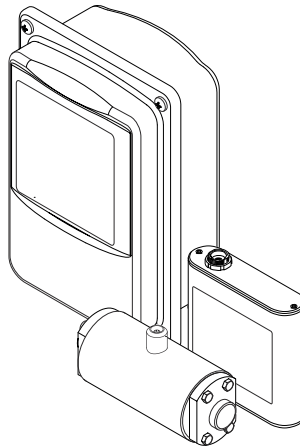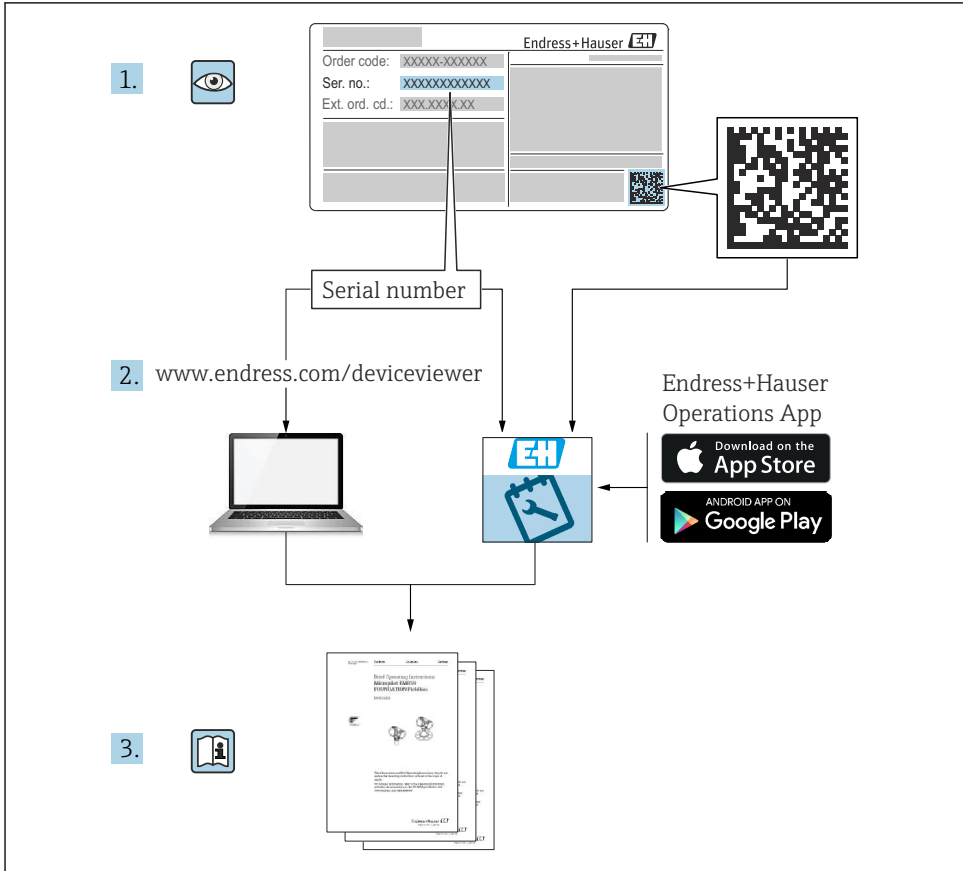# Brief Operating Instructions
Teqwave H

Ultrasonic concentration meter

These Instructions are Brief Operating Instructions; they are not a substitute for the Operating Instructions pertaining to the device.

Detailed information about the device can be found in the Operating Instructions and the other documentation:
- On the CD-ROM supplied (not included in the delivery for all device versions).
- Available for all device versions via:
  - Internet: www.endress.com/deviceviewer
  - Smart phone/tablet: *Endress+Hauser Operations App*

Endress+Hauser [EH]

People for Process Automation

1.

Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXXX
Ext. ord. cd.: XXX.XXXX.XX

Endress+Hauser

Serial number

2. www.endress.com/deviceviewer

Endress+Hauser
Operations App

Download on the
App Store

ANDROID APP ON
Google Play

3.

A0023555

Table of contents

1   About this document

1.1   Symbols used

1.1.1   Safety symbols

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

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

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

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

1.1.2   Symbols for certain types of information

Symbol	Meaning	Symbol	Meaning
✅	**Permitted** Procedures, processes or actions that are permitted.	✅✅	**Preferred** Procedures, processes or actions that are preferred.
❌	**Forbidden** Procedures, processes or actions that are forbidden.	ℹ	**Tip** Indicates additional information.
📖	Reference to documentation	📄	Reference to page
🖼	Reference to graphic	1., 2., 3. ...	Series of steps
↳	Result of a step	👁	Visual inspection

1.1.3 Electrical symbols

Symbol	Meaning	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.
⏛	**Signal ground connection** A terminal that can be used as the ground contact for the digital input.	╱─	**Relay output connection** A terminal that can be used as a relay output.

Symbol	Meaning
⏦	**Protective Earth (PE)** A terminal which must be connected to ground prior to establishing any other connections. The ground terminals are situated inside and outside the device: • Inner ground terminal: Connects the protectiv earth to the mains supply. • Outer ground terminal: Connects the device to the plant grounding system.

1.1.4 Communication-specific symbols

Symbol	Meaning	Symbol	Meaning
📶	**Wireless Local Area Network (WLAN)** Communication via a wireless, local network.	🅱	**Bluetooth** Wireless data transmission between devices over a short distance.
((•))	Promag 800 **Cellular radio** Bidirectional data exchange via cellular network.	▣	**LED** Light emitting diode is off.
☼	**LED** Light emitting diode is on.	☼	**LED** Light emitting diode is flashing.

1.1.5 Tool symbols

Symbol	Meaning	Symbol	Meaning
✴	Torx screwdriver	▯	Flat blade screwdriver
✚	Cross-head screwdriver	⬡	Allen key
⌀	Open-ended wrench		

1.1.6 Symbols in graphics

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

2   Basic safety instructions

2.1   Requirements for personnel

The personnel must fulfill the following requirements for its tasks:
▸ Trained, qualified specialists must have a relevant qualification for this specific function and task.
▸ Personnel must be authorized by the plant owner/operator.
▸ Personnel must be familiar with federal/national regulations.
▸ Before starting work: personnel must read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
▸ Personnel must follow instructions and comply with general policies.

2.2   Designated use

2.2.1   Application and media

Only use the measuring device described in these Operating Instructions for the measurement of liquids and liquid analysis.

Only operate the measuring device within the limits specified in the technical data and for the specific concentration app.

To ensure that the measuring device remains in proper condition for the operation time:

▸ Only use the measuring device for media to which the process-wetted materials are sufficiently resistant.

2.2.2   Incorrect use

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

2.2.3   Residual risks

⚠ WARNING

Hot media can present a burn hazard.
▶ In the event of elevated medium temperatures, ensure protection against contact to prevent burns.

2.3   Workplace safety

For work on and with the device:
▶ Wear the required personal protective equipment according to national regulations.

For welding work on the piping:
▶ Do not ground the welding unit via the measuring device.

If working on and with the device with wet hands:
▶ Due to the increased risk of electric shock, wear suitable gloves.

2.4   Operational safety

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

2.5   Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and 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.

Furthermore, 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

2.6   IT security

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

IT security measures, which provide additional protection for the device 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 or M12 plug interconnects the sensor and transmitter.

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

3.1   Product design

Several transmitter versions are available.

3.1.1   Measuring device with transmitter in aluminum housing
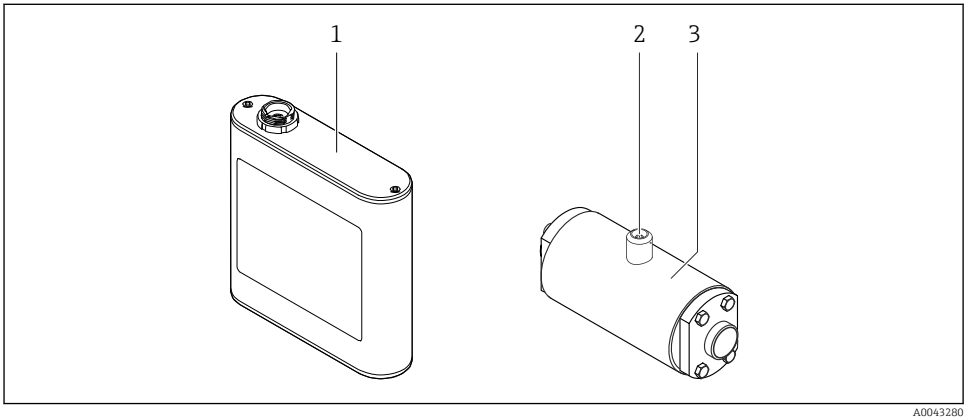
A0043280

🖼 *1   Important components of the measuring device*

1   Transmitter in aluminum transmitter housing with LED status indication or touch screen and push-pull connection for connecting to the sensor, terminal strip and Ethernet interface
2   Push-pull or M12 connection for connecting to the transmitter
3   Sensor

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

3.1.2   Measuring device with transmitter in stainless steel housing
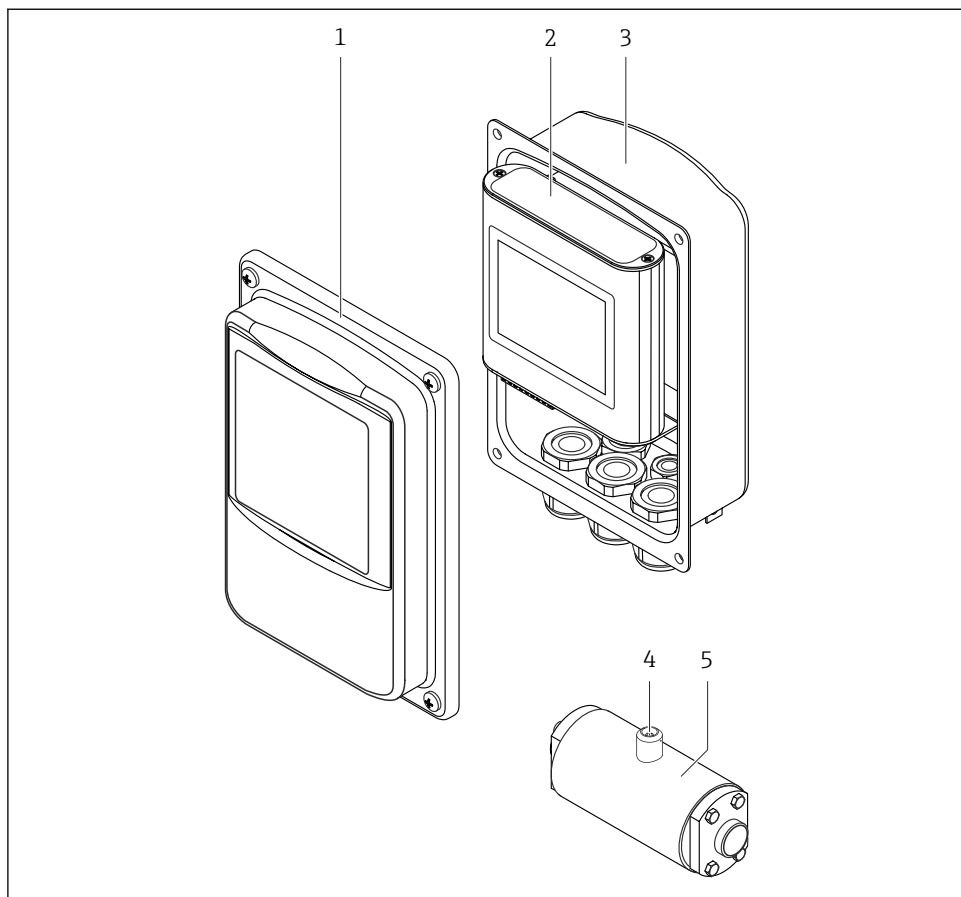
A0043281

⊞ *2*   *Important components of the measuring device*

1   *Stainless steel housing cover with viewing window*
2   *Transmitter with touch screen and push-pull connection for connecting to the sensor, terminal strip*
       and Ethernet interface
3   *Stainless steel housing with cable entries*
4   *Push-pull or M12 connection for connecting to the transmitter*
5   *Sensor*

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

3.2 Concentration apps

Endress+Hauser provides a separate concentration app for every medium. A concentration app contains the necessary specific characteristics of speed of sound and acoustic density in a defined temperature range, which are required to calculate the concentration and other analysis parameters (e.g. the degree of inversion of sugar) of a liquid.

The available concentration apps and analysis parameters, as well as the associated measuring ranges, are listed in the Applicator.

With the "Teqwave Viewer" operating tool, it is also possible to customize a concentration app to specific customer requirements and save the changes as a recipe. Furthermore, the accuracy of the analysis parameters of certain concentration apps can be improved by integrating additional external or entered measured values (e.g. pressure).

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

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

Every transmitter can manage a maximum of 25 concentration apps or recipes.

The data sheet provided with a concentration app contains information about the medium, the analysis parameters, the permitted measuring ranges, the compensation values and the accuracy of the concentration measurement.

3.3 Applications

Packages with multiple concentration apps can be ordered for the measuring device either during the initial purchase or subsequently. The concentration apps are grouped by application area and enable the measurement of analysis parameters (e.g. concentration of sugar and alcohol) of different media in an industry, e.g. in distilleries or the production of soft drinks.

For information on the concentration apps contained in the areas of application and the associated measuring ranges, see the "Technical Information" document, "Measuring ranges" section.

4   Mounting

4.1   Installation conditions

4.1.1   Mounting position

Mounting location
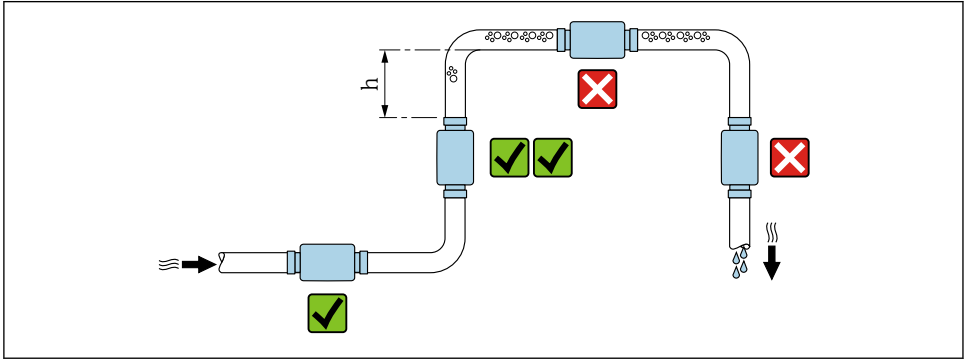
A0032998

⬛ *3   Mounting location*

Preferably install the sensor in an ascending pipe, and ensure a sufficient distance to the next pipe elbow: h ≥ 5 x DN.

Inlet and outlet runs

Observe the following inlet and outlet runs to comply with accuracy specifications:
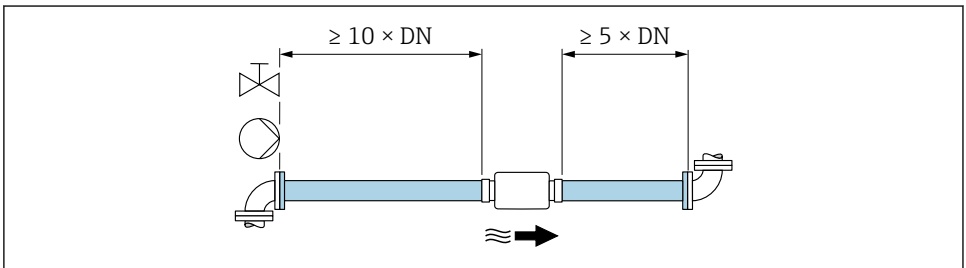
A0035458

⬛ *4   Inlet and outlet runs*

4.1.2   Environment and process requirements

Ambient temperature range

For detailed information on the ambient temperature range, see the Operating Instructions for the device.

If operating outdoors:
- Install the measuring device in a shady location.
- Avoid direct sunlight, particularly in warm climatic regions.
- Avoid direct exposure to weather conditions.

4.2   Mounting the measuring device

4.2.1   Mounting the sensor

⚠ 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 are clean and undamaged.
▶ Secure the seals correctly.

Mounting the sensor with the threaded adapter in the pipe

▶ Mount the sensor in the pipe in full compliance with the mounting conditions → 🖹 11.

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 vent 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).

4.2.2   Mounting the transmitter

⚠ CAUTION

Ambient temperature too high!
Danger of electronics overheating and housing deformation.
▶ Do not exceed the permitted maximum ambient temperature → 🖹 12.
▶ If operating outdoors: Avoid direct sunlight and exposure to weathering, particularly in warm climatic regions.

⚠ CAUTION

Excessive force can damage the housing!

▶ Avoid excessive mechanical stress.

Transmitter with stainless steel housing

The transmitter can be mounted in the following ways:
- Mounting with mounting plate
- Mounting with transmitter holder for post mounting (accessory)

Mounting with mounting plate
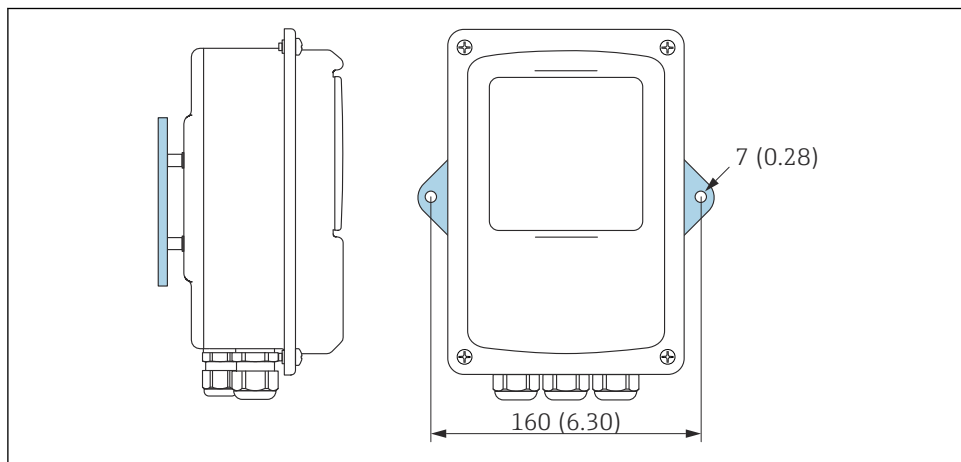
⊞ *5   Engineering unit mm (in)*

▶ Secure the mounting plate according to the bores provided.

Mounting with transmitter holder for post mounting (accessory)
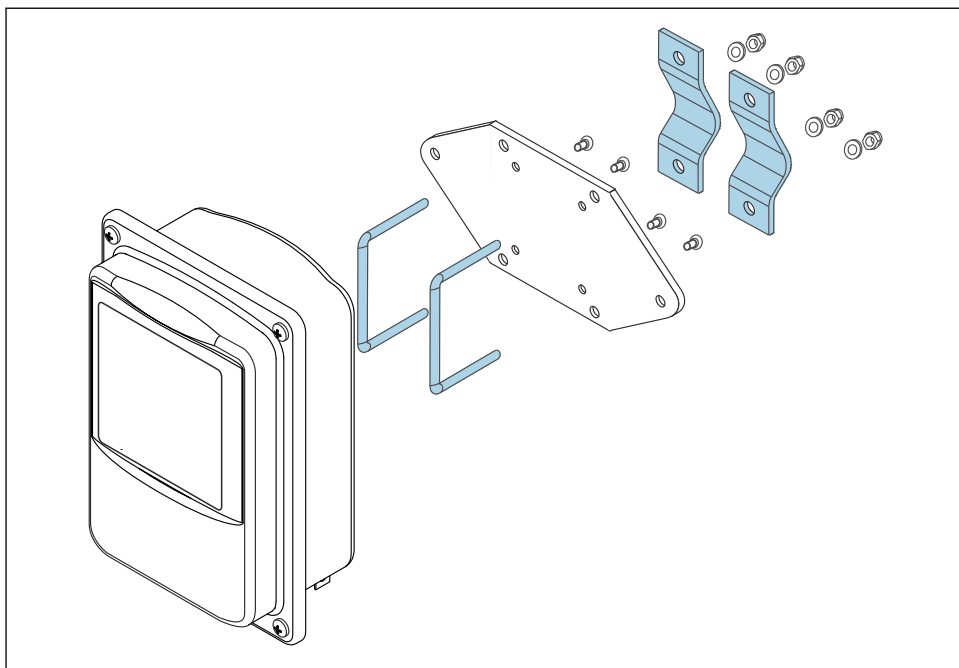
A0044706

1. Unscrew the mounting plate.
2. Guide the holder rods through the pre-drilled openings in the mounting plate and screw the mounting plate back onto the transmitter.
3. Secure the transmitter holder to a post with the clamps.
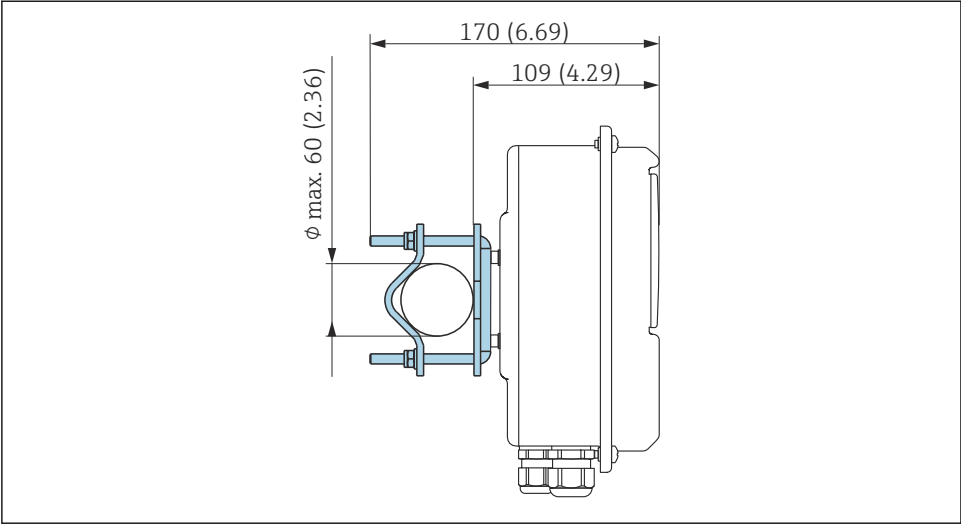
A0044740

4.3   Post-installation check

Perform the following checks after the installation:

Device condition and specification	Note
Is the device damaged (visual inspection)?	❏
Does the device meet the specifications, such as • Ambient temperature • Nominal pressure • Measuring range	❏
Installation	**Note**
Has the correct mounting location been selected? → 🖹 11	❏
Process environment/process conditions	**Note**
Are the specifications for the inlet run observed? Inlet run ≥ 10 × DN	❏
Are the specifications for the outlet run observed? Outlet run ≥ 5 × DN	❏
Is the measuring device protected against precipitation and direct sunlight?	❏

5   Electrical connection

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

5.1 Connecting requirements

5.1.1 Requirements for connecting cable

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

Electrical safety

In accordance with applicable national regulations.

Sensor/transmitter connecting cable

Only use the cable supplied.

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)

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)
Temperature range	• −40 to 70 ℃ (−40 to +158 ℉) when mounted in a fixed position • −10 to 50 ℃ (+14 to +122 ℉) when cable can move freely
Cable length	Max. 30 m (98 ft)
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.

5.1.2 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

Terminal	Assignment	Description
1		
⊥		Digital input ground
✓	**alarm** Max. AC 30 V/DC 50 V, 1 A	Switch output
✓		

5.1.3 Requirements for the supply unit

Supply voltage	DC 24 V ±20%
Version	Touch-safe circuit according to DIN EN 61010-1, as terminal V- is electrically connected to the transmitter housing.
Power unit	The power unit must be tested to ensure it meets safety requirements (PELV), as the measuring device is Class III equipment.

5.2 Connecting the measuring device: transmitter with aluminum housing

⚠ DANGER

Incorrect connection may result in injury or death
▶ Have electrical connection work carried out by appropriately trained specialists only.
▶ Observe applicable federal/national installation codes and regulations.
▶ Comply with local workplace safety regulations.

5.2.1 Connecting the connecting cable

Connect the sensor to the transmitter only using the connecting cable supplied.

NOTICE

Measuring device malfunction
Damaged cables can impact the functional integrity of the measuring device.
▶ 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).

🖼 6   Connecting the connecting cable

ℹ️ 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.

Connecting the connecting cable with the order code for "Sensor options", option CM (IP69)

1. Insert the M12 plug of the connecting cable into the sensor socket at the position indicated and tighten.

2. Insert the push-pull connector of the connecting cable into the transmitter socket at the position indicated until it engages with a click.

5.2.2   Connecting the signal and supply voltage cables

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

The signal can be transmitted using analog technology via the analog output and using digital technology via Ethernet (Modbus protocol). The connection to the "Teqwave Viewer" operating tool is also established via the Ethernet interface. For information on establishing the connection to the "Teqwave Viewer", see the Operating Instructions for the device.

⚠ DANGER

Serious or fatal injury from electric shock

▸ Ground terminal V- and the sensor housing separately from one another because terminal V- is connected to the sensor housing.

1. Connect the protective conductor to terminal V-.

2. Ground the transmitter housing. Make sure that terminal V- and the transmitter housing are grounded separately from one another.

3. Connect the signal and supply voltage cables to the transmitter via screw terminals, terminal assignment → 🖥 16.

4. For transmission via Modbus protocol or connection to the Teqwave Viewer, connect the Ethernet cable to the Ethernet port of the transmitter and the Ethernet port of the computer or network. For information on establishing the connection to the "Teqwave Viewer", see the Operating Instructions for the device.

5.2.3 Ensuring potential equalization

The measuring device must be included in the potential equalization. The transmitter and sensor are connected to the same potential via the connecting cable. This potential must be current-free.

5.3 Connecting the measuring device: transmitter with stainless steel housing

⚠ DANGER

Incorrect connection may result in injury or death
▶ Have electrical connection work carried out by appropriately trained specialists only.
▶ Observe applicable federal/national installation codes and regulations.
▶ Comply with local workplace safety regulations.

5.3.1 Opening the housing cover

1. Loosen the 4 fixing screws on the housing cover.

2. Open the housing cover.

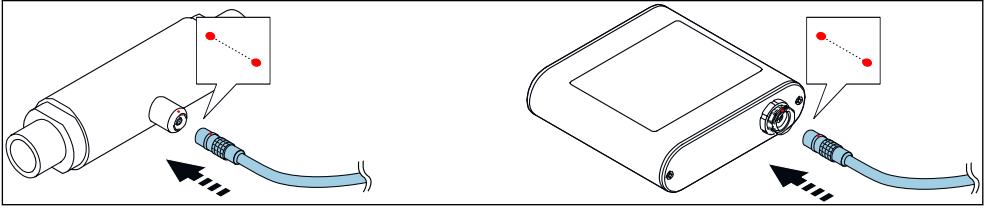### 5.3.2 Connecting the connecting cable

Connect the sensor to the transmitter only using the connecting cable supplied.

NOTICE

Measuring device malfunction
Damaged cables can impact the functional integrity of the measuring device.
▶ 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).
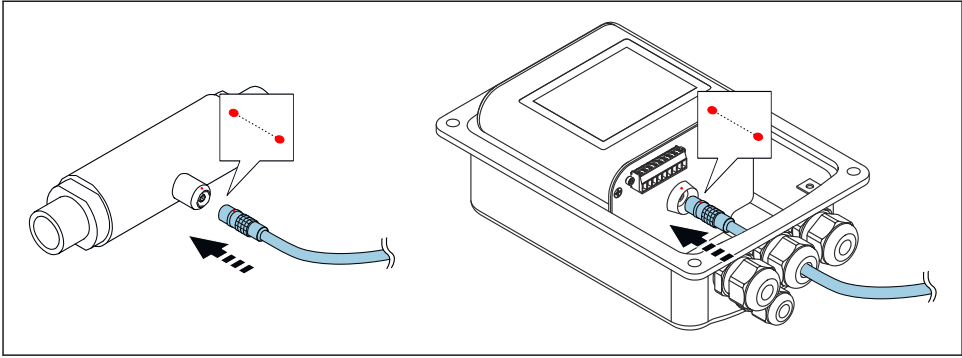
A0043295

Red dots on the connectors indicate the position.

1. Push the connecting cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.

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. Firmly tighten the cable glands.

Connecting the connecting cable with the order code for "Sensor options", option CM (IP69)

1. Push the connecting cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.

2. Insert the M12 plug of the connecting cable into the sensor socket at the position indicated and tighten.

3. Insert the push-pull connector of the connecting cable into the transmitter socket at the position indicated until it engages with a click.

4. Firmly tighten the cable glands.

5.3.3   Connecting the signal and supply voltage cables

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

The signal can be transmitted using analog technology via the analog output and using digital technology via Ethernet (Modbus protocol). The connection to the "Teqwave Viewer" operating tool is also established via the Ethernet interface. For information on establishing the connection to the "Teqwave Viewer", see the Operating Instructions for the device.

⚠ DANGER

Serious or fatal injury from electric shock

▶ Ground terminal V- and the sensor housing separately from one another because terminal V- is connected to the sensor housing.

A0043296

1. Push the signal and supply voltage cables through cable entries (1) and (2) and (where applicable) push the Ethernet cable through the cable entry (3). To ensure tight sealing, do not remove the sealing ring from the cable entry.

2. Connect the protective conductor to terminal V-.

3. Ground the transmitter housing with ground terminal (4). Make sure that terminal V- and the transmitter housing are grounded separately from one another.

4. Connect the signal and supply voltage cables to the transmitter via screw terminals, terminal assignment → 🖺 16.

5. For transmission via Modbus protocol or connection to the Teqwave Viewer, connect the Ethernet cable to the Ethernet port of the transmitter and the Ethernet port of the computer or network. For information on establishing the connection to the "Teqwave Viewer", see the Operating Instructions for the device.

6. Firmly tighten the cable glands.

5.3.4   Ensuring potential equalization

The measuring device must be included in the potential equalization. The transmitter and sensor are connected to the same potential via the connecting cable. This potential must be current-free.

5.3.5   Closing the housing cover

1. Close the housing cover.

2. Tighten the 4 fixing screws on the housing cover. Screw in the screws **without** using any lubricant (grease). If lubricant is used, the housing degree of protection can be compromised due to poor housing sealing.

5.4 Special connection instructions

5.4.1 Connection examples

Current output 4 to 20 mA

A0028758
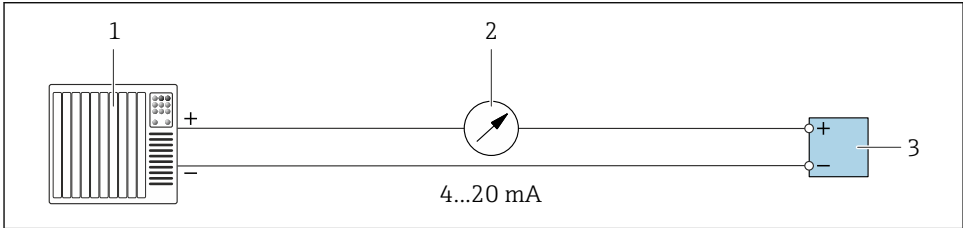
⊡ *7   Connection example for current output, active, 4 to 20 mA*

1   Automation system with current input (e.g. PLC)
2   Analog display unit: maximum load 500 Ω
3   Transmitter

Voltage output 0 to 10 V
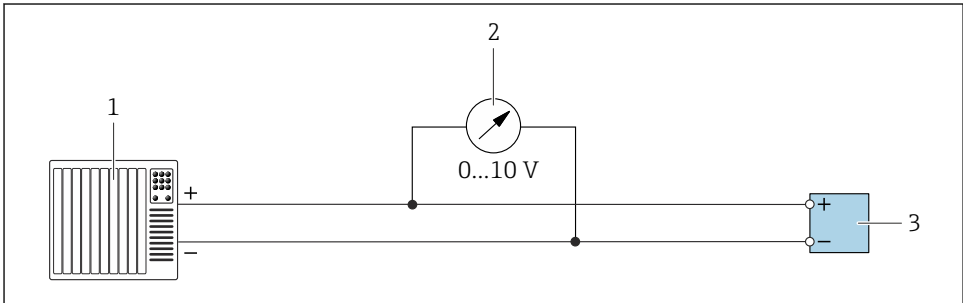
A0035460

⊡ *8   Connection example for voltage output, active, 0 to 10 V*

1   Automation system with current or voltage input (e.g. PLC)
2   Analog display unit for voltage: the load must be at least 750 Ω
3   Transmitter

Switch output
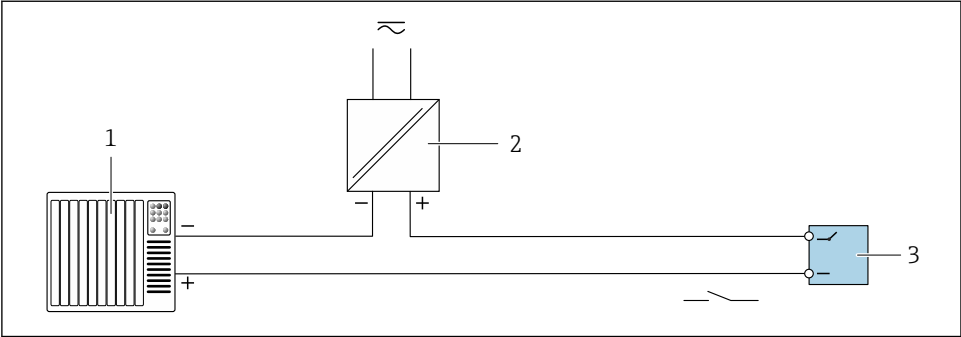
A0035461

⊡ 9   *Connection example for switch output, passive*

1   *Automation system with switch input (e.g. PLC)*
2   *Supply voltage: max. AC 30 V/DC 50 V*
3   *Transmitter*

Digital input (elective inputs)

The digital input can output up to four measured variables on the analog output.

Configuration options:

Active analog output	Digital input "0"	Digital input "1"
Channel 1	Open	Open
Channel 2	Ground	Open
Channel 3	Open	Ground
Channel 4	Ground	Ground

NOTICE
Interference at the digital input
If the measuring device is connected incorrectly, this can impact the functional integrity of the device.
▶ If the digital input is used, only connect digital inputs "0" and "1" to signal ground.

A0035462
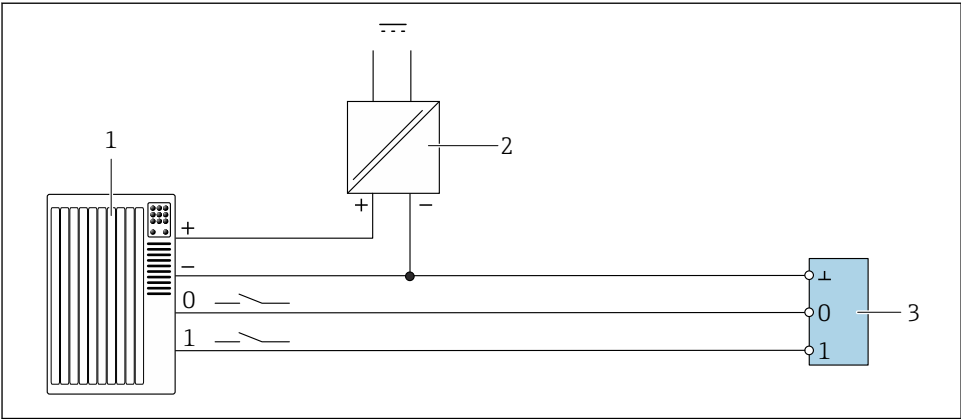
⊡ 10   *Connection example for the digital input*

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

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

5.5   Post-connection check

Are cables or the device undamaged (visual inspection)?	❏
Do the cables used comply with the requirements → 🖺 16?	❏
Do the mounted cables have adequate strain relief?	❏
Are all the connectors firmly seated?	❏
Is the terminal assignment correct?	❏
Are terminal V- and the transmitter housing grounded separately from one another?	❏
Are all of the screw terminals well-tightened?	❏
Are all the cable glands installed, tightened and sealed?	❏
If the supply voltage is applied, is the device ready for operation and does anything appear on the display module (transmitter with a touch screen) or is the power LED on the measuring device lit (transmitter with LED status indication)?	❏

6   Operation options

6.1   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 "Teqwave Viewer" operating tool supplied

6.2   Access to the measuring device via the local display

If you are using the transmitter with a touch screen, it is possible to access the measuring device via the transmitter touch screen and via the "Teqwave Viewer" operating tool.

🛈   If the transmitter is located in the stainless steel housing, the housing must be opened and the housing cover removed to gain access to the touch screen.

Functions supported by the transmitter with a touch screen:
• Display and graphic visualization of measured variables
• Selection of a concentration app or recipe
• Device configurations

6.2.1   Operational display of the transmitter with a touch screen

The operational display is used to display the measured values and the sensor status. In addition, users can access the Settings menu from this display. Select a measured variable to switch to the graph display format.
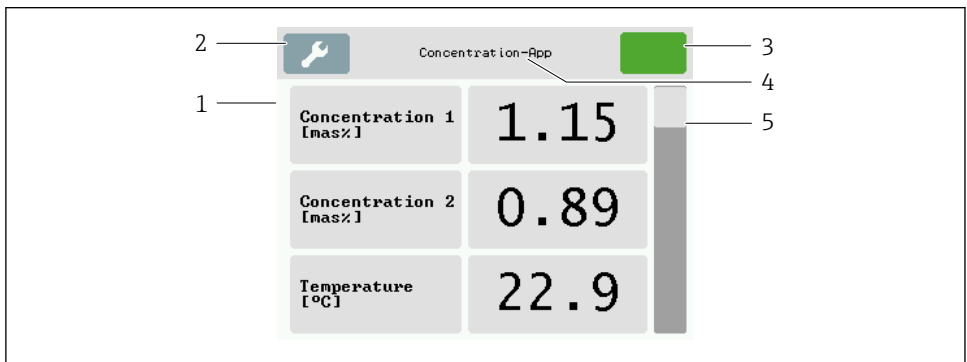
A0035464-EN

▣ 11   Operational display

1   Measured value display
2   Settings menu
3   Status indicator
4   Name of the concentration app or recipe
5   Scroll bar

> **NOTICE**
>
> **Double measured value display of alcohol concentration in the "Distillery; sugar, invert sugar, alcohol" application package**
> Concentration apps where the physical density can be compensated display the alcohol concentration twice.
> ▶ For more information see the channel description in the data sheet of the concentration app.
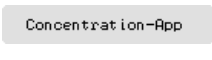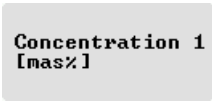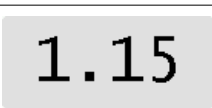
Measured value display

Each line shows an active measured variable, its name and the physical unit and measured value. Users can choose from a total of three different display modes, in which three, five or seven measured values can be displayed. If there are several measured values, users must scroll down using the scroll bar on the right to be able to see all the measured variables.

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 status messages in text format.
Concentration-App	**Concentration app name or operational display button** Displays the name of the concentration app, and navigation to the operational display.
Concentration 1 [mas%]	**Measured variable display** Displays the measured variable and its unit, and navigation to the Graph View.
1.15	**Measured value display** Displays the measured value, and navigation to the Graph View.
	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
Deutsch	**Blue background** Parameter is selected or function is activated.
English	**Gray background** Parameter is not selected or function is deactivated.

Editing elements

Numeric editor	Text editor
 A0035468	 A0035469
1 Display area of the entered values *2 Input mask*	*1 Display area of the entered values* *2 Input mask*

Input mask

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

Input and operating symbols in the editors

Symbol	Meaning
A ... Z	Selection of letters from A to Z.
0 ... 9	Selection of numbers from 0 to 9 and special characters.
.	Inserts decimal separator at the cursor position.
−	Inserts minus sign at the cursor position.

Symbol	Meaning
↵	Confirms selection.
←	Clears the last character entered.

6.2.2 LED status indication (transmitter with LED status indication)

For a description, see "Diagnostics information for transmitter with LED status indication" → 🕮 41.

6.3 Access to the measuring device via the operating tool

🛈 For detailed information on access to the measuring device, see the Operating Instructions for the device.

7 Commissioning

NOTICE

Damage to the touch screen
Sharp objects, electrostatic discharge, water and the use of pens not designed for touch screens, such as standard pencils, can cause a malfunction of the transmitter or damage the touch screen.
▶ Do not use sharp objects to operate the touch screen.
▶ To avoid electrostatic discharge, make sure the touch screen 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 touch screen.

7.1 Function check

Before commissioning the measuring device:

▶ Make sure that the post-installation and post-connection checks have been performed.

• "Post-installation check" checklist→ 🕮 15
• "Post-connection check" checklist→ 🕮 24

7.2 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.

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

7.3 Setting the operating language

In the case of transmitters with a touch screen, the operating language is configured via the local display.

ℹ️ If the transmitter is located in the stainless steel housing, to set the operating language the housing must be opened and the housing cover removed in order to gain access to the touch screen.

ℹ️ The language is selected for the Viewer via "Teqwave Viewer" → "Language settings". The same range of options are available.

Navigation using transmitter with touch screen
Settings menu → "Language settings"

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

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

7.4 Configuring the measuring device

If you are using the transmitter with a touch screen, it is possible to configure the device either via the transmitter touch screen or via the "Teqwave Viewer" operating tool. If you are using the transmitter with an LED status indication, the configuration must be performed via the Viewer.

ℹ️ If using areas of application: for information on the concentration apps contained in the areas of application and the associated measuring ranges, see the "Technical Information" document, "Measuring ranges" section.

7.4.1 Selecting the concentration app

A concentration app is enabled via the menu **Select concentration app** (transmitter with touch screen) or **Manage concentration app** (Viewer).

Navigation using transmitter with touch screen
Settings menu → "Select concentration app"

Navigation using the Viewer
Menu "Teqwave Transmitter" → "Manage concentration app"

ℹ️ For detailed information on parameters, see the Operating Instructions for the device.

7.4.2   Configuring the measuring unit

All the measured values are configured via the **Measuring unit** menu (transmitter with touch screen) or via the **View settings** menu (Viewer).

ℹ️
- The measured value is automatically converted if the unit is changed.
- The unit for the speed of sound is m/s and cannot be changed.

Navigation using transmitter with touch screen
- 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 using the Viewer
- Menu "Teqwave Transmitter" → "Display settings" → "Analysis parameter 1-n"
- Menu "Teqwave Transmitter" → "View settings" → "Temperature"
- Menu "Teqwave Transmitter" → "View settings" → "Density"

ℹ️
- The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.
- For detailed information on parameters, see the Operating Instructions for the device.

7.4.3   Configuring the analog output

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

Navigation using transmitter with touch screen

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 using the Viewer

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"

ℹ️
- The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.
- For detailed information on parameters, see the Operating Instructions for the device.

7.4.4   Displaying calibration ranges

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

Navigation using transmitter with touch screen

▶   Settings menu → "Select concentration app" → "Calibration range" → Select temperature, concentration or compensation value

7.4.5   Configuring the measuring range

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

> ℹ   ▪ The settings made 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 configured for the selected concentration app in order to ensure correct operation. In addition, the calibration range is also specified for measured variables that are relevant for the calibration of the concentration app (temperature and concentration). The measuring device takes this calibration range from the concentration app file. It cannot be modified.

Navigation using transmitter with touch screen

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 using the Viewer

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"

> ℹ   ▪ The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.
> ▪ For detailed information on parameters, see the Operating Instructions for the device.

7.4.6   Configuring the switch output

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

Navigation using transmitter with touch screen

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 using the Viewer

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.
- For detailed information on parameters, see the Operating Instructions for the device.

7.4.7 Configuring the measured value display

The measured value display is configured via various menus in the transmitter with a touch screen and in the Viewer.

Navigation using transmitter with touch screen

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 using the Viewer

1. Menu "Teqwave Transmitter" → "View settings"

2. Menu "Teqwave Transmitter" → "Averaging" → Select measured variable

3. Menu "Teqwave Transmitter" → "Averaging" → Select the "Temperature" measured variable → "Kalman filter"

ℹ️
- The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.
- For detailed information on parameters, see the Operating Instructions for the device.

7.4.8   Configuring the touch screen

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

ℹ️ If the transmitter is located in the stainless steel housing, to configure the touch screen the housing must be opened and the housing cover removed in order to gain access to the touch screen.

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" → "Deactivated"
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" → "App"
11. Settings menu → "User settings" → "Password protection" → "Settings"

ℹ️ For detailed information on parameters, see the Operating Instructions for the device.

7.4.9   Configuring the failsafe mode

The menus **Diagnosis** (transmitter with touch screen) and **View filter** (Viewer) 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 using transmitter with touch screen

1. Settings menu → "Application parameters" → "Diagnosis" → "View options"

2. Settings menu → "Application parameters" → "Diagnosis" → "Change in → Select measured variable

3. Settings menu → "Application parameters" → "Diagnosis" → "Process disturbance" → "Switch point"

Navigation using the Viewer

1. Menu "Teqwave Transmitter" → "View filter" → "Filter options" and "Filter arrangements"

2. Menu "Teqwave Transmitter" → "View filter" → "Change in" → Select measured variable

3. Menu "Teqwave Transmitter" → "View filter" → "Process disturbance" → "Switch point"

| For detailed information on parameters, see the Operating Instructions for the device.

7.5   Advanced settings

Offsets, compensations and field calibrations can be performed to increase measuring accuracy. Furthermore, with the recipe generator it is possible to save combinations of settings as an initial setting or recipe for every concentration app.

7.5.1   Recipe generator

The recipe generator in the Viewer allows users to permanently save initial settings (unit, measuring range and offset) of an analysis parameter and compensation values for a concentration app. The initial settings are saved as a recipe in rcp format. Once a recipe has been saved, it can be added to the transmitter so that the initial setting is available in the transmitter. Any number of recipes can be created for a concentration app. However, together a maximum of 25 concentration apps and recipes can be used on the transmitter.

Creating or changing a recipe

1. Select the menu "Teqwave Viewer" → "Recipe generator".
   ↳ The "Recipe generator" window appears.

2. Click the "Load concentration app/recipe" button.
   ↳ The "Enter path of file(s)" window appears.

3. Select the concentration app file (saved locally or on the DVD) for which a new recipe should be created or select the recipe file that is to be changed. Concentration app files are in lmf format and recipe files in rcp format.
   ↳ The initial setting options of a concentration app or recipe are displayed in the recipe generator.

4. 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.

5. Make initial settings. Set concentrations 1...3→ 🖺 35;
   set compensation values→ 🖺 35.

6. Use the "Save" button to save the recipe.
   ↳ The "Enter path of file(s)" window appears.

7. Select the path and file name to save the recipe. A new recipe has been created: the recipe name is the default for the file name but it may be overwritten if the user requires; a recipe has been edited: either overwrite the rcp file or save the settings under another file name.

Setting the concentration 1...3

The unit, measuring range and offset for the concentrations calculated in a concentration app can be preset with the recipe generator and saved for permanent use.

▶ In the recipe generator, select the [Concentration 1...3] tab and make the initial settings, see the Operating Instructions for the device.

Setting the compensation values

To increase measuring accuracy, predefined compensation values can be used for the compensation of the speed of sound and acoustic density specifically for your application. The compensation values can be read into a recipe from external measuring devices via Modbus TCP or entered as constant measured values.

Typical compensation values are:
- Operating pressure
- CO_2 concentration
- Degree of inversion
- Mineralization
- Physical density
- Acid content
- Sugar concentration

> Compensation values are only available if they were provided in the data record of the concentration app upon delivery.

▶ Set the compensation values in the "Compensation values" section of the recipe generator, see the Operating Instructions for the device.

Adding a recipe to the transmitter

Recipes which the customer has created using the recipe generator can be added to, or removed from, the transmitter with the "Manage concentration apps" function.

▶ Manage concentration apps .

7.5.2   Setting the compensation values

The compensation values available for a concentration app can be configured manually via the **Select concentration app** menu (transmitter with touch screen). To use compensation values permanently in a recipe and for further information on the compensation values, see the recipe generator → 🖹 34.

Navigation using transmitter with touch screen
Settings menu → "Select concentration app" → Select concentration app or recipe →
"Compensation values" → Select compensation value

ℹ The **Compensation value** function can only be accessed if the concentration app was activated beforehand with the **Activate application** function.

ℹ Compensation values are only available if they were provided in the data record of the concentration app upon delivery.

ℹ For detailed information on parameters, see the Operating Instructions for the device.

7.5.3 Setting the concentration offset

Manual offsets are configured for the calculated concentrations via the menus **Select concentration app** (transmitter with a touch screen) and **Concentration offset** (Viewer). This allows users to adapt the measuring technology to different process conditions (e.g. foreign substances/admixtures).

ℹ For information on using a concentration offset in a recipe, see the recipe generator → 🔖 34.

Navigation using transmitter with touch screen
Settings menu → Select concentration app → "Medium settings" → "Concentration 1…3 offset"

ℹ The **Medium settings** function can only be accessed if the concentration app was activated beforehand with the **Activate application** function.

Navigation using the Viewer
Menu "Teqwave Transmitter" → "Concentration offset" → "Offset"

ℹ • The operating tool communicates the settings to the transmitter as soon as the **Apply** button is clicked.
   • For detailed information on parameters, see the Operating Instructions for the device.

7.5.4 Performing field calibration with a medium

Different conditions when the concentration app is created in the laboratory compared with real-life process conditions can lead to undesired effects. Measurement accuracy can be increased by performing a **field calibration** under process conditions. The field calibration can only be performed using the transmitter with a touch screen and also only for concentration apps that do not output more than two analysis parameters.

If a field calibration is performed, it only applies to the concentration app currently in use. The field calibration is disabled if the user switches the concentration app.

ℹ If a field calibration is not possible, e.g. in the case of concentration apps that output more than two analysis parameters, we recommend setting a concentration offset either manually → 🔖 36 or via the recipe generator → 🔖 34.

> **NOTICE**

Measurement result is not representative

Changes to the process conditions after performing a field calibration can cause incorrect measurement results.

▶ Ensure process conditions are uniform after the field calibration. In particular, keep the flow, pressure and droplet size distribution constant.

▶ After the field calibration, do not take any actions that could alter the properties of the medium (exception: material composition as per concentration app).

Navigation

"Settings" → "Application parameters" → "Field calibration"

🛈 For detailed information on performing a field calibration, see the Operating Instructions for the device.

7.6 Application package "Viewer with interface for data download"

7.6.1 Availability

If the "Viewer with interface for data download" application package is ordered from the factory, the functions of this package are available in the Viewer when the device is delivered.

Ways to check function availability:
Using the serial number on the measuring device:
W@M Device viewer → order code option EP "Viewer with interface for data download"

Via the "Viewer" operating tool:
Check whether the functions appear in the Viewer. The function is activated if the **Read memory** function is not grayed out in the **Teqwave Transmitter** menu.

If the function cannot be opened in the measuring device, the application package was not selected when the device was ordered. In this case, you can subsequently activate the functions for data readout.

7.6.2 Activation

Endress+Hauser provides users with a license key to activate the functions. The license key must be entered to enable the functions of the application package. The key is entered in the Viewer via the "Teqwave Transmitter" → "License key" menu.

The application package is individually licensed for a specific measuring device and can only be used with this particular device. The system uses a serial number saved in the license key to automatically check whether there is authorization to enable the application package on the connected transmitter.

7.6.3 General information

The "Viewer with interface for data download" application package is only available via the Viewer. Once the application package has been enabled, it is possible, for example, to open the measured values that are saved in the memory via the **Read memory** function. It is also possible to save the measured data and physical units to a .csv file. This file can be imported

into a database. If the application package has not been enabled, the corresponding functions are disabled in the Viewer and it is not possible to access the measured data.

ℹ️ For more information on retrieving the measured values, see the Operating Instructions for the device.

7.6.4   Device memory disk space

Once the internal memory is full, the most recent data records overwrite the oldest data records. There are 2 GB of space available on the internal memory. With a storage interval of 60 sec, the device memory lasts for approx. 7.5 years.

7.6.5   Specifying the storage interval

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

Navigation using transmitter with touch screen
Settings menu → "Application parameters" → "Storage interval (s)"

Navigation using the Viewer
Menu "Teqwave Transmitter" → "Storage interval"

ℹ️ • The operating tool communicates the settings to the transmitter as soon as the Apply button is clicked.
• For detailed information on parameters, see the Operating Instructions for the device.

8   Diagnostic information

8.1   General troubleshooting

8.1.1   For the local display: transmitter with touch screen

Error	Possible causes	Remedial action
Local display dark and no output signals.	Supply voltage does not match that 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.

8.1.2   For the local display: transmitter with LEDs

Error	Possible causes	Remedial action
LEDs on the measuring device are not lit and no output signals.	Supply voltage does not match that specified on the nameplate.	Apply the correct supply voltage.
LEDs on the measuring device are not lit but signal output within the valid range.	Display module is faulty.	Contact Endress+Hauser Service.

8.1.3   For output signals

Error	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 failure mode of the outputs as indicated under "Signal on alarm" in the "Technical data" section.
Device 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 continuous flow of liquid to the sensor. 2. Remove air bubbles and/or particles. 3. Ensure the temperature value is stable.
	Suboptimal configuration.	Check the configuration of the "Averaging" parameter. The following values are recommended: • Temperature: 10 • Speed of sound: 5 • Analysis parameter: 5
Measuring device measures incorrectly or concentration value is zero.	Concentration app not used correctly.	Check the selected concentration app and change the concentration app if necessary.
	Communication error.	Restart the transmitter. In doing so, disconnect the device from the supply voltage for at least 30 seconds.

Error	Possible causes	Remedial action
	Operation outside the range of application.	1. Ensure homogeneous mixing of the liquid and continuous flow of liquid 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.

8.1.4 For access via the "Teqwave Viewer" operating tool

Problem	Possible causes	Remedial action
Not possible to connect to the "Teqwave 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 "Teqwave 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 device 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 uninterruptible network connection.

Problem	Possible causes	Remedial action
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 the 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 the Endress+ Hauser Service.

8.2 Diagnostics information for transmitter with LED status indication

Four light emitting diodes (LEDs) on the transmitter provide information on the condition of the device.

Transmitter with LED status indication

LED	Signal	Meaning
Power	Lit green	Supply voltage connected, initialization completed.
Error	Lit red	Measuring system error; read exact error code with the Viewer.
Sensor ok	Lit green	The sensor is working perfectly.
	Flashes	The measurement is not stable and/or at least one of the measured variables is outside the valid range. This can be caused by the following system conditions: • **Measuring range limits exceeded/undershot:** At least one of the measured variables has breached its configured permitted range. • **Calibration range limits exceeded/undershot:** At least one of the measured variables (temperature or concentration) has breached its permitted calibration range. • **Change in temperature too high:** The change in the temperature of the liquid has exceeded the limit value saved in the transmitter. Wait until the liquid is stable again. • **Change in concentration too high:** The change in the concentration of the liquid has exceeded the limit value saved in the transmitter. Wait until the liquid is stable again.
Sensor error	Lit red	Sensor error. Read exact error code with the Viewer. The following errors are possible: • **No liquid present:** Ensure that there is sufficient bubble-free liquid in the sensor. • **No sensor connected:** Ensure that the sensor is connected to the transmitter via the connecting cable.

8.3 Diagnostic information on local display and in operating tool

The transmitter with a touch screen and the "Teqwave 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 concentration > [*limit value*]"	Concentration of liquid changes too quickly and configured limit value is exceeded. The calculated measured value may be incorrect.	Ensure a stable medium concentration.
	"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 → 🗐 11.
	"Stationarity"	The concentration of the liquid changes too quickly and the measured value changes more frequently within 20 s than allowed by the statistical uncertainty considered in the measuring device. Settling processes can occur. The calculated measured value may be incorrect.	Ensure a stable medium concentration.
	"Measuring range [*measured variable*] < ; [*measured variable*] >"	The measured value is above or below the specified measuring range limits.	Select a measured value that is within the measuring range limits.
	"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.

Signal color	Diagnostic message	Description	Measures
	"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 devices. 2. Check and guarantee Modbus communication with external measuring devices.
	"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 device 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 → 🕮 11 into consideration. 3. If the error persists, contact Endress+Hauser-Service.

Signal color	Diagnostic message	Description	Measures
	"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.

8.4   Diagnostic information via the Modbus protocol

The diagnostic information can be indicated via status bits:

Bit	Hexadecimal	Diagnostic message	Description	Measures
0	0x00000001	No sensor	The sensor is not connected.	Make sure that the sensor is connected to the transmitter via the connecting cable → 🕮 17.
1	0x00000002	No liquid	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.
2	0x00000004	Temperature chip is defective	Sensor is faulty.	Contact Endress+Hauser Service.
3	0x00000008			
4	0x00000010	Sensor memory faulty	EEPROM in the sensor is faulty.	Contact Endress+Hauser Service.
7	0x00000080	System is starting	Measuring device is initializing.	-
8	0x00000100	Process disturbance detected	The measured dispersion is greater than the configured switch point.	▪ Remove air bubbles and/or particles. ▪ Take the recommended mounting position into consideration → 🕮 11.

Bit	Hexadecimal	Diagnostic message	Description	Measures
9	0x00000200	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 into consideration → 🖹 11. 3. If the error persists, contact Endress+Hauser Service.
10	0x00000400	Sensor configuration failed: sensor data do not match the transmitter software.	Missing calibration.	Contact Endress+Hauser Service.
11	0x00000800			
12	0x00001000			
16	0x00010000	System error	Communication error between internal processors.	1. Restart the transmitter. 2. If the error persists, contact Endress+Hauser Service.
17	0x00020000	Compensation not possible: Modbus communication faulty.	Missing compensation value.	1. Check the functional integrity of the external measuring devices. 2. Check and guarantee Modbus communication with external measuring devices.

Modbus communication errors

Code	Name	Description
0x00	-	No error
0x01	Illegal function	The selected function code is not permitted in the transmitter. Always use Read Input Registers (0x04) to read measured values.
0x02	Illegal data address	The selected start address is not permitted in the transmitter. Only use the start addresses listed to read measured values.

8.5   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 device 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 measured error. On the other hand, the density measured error can already be greater than the measured error specified under reference conditions at values over 0.25.

Therefore, if the speed of sound and temperature are used for concentration measurement, the value of 1 should not be exceeded. If the density is used, the value of 0.25 should not be exceeded.

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

Navigation using transmitter with touch screen: "Settings" → "Application parameters" → "Diagnosis" → "Process disturbance" → "Switch point"

Navigation using the Viewer: menu "Teqwave Transmitter" → "View filter" → "Process disturbance" → "Switch point"

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