--------	------------------------

NOTICE
Large and particularly rapid temperature increases can damage the sensor.
► Ensure that the immediate temperature increase of the medium does not exceed 55 °C/s (99 °F/s).

Nominal pressure	Sensor	0 to 16 bar (0 to 232 psi)
------------------	--------	----------------------------

Internal cleaning  For more information on cleaning, see the "Maintenance" section →  81

Inline sensor	CIP cleaning
Insertion sensor	■ CIP cleaning ■ SIP cleaning

Flow velocity	Inline sensor	Max. 10 m/s (32.8 ft/s)
	Insertion sensor	Max. 5 m/s (16.4 ft/s)

16.10 Mechanical construction

Design, dimensions	 For the dimensions and installed lengths of the device, see the "Technical Information" document, "Mechanical construction" section
--------------------	---

Weight	Transmitter	
	Transmitter with Aluminum housing	0.34 kg (0.8 lb)
	Transmitter with Stainless steel housing	4.75 kg (10.47 lb)

Inline sensor

DN 25 mm (DIN)	Max. 2.42 kg (5.34 lb)
DN 1" (ANSI)	Max. 2.48 kg (5.47 lb)

The weight refers to the weight of a device with flanges. It can be lower than specified depending on the process connection.

Insertion sensor

Process connection	Device version weight		
	Insertion DN50	Insertion DN65-100	Insertion tank 220 mm
External thread ISO 228, 1"	–	0.37 kg (0.82 lb)	0.41 kg (0.90 lb)
DN50 DIN 11851 conical coupling incl. union nut	0.57 kg (1.26 lb)	0.57 kg (1.26 lb)	–
Tri-Clamp 2"	0.30 kg (0.66 lb)	0.30 kg (0.66 lb)	0.38 kg (0.84 lb)
Varivent N	0.61 kg (1.34 lb)	0.71 kg (1.57 lb)	0.79 kg (1.74 lb)

Materials	Transmitter housing		
	<i>Aluminum transmitter housing, order code for "Transmitter housing", option A</i>		
Housing	Anodized aluminum		
Window material	Glass		
Terminal connection	Polyamide (PA66)		
Ethernet interface	- Socket: Ferrite - Contact housing: Thermoplastic - Contacts: 100 % tin with nickel coating, gold-plated		
Push-pull connection	- Socket: Brass, nickel-plated - Contact housing: Polyetheretherketone (PEEK) - Contacts: Brass, gold-plated		

Stainless steel transmitter housing, order code for "Transmitter housing", option B

Housing	Stainless steel 1.4301 (304)
Sealing system	Seamless foamed PU seal
Window material	Polycarbonate
Cable glands	Polyamide (PA)
Terminal connection	Polyamide (PA66)
Ethernet interface	▪ Socket: Ferrite ▪ Contact housing: Thermoplastic ▪ Contacts: 100 % tin with nickel coating, gold-plated
Push-pull connection	▪ Socket: Brass, nickel-plated ▪ Contact housing: Polyetheretherketone (PEEK) ▪ Contacts: Brass, gold-plated

Sensor

Stainless steel, 1.4404 (316L)

Connecting cable

Cable, external material	Polyurethane as per EN 60811-2-1 (oil-resistant, halogen-free)
Push-pull connector (standard)	▪ Socket: Brass, nickel-plated ▪ Contact housing: Polyetheretherketone (PEEK) ▪ Contacts: Brass, nickel, gold

Process connections

Stainless steel, 1.4404 (316L)

Seals of the inline measuring instrument

- EPDM, not resistant to mineral oils
- FKM
- VMQ (silicone)

Process connections

Inline measuring instrument with aseptic gasket seal:

- Welding nipple:
 - ASME BPE
 - ISO 2037)
 - EN 10357 Series A (DIN 11850)
- Clamp:
 - ASME BPE (Tri-Clamp)
 - ISO 2852
 - DIN 32676 Series A
- Glands:
 - DIN 11864-1 A (aseptic threaded hygienic connection)
 - DIN 11851
 - SMS 1145
- Flange:
 - DIN 11864-2 A (aseptic grooved flange)

Insertion measuring instrument

- Varivent N
- Tri-Clamp, 2" (ISO 2852/DIN 32676, 53 × 1.5)
- External thread ISO 228, 1"
- Milk thread fitting DN50 (DIN 11851, conical coupling incl. union nut)

Surface roughness

All data relates to metallic parts in contact with medium.

Inline sensor

Ra ≤ 0.76 µm (30 µin), mechanically polished (order code for "Measuring tube mat., wetted surface", option BB)

Insertion sensor

Surface roughness option	Method	Order code option "Measuring tube mat., wetted surface"
Not specified	Not polished, welds in as-welded condition	SA ¹⁾
Ra ≤ 0.76 µm (30 µin)	Electropolished	BD

1) Option: Ra ≤ 0.76 µm (30 µin) with order code for "Additional approval" option LT or LP

16.11 Operability

Local operation

Via display module

Order code for "Display, operation", touchscreen



In the case of transmitters with a stainless steel housing, the touchscreen can only be operated when the housing is open.

Supported operating tools

Operation via "Teqwave Viewer" Windows Desktop operating tool.

Reliable operation

If the power supply fails, data saved in the device and device configurations are retained.

Languages

Can be operated in the following languages:

- Via local operation (transmitter with touch screen)
English, German, French, Spanish, Italian
- Via operating tool
English, German, French, Spanish, Italian

16.12 Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

CE mark	The device meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
UKCA marking	The device meets the legal requirements of the applicable UK regulations (Statutory Instruments). These are listed in the UKCA Declaration of Conformity along with the designated standards. By selecting the order option for UKCA marking, Endress+Hauser confirms a successful evaluation and testing of the device by affixing the UKCA mark. Contact address Endress+Hauser UK: Endress+Hauser Ltd. Floats Road Manchester M23 9NF United Kingdom www.uk.endress.com
Pressure Equipment Directive	The devices are designed and manufactured according to good engineering practice. They meet the requirements of a) Art. 4, Section 3 of the Pressure Equipment Directive 2014/68/EU or b) Part 1, Section 8 of Statutory Instruments 2016 No. 1105. The scope of application is indicated a) in diagrams 6 to 9 in Annex II of the Pressure Equipment Directive 2014/68/EU or b) in Schedule 3, Section 2 of Statutory Instruments 2016 No. 1105.
Sanitary compatibility	■ 3-A SSI 28-06 ■ Confirmation by affixing the 3-A logo for measuring instruments with the order code for "Additional approval", option LP "3-A". ■ The 3-A approval refers to the measuring instrument. ■ When installing the measuring instrument, ensure that no liquid can accumulate on the outside of the measuring instrument. ■ Accessories (e.g. weather protection cover, wall holder unit) must be installed in accordance with the 3-A Standard. - Each accessory can be cleaned. Disassembly may be necessary under certain circumstances. ■ EHEDG certified: Type EL Class I ■ The EHEDG approval refers to the sensor. ■ Confirmation by affixing the EHEDG symbol for sensors with the order code for "Additional approval", option LT "EHEDG". ■ CIP must be performed without dismantling the instrument, maintaining a minimum flow velocity of 1.5 m/s (4.9 ft/s) to meet the EHEDG requirements. ■ For inline sensors: To meet the requirements for EHEDG certification, the sensor must be connected with process connections in accordance with the EHEDG position paper entitled "Easy Cleanable Pipe Couplings and Process Connections" (www.ehedg.org). ■ For insertion sensors with process connections Varivent N as well as Tri-Clamp, 2" ISO 2852/Clamp connection DIN 32676, 53 × 1.5: The device complies with the EHEDG hygienic design criteria and shall be installed according to the EHEDG Position Paper with specific gaskets for tri-clamp connection. To ensure hygienic installation, the generally accepted hygiene measures for the entire production line must be observed. Any dead leg should be compliant with $L/(D-d) \leq 1$. ■ Seals of the inline measuring instrument ■ EPDM is not a suitable seal material for media with a fat content > 8 %. ■ FDA-compliant seals: EPDM, FKM, VMQ. ■ EHEDG-compliant seals: EPDM, FKM. ■ Food Contact Materials Regulation (EC) 1935/2004 ■ Food Contact Materials Regulation China GB 4806 ■ TSE/BSE Certificate of Suitability

Other certificates

Tests and certificates

EN10204-3.1 material certificate, wetted parts (order code for "Test, certificate", option JA)

External standards and guidelines

- EN 60529
Degrees of protection provided by enclosure (IP code)
- EN 61010-1
Safety requirements for electrical equipment for measurement, control and laboratory use – general requirements
- IEC/EN 61326-1; IEC/EN 61326-2-3
Electromagnetic compatibility (EMC requirements)
- IEC 63000
Restriction of hazardous substances in electric and electronic devices.

16.13 Accessories

 Overview of accessories available to order →  85

16.14 Documentation

 For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

Standard documentation

Document type	Documentation code
Technical Information	TI01882D
Brief Operating Instructions	KA01501D

Supplementary device-dependent documentation

Special Documentation

Contents	Documentation code
Modbus TCP system integration	SD03565D
Downloading Fluid Profiles, Device Viewer Data and Firmware Updates via Netilion	SD03630D

Installation instructions

Contents	Comment
Installation instructions for spare part sets and accessories	■ Access the overview of all the available spare part sets via <i>Device Viewer</i> →  83 ■ Accessories available for order with Installation Instructions →  85

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