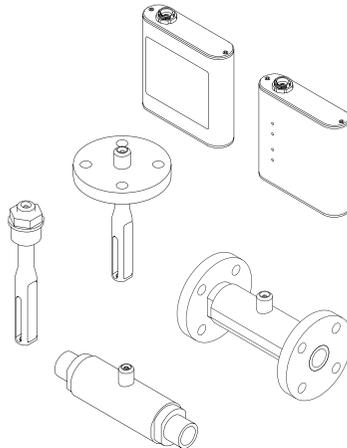


# Brief Operating Instructions Teqwave F/I

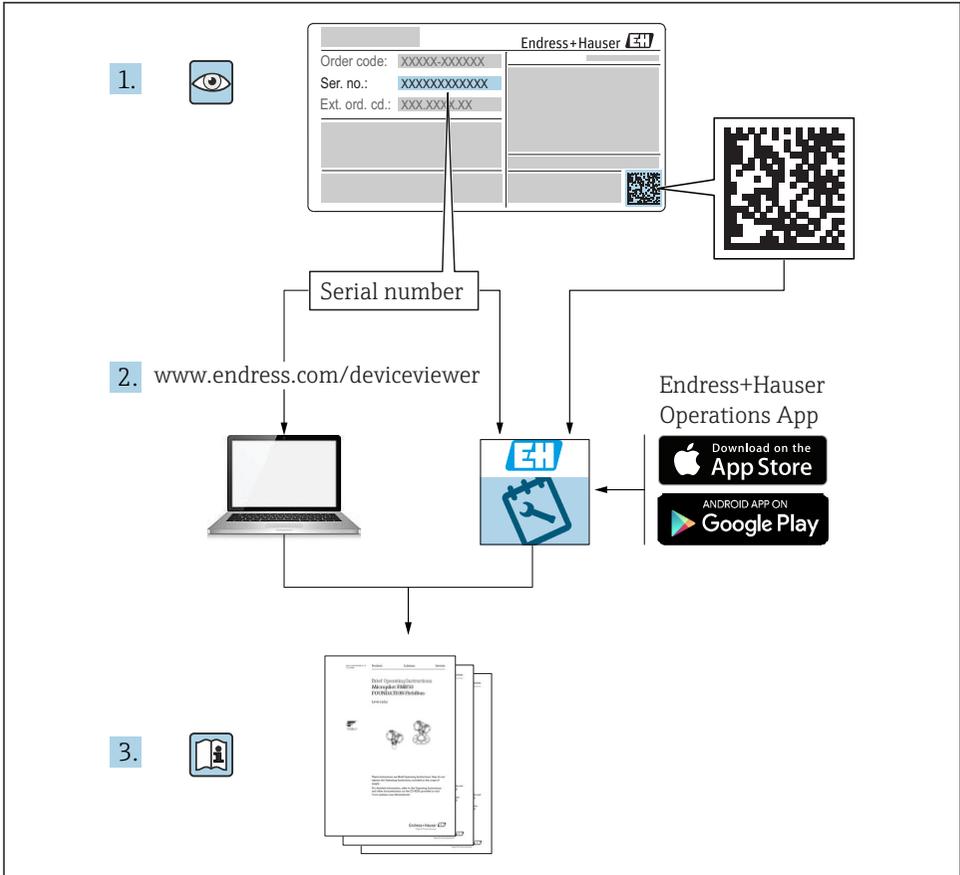
Device with acoustic surface wave technology



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](http://www.endress.com/deviceviewer)
  - Smart phone/tablet: *Endress+Hauser Operations App*



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# 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
	<b>Permitted</b> Procedures, processes or actions that are permitted.		<b>Preferred</b> Procedures, processes or actions that are preferred.
	<b>Forbidden</b> Procedures, processes or actions that are forbidden.		<b>Tip</b> Indicates additional information.
	Reference to documentation		Reference to page
	Reference to graphic		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		<b>Ground connection</b> A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	<b>Signal ground connection</b> A terminal that can be used as the ground contact for the digital input.		<b>Relay output connection</b> A terminal that can be used as a relay output.

Symbol	Meaning
	<b>Protective Earth (PE)</b> A terminal which must be connected to ground prior to establishing any other connections.  The ground terminals are situated inside and outside the device: <ul style="list-style-type: none"> <li>▪ Inner ground terminal: Connects the protective earth to the mains supply.</li> <li>▪ Outer ground terminal: Connects the device to the plant grounding system.</li> </ul>

### 1.1.4 Communication symbols

Symbol	Meaning	Symbol	Meaning
	<b>Wireless Local Area Network (WLAN)</b> Communication via a wireless, local network.		<b>Bluetooth</b> Wireless data transmission between devices over a short distance.
	<b>LED</b> Light emitting diode is off.		<b>LED</b> Light emitting diode is on.
	<b>LED</b> Light emitting diode is flashing.		

Symbol	Meaning	Symbol	Meaning
	<b>Wireless Local Area Network (WLAN)</b> Communication via a wireless, local network.		<b>LED</b> Light emitting diode is off.
	<b>LED</b> Light emitting diode is on.		<b>LED</b> 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	<u>1</u> , <u>2</u> , <u>3</u> ...	Series of steps
A, B, C, ...	Views	A-A, B-B, C-C, ...	Sections
	Hazardous area		Safe area (non-hazardous area)
	Flow direction		

## 2 Basic safety instructions

### 2.1 Requirements for the 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.
- ▶ 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.

### 2.2 Designated use

#### Application and media

The measuring device described in these Brief Operating Instructions is intended only for flow measurement of gases.

The measuring device described in these Brief Operating Instructions is intended only for concentration measurement of liquids.

Depending on the version ordered, the measuring device can also measure potentially explosive, flammable, poisonous and oxidizing media.

Measuring devices for use in hazardous areas, in hygienic applications or where there is an increased risk due to process pressure, are labeled accordingly on the nameplate.

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

- ▶ Keep within the specified pressure and temperature range.
- ▶ Only use the measuring device in full compliance with the data on the nameplate and the general conditions listed in the Operating Instructions and supplementary documentation.
- ▶ Based on 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 device only for media to which the process-wetted materials are sufficiently resistant.
- ▶ If the ambient temperature of the measuring device is outside the atmospheric temperature, it is absolutely essential to comply with the relevant basic conditions as specified in the device documentation.
- ▶ Protect the measuring device 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 fluid-wetted materials in the process.
- ▶ Keep within the specified pressure and temperature range.

#### **NOTICE**

#### **Verification for borderline cases:**

- ▶ For special fluids and fluids for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of fluid-wetted materials, but does not accept any warranty or liability as minute changes in the temperature, concentration or level of contamination in the process can alter the corrosion resistance properties.

### Residual risks

#### **WARNING**

**The electronics and the medium may cause the surfaces to heat up. This presents a burn hazard!**

- ▶ For elevated fluid 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 federal/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, gloves must be worn.

## 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. Endress+Hauser confirms this by affixing the CE mark to the device.

## 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 connector interconnects the sensor and transmitter.

## 3.1 Product design

Two sensor versions are available:

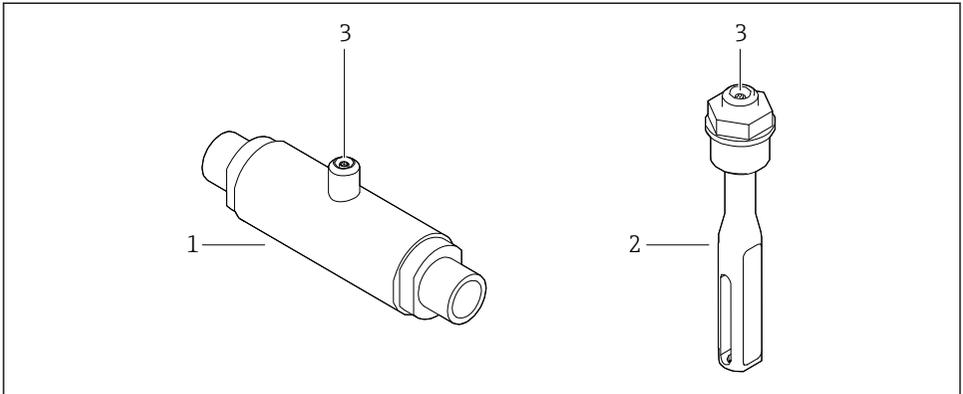
- "Teqwave F" sensor
- "Teqwave I" sensor

Two transmitter versions are available:

- Transmitter with a touchscreen
- Transmitter with LED status indication

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.

### 3.1.1 Sensor

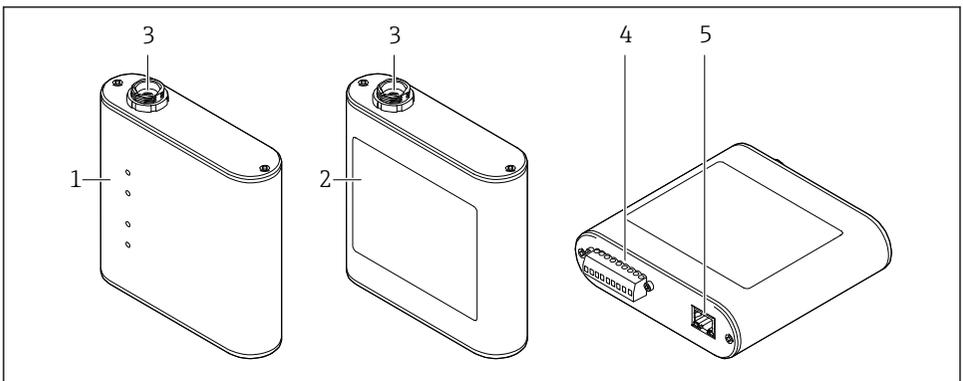


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#### 1 Sensor versions

- 1 "Teqwave F" sensor
- 2 "Teqwave I" sensor
- 3 Push-pull connection for connecting to the transmitter

### 3.1.2 Transmitter



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#### 2 Transmitter versions

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

### 3.1.3 Concentration apps

A concentration app contains specific configurations for the measurement of a certain liquid and, along with the measured sensor signals, is used as the basis for calculating the concentration. Endress+Hauser provides a separate concentration app for every type of fluid.

The concentration app is a file with lmf format. A list of the available concentration apps is provided in the Applicator .

If you require a concentration app that is not already listed in the Applicator, Endress+Hauser requires a sample of the fluid to create the concentration app. Every transmitter can use a maximum of 25 concentration apps.

Concentration apps are individually encoded to work only with the serial number of a specific transmitter. The transmitter in service uses the serial number saved in the .lmf file to check whether the concentration app has been specifically configured for use with this transmitter. If this is not the case, it is not possible to add the concentration app.

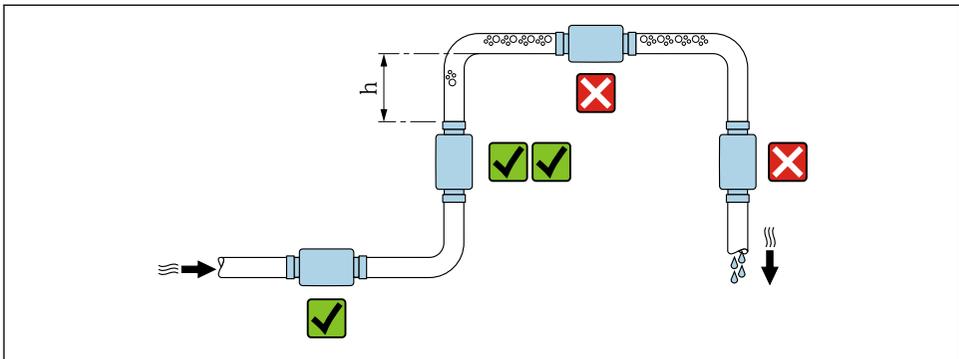
The data sheet provided with the concentration app contains information about the fluid, the permitted measuring ranges and the accuracy of the concentration measurement.

## 4 Installation

### 4.1 Mounting requirements

#### 4.1.1 Mounting position

##### Mounting location

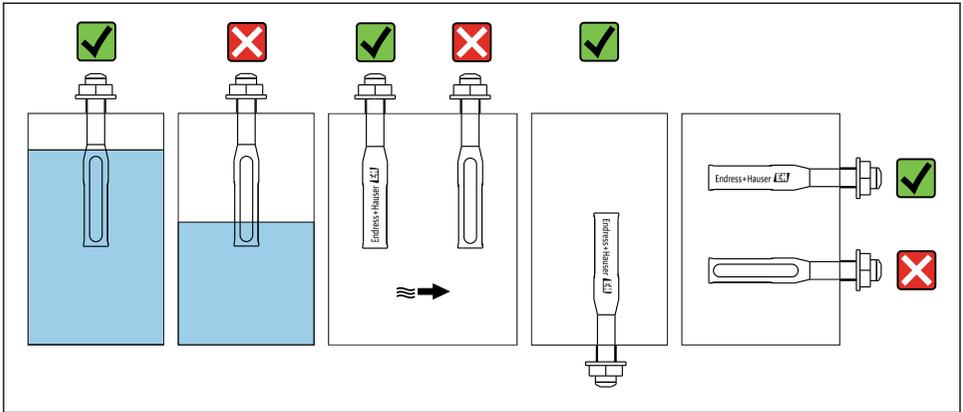


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3 Mounting location

Ideally, the sensor should be installed in an ascending pipe, while ensuring a sufficient distance is kept to the next pipe elbow:  $h \geq 5 \times DN$ .

## Orientation Teqwave I



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### 4 Orientation of Teqwave I

Mount Teqwave I so that the active sensor area can be fully immersed in the measured liquid.

If installing the sensor in a pipe, make sure the sensor is aligned correctly to avoid irregular flow to the sensor. Rotate the sensor so that the dot on the process connection is aligned with the flow direction.

If installing the sensor in a horizontal position, make sure the sensor is aligned correctly to avoid the buildup of deposits around the sensing element. Rotate the sensor so that the black dot on the process connection points up or down.

### NOTICE

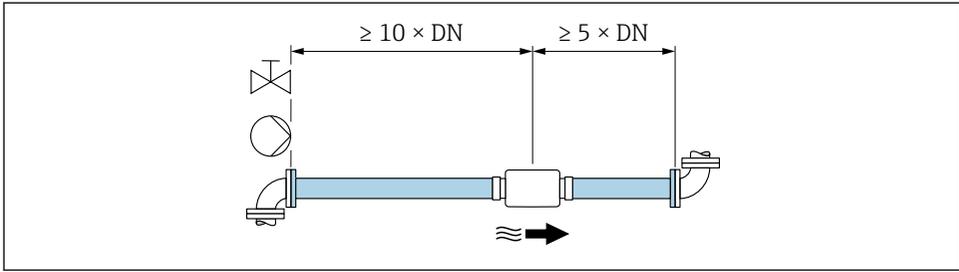
#### Measurement result is not representative

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

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

#### Inlet and outlet runs

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



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5 Inlet and outlet runs

## 4.2 Mounting the measuring device

### 4.2.1 Installing the sensor

#### **WARNING**

#### Danger due to improper process sealing

- ▶ Use seals whose internal diameters are larger than or the same size as the process connection and pipe.
- ▶ Use clean, undamaged seals only.
- ▶ Secure the seals correctly.

#### Mounting the sensor: Teqwave F

#### **NOTICE**

#### Damage to the sensor

Twisting the sensor when tightening the threaded joints can damage the sensor.

- ▶ When tightening the threaded joint, always use a second open-ended wrench or pipe wrench to apply counter-pressure (prevents twisting).
- ▶ Do not hold the housing with the pipe wrench or open-ended wrench.
- ▶ Mount the sensor in the pipe or on the tank wall in full compliance with the mounting conditions → 10.

#### Mounting the sensor: Teqwave I

Mount the sensor on the pipe or tank wall on a threaded adapter or flange adapter in full compliance with the mounting conditions → 10.

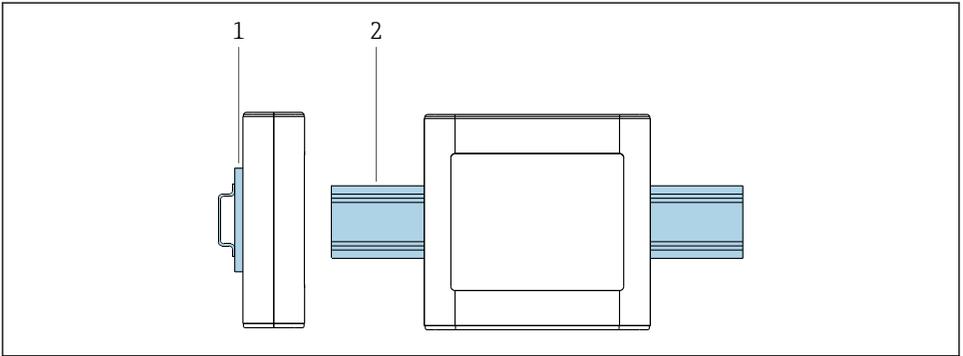
### 4.2.2 Mounting the transmitter

#### **NOTICE**

#### Ambient temperature too high

Danger of electronics overheating and deformation of the housing.

- ▶ Do not exceed the maximum permissible ambient temperature.
- ▶ If operating outdoors, avoid direct sunlight and exposure to severe weather conditions, particularly in warmer climatic regions.



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#### 6 Mounting the transmitter

- 1 DIN rail holder
- 2 DIN rail according to DIN EN 60715 TH 35

Mount the transmitter on the DIN rail using the DIN rail holder.

### 4.3 Post-mounting check

Perform the following checks once you have installed the measuring device:

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	<input type="checkbox"/>
Does the device meet the specifications, such as: <ul style="list-style-type: none"> <li>▪ Ambient temperature</li> <li>▪ Nominal pressure</li> <li>▪ Measuring range</li> </ul>	<input type="checkbox"/>
Installation	Notes
Is there a sufficient distance between the sensor and the next pipe elbow? → 10	<input type="checkbox"/>
Teqwave I: Is the active sensor area fully immersed in the liquid? → 11	<input type="checkbox"/>
If installing Teqwave I in a pipe: Is the black dot on the process connection aligned with the flow direction?	<input type="checkbox"/>
If installing Teqwave I in a horizontal position: Align the dot on the process connection so that it points either up or down?	<input type="checkbox"/>
Process environment/process conditions	Notes
Are the specifications for the inlet run observed? Inlet run $\geq 10 \times DN$	<input type="checkbox"/>
Are the specifications for the outlet run observed? Outlet run $\geq 5 \times DN$	<input type="checkbox"/>
Is the measuring device protected against precipitation and direct sunlight?	<input type="checkbox"/>

## 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

##### Connecting cable between sensor and transmitter

Only use the cable supplied.

##### Electrical safety

National regulations and standards apply.

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

##### *Modbus Ethernet cable*

<b>Cable type</b>	100 Base-TX
<b>Cable category</b>	Min. CAT5
<b>Plug type</b>	RJ-45 (8P8C)
<b>Shielding</b>	S/FTP, F/FTP, SF/FTP, S/UTP, F/UTP or SF/UTP
<b>Cable length</b>	Max. 30 m (98 ft)

##### *Power supply and signal cables*

<b>Cable type</b>	Strand or solid wire
<b>Conductor cross-section</b>	0.129 to 1.31 mm <sup>2</sup> (16 to 26 AWG)
<b>Temperature range</b>	<ul style="list-style-type: none"> <li>▪ -40 to 70 °C (-40 to 158 °F) when mounted in a fixed position</li> <li>▪ -10 to 50 °C (14 to 122 °F) when cable can move freely</li> </ul>
<b>Cable length</b>	Max. 30 m (98 ft)
<b>Power supply cable</b>	Standard installation cable is sufficient.
<b>Analog output</b>	
<b>Digital input</b>	
<b>Relay output (alarm)</b>	

#### 5.1.2 Terminal assignment

Terminal	Assignment	
V+	<b>V<sub>in</sub></b> 24 V DC	Supply voltage
V-		

Terminal	Assignment	
+	<b>out</b> 0 to 10 V; 4 to 20 mA	Analog output
-		
0	<b>output</b> selection	Digital input
1		
		Signal ground
	<b>alarm</b> max. 50 V, 1 A	Relay output
		

### 5.1.3 Requirements for supply unit

Supply voltage	DC 24 V (nominal voltage: DC 18 to 35 V)
Power unit	The power unit must be tested to ensure it meets safety requirements (e.g. PELV, SELV).

## 5.2 Connecting the measuring device



### 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

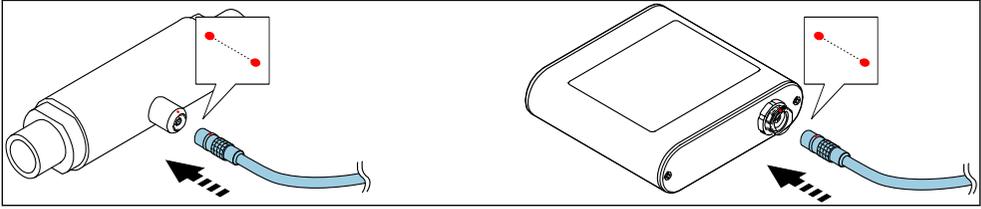
Connect the sensor to the transmitter only using the connecting cable supplied.



### Damage to the measuring device

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).



7 Connecting the connecting cable

Insert the push-pull connector of the connecting cable into the socket at the position indicated until they engage with a click.

**i** Red dots on the connectors indicate the position.

### 5.2.2 Connecting the supply voltage cables

**i** 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.

Connect the supply voltage cables to the transmitter via screw terminals, terminal assignment → 17.

### 5.2.3 Connecting the signal cables

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.

#### Connecting the analog output, digital input, signal ground and relay output

Connect the cable to the transmitter via screw terminals, terminal assignment → 14.

#### Connecting the Ethernet cable

Connect the Ethernet cable to the Ethernet port of the transmitter and the Ethernet port of the computer or network.

Connecting to the "Teqwave Viewer" operating tool .

### 5.2.4 Ensuring potential equalization

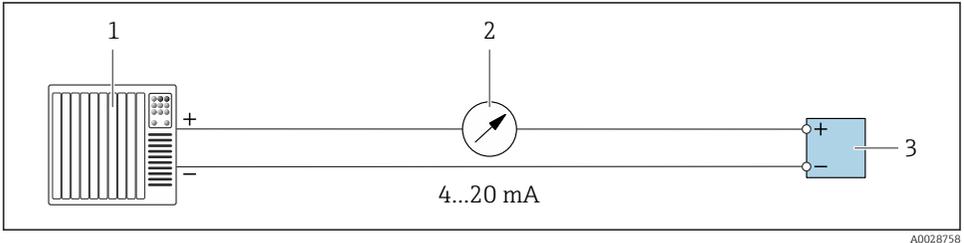
The measuring device must be included in the potential equalization. The transmitter and sensor are connected to the same potential via the connecting cable. This potential must be current-free.

**i** Terminal **V-** is electrically connected to the transmitter housing and can be used for potential equalization.

## 5.3 Special connecting instructions

### 5.3.1 Connecting examples

#### Current output 4 to 20 mA

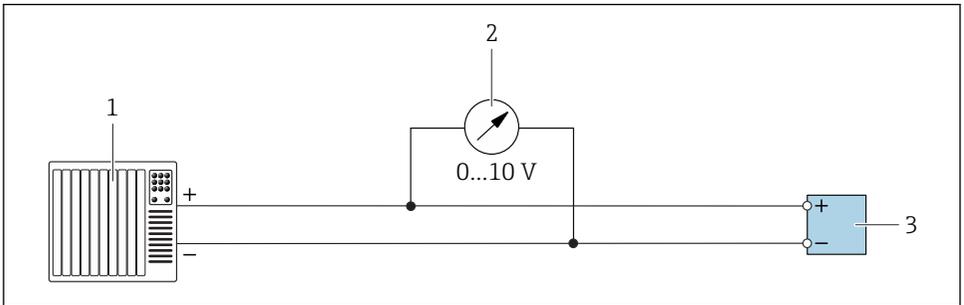


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8 Connection example for current output, active, 4 to 20

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

#### Voltage output 0 to 10 V

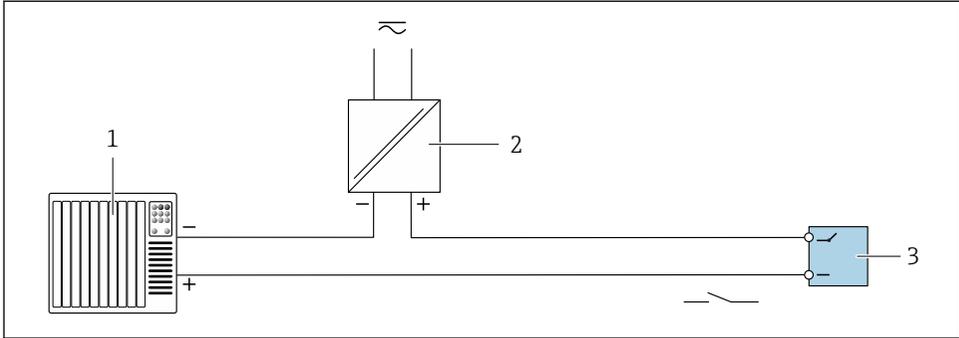


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9 Connection example for voltage output, active, 0 to 10 V

- 1 Automation system with current or voltage input (e.g. PLC)
- 2 Analog display unit for voltage: minimum load  $750 \Omega$
- 3 Transmitter

## Relay output



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### 10 Connection example for relay output, passive

- 1 Automation system with switch input (e.g. PLC)
- 2 Power supply: max. 50 V AC/DC
- 3 Transmitter

## Digital input (elective inputs)

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

Configuration options:

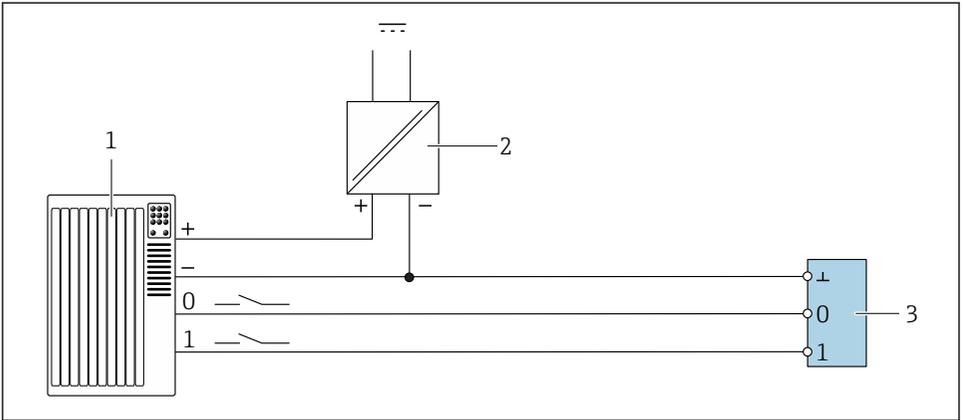
Active analog output	Digital input "0"	Digital input "1"
Channel 1	Open	Open
Channel 2	Ground	Open
Channel 3	Open	Ground
Channel 4	Ground	Ground

### NOTICE

#### Interference at the digital input

If the device is connected incorrectly, this impacts the functional integrity of the measuring device.

- If the digital input is used, connect digital inputs "0" and "1" to signal ground.



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11 Connection example for the digital input

- 1 Automation system with switch input (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.

### 5.4 Post-connection check

Are the cables and measuring device undamaged (visual inspection)?	<input type="checkbox"/>
Do the cables used comply with the requirements → 14?	<input type="checkbox"/>
Do the cables have adequate strain relief?	<input type="checkbox"/>
Are all the connectors firmly seated?	<input type="checkbox"/>
Is the terminal assignment correct?	<input type="checkbox"/>
Are all screw terminals firmly tightened?	<input type="checkbox"/>
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)?	<input type="checkbox"/>

## 6 Operating options

### 6.1 Overview of the operating 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

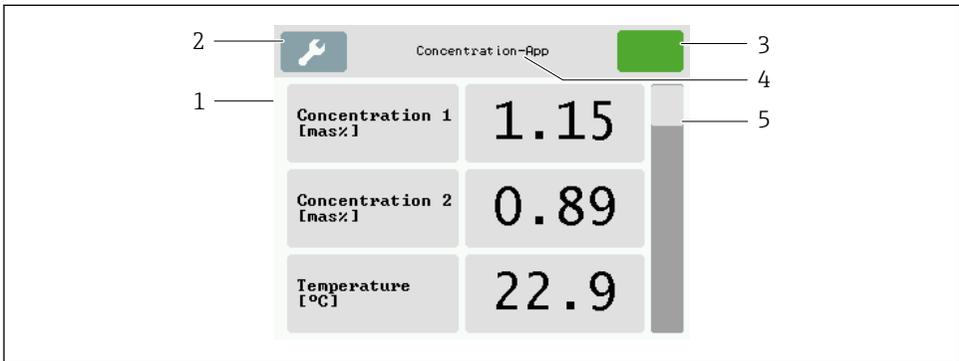
If you are using the transmitter with a touch screen, it is possible to access the measuring device via the transmitter touch screen and via the "Teqwave Viewer" operating tool.

Functions supported by the transmitter with a touch screen:

- Display and graphic visualization of measured variables
- Selection of concentration apps
- Device configuration

#### 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.



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#### 12 Operational display

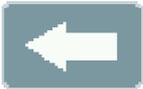
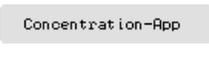
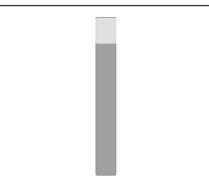
- 1 Measured value display
- 2 Settings menu
- 3 Status indication
- 4 Name of the concentration app
- 5 Scroll bar

#### 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 see all the measured variables.

## Functions of the display and operating elements

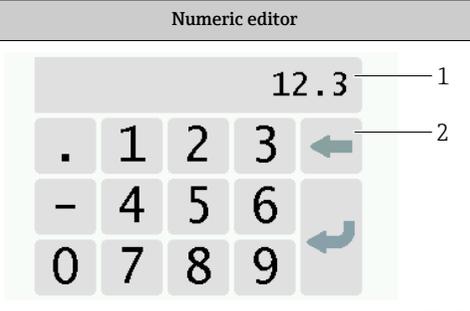
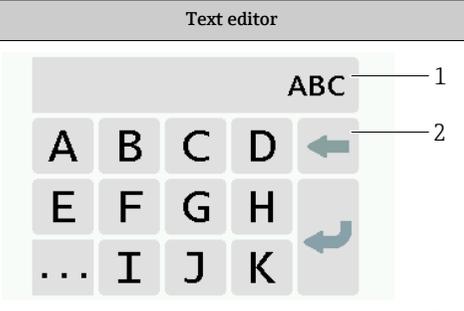
Button	Description
	<b>Settings menu</b> Opens the settings.
	<b>Navigation</b> Navigate between the menus or submenus.
	<b>Status indication</b> Indicates the current status, and navigation to more detailed status messages in text format.
	<b>Concentration app name or operational display button</b> Displays the name of the concentration app, and navigation to the operational display.
	<b>Measured variable display</b> Displays the measured variable and its unit, and navigation to the Graph View.
	<b>Measured value display</b> Displays the measured value, and navigation to the Graph View.
	<b>Scroll bar</b> 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
	<b>Blue background</b> Parameter is selected or function is activated.
	<b>Gray background</b> Parameter is not selected or function is deactivated.

### Editing elements

Numeric editor	Text editor
	
<small>A0035468</small>	<small>A0035469</small>
<p>1 Display area for the entered values</p> <p>2 Input mask</p>	<p>1 Display area for the entered values</p> <p>2 Input mask</p>

### Input mask

The following input symbols are available in the input mask 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 input position.
	Inserts minus sign at the input position.
	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" →  34.

## 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 surface

Sharp objects, electrostatic discharge, water and the use of pens not designed for touch screens, such as standard pencils, can cause a malfunction of touch-control transmitters or damage the touch surface.

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

## 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 →  13
- "Post-connection check" checklist →  19

## 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 initial display to the measured value display.



If nothing appears on the local display or an error message is displayed, refer to the "Diagnostics and troubleshooting" section →  31

## 7.3 Setting the operating language

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



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"

 Once the user has selected the language, the operating tool communicates the language setting to the transmitter.

Parameter	Procedure	Selection/input	Factory setting
Language settings	Tap to select the language.	<ul style="list-style-type: none"> <li>▪ German</li> <li>▪ English</li> <li>▪ French</li> <li>▪ Spanish</li> <li>▪ Italian</li> </ul>	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 LED status indication, the configuration must be performed via the Viewer.

### 7.4.1 Selecting the concentration app

A concentration app is enabled via the menu **Select concentration app** (transmitter with a 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 apps"

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

### 7.4.2 Setting the concentration offset

Manual offsets are configured for the calculated concentrations via the menu **Select concentration app** (transmitter with a touch screen) or **Concentration offset** (Viewer). This allows users to adapt the measuring technology to different process conditions (e.g. higher line pressure).

*Navigation using transmitter with touch screen*

Settings menu → Select concentration app → "Application settings" → "Concentration 1-2 Offset"

 The **Application 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"



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

### 7.4.3 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).



- 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

1. Settings menu → "Application parameter" → "Measuring unit" → "Concentration 1-2"
2. Settings menu → "Application parameter" → "Measuring unit" → "Temperature"
3. Settings menu → "Application parameter" → "Measuring unit" → "Density"

#### Navigation using the Viewer

1. Menu "Teqwave Transmitter" → "View settings" → "Concentration 1-2"
2. Menu "Teqwave Transmitter" → "View settings" → "Temperature"
3. Menu "Teqwave Transmitter" → "View settings" → "Density"



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

### 7.4.4 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" → "Analog 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.
- For detailed information on the parameters, see the Operating Instructions for the device.

### 7.4.5 Configuring the measuring range

The Measurement range menu contains parameters for configuring the measuring range.

-  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 maximum (10 V/20 mA).
- A valid measuring range must be configured for the selected concentration app in order to ensure the function works correctly. 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"

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

### 7.4.6 Configuring the relay 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" → Select measured value → "Hysteresis"
4. Settings menu → "Application parameters" → "Relay output" → "Settings" → Select measured value → "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 the 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 "Temperature" → "Kalman filter"

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

#### 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" → "Deactivated"
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"

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

### 7.4.9 Configuring the failsafe mode

The menus **Diagnosis** (transmitter with a touch screen) and **Display 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 actions"
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 the parameters, see the Operating Instructions for the device.

## 7.5 Advanced settings

The measuring device supports the performance of a field calibration.

### 7.5.1 Performing field calibration with a fluid

Different conditions when the concentration app is created in the laboratory compared with real-life process conditions can cause 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.

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.



In addition to performing a field calibration with a fluid, a concentration offset can also be set → 24.

#### 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 fluid (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 ex-works, 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 such cases, 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 values and physical units to a .csv file. This file can then 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 values.



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 automatically overwrite the oldest data records. There are 2 GB of space available on the internal memory. With a storage interval of 60 sec, there is enough space in the memory for approximately 7.5 years.

### 7.6.5 Specifying the storage interval

A storage interval of between 10 to 7200 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"



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

## 8 Diagnostics and troubleshooting

### 8.1 General troubleshooting

#### 8.1.1 For the local display: Transmitter with touch screen

Problem	Possible causes	Remedial action
Local display dark and no output signals.	The supply voltage does not match the specifications 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 using the "Brightness" function via the "Teqwave Viewer" operating tool.
	Display module is defective.	Contact Endress+Hauser Service.

#### 8.1.2 For the local display: Transmitter with LEDs

Problem	Possible causes	Remedial action
LEDs on the measuring device are not lit and no output signals.	The supply voltage does not match the specifications on the nameplate.	Apply the correct supply voltage.
LEDs on the measuring device are not lit, but signal output is within valid range.	Display module is defective.	Contact Endress+Hauser Service.

### 8.1.3 For output signals

Problem	Possible causes	Remedial action
Signal output outside the valid range.	Incorrect configuration.	<ol style="list-style-type: none"> <li>1. Check the configuration and correct if necessary.</li> <li>2. Stay within the specifications for the outputs indicated in the "Technical data".</li> <li>3. Pay attention to the failsafe mode of the outputs indicated under "Signal on alarm" in the "Technical data".</li> </ol>
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 is not stable.	Operation outside the range of application.	<ol style="list-style-type: none"> <li>1. Ensure the homogeneous mixing of the liquid and continuous flow of liquid to the sensor.</li> <li>2. Remove air bubbles and/or particles.</li> <li>3. Ensure the temperature value is stable.</li> </ol>
	Unfavorable configuration.	Check the configuration of the "Averaging" parameter. The following values are recommended: <ul style="list-style-type: none"> <li>▪ Temperature: 10</li> <li>▪ Speed of sound: 5</li> <li>▪ Concentration: 5</li> </ul>
Measuring device measures incorrectly or concentration value is zero	Concentration app not used correctly.	Check the concentration app selected and change the app if necessary.
	Communication error	Restart the transmitter. In doing so, disconnect it from the supply voltage for at least 30 s.
	Operation outside the range of application.	<ol style="list-style-type: none"> <li>1. Ensure the homogeneous mixing of the liquid and continuous flow of liquid to the sensor.</li> <li>2. Remove air bubbles and/or particles.</li> <li>3. Ensure the temperature value is stable.</li> </ol>

Problem	Possible causes	Remedial action
	Sensor is fouled.	Make sure the sensor is free from dirt and deposit build-up.
	Sensor is defective.	<ol style="list-style-type: none"> <li>1. Check the sensor with the "Check sensor" function.</li> <li>2. Contact Endress+Hauser Service if limit value is exceeded.</li> </ol>

#### 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.
Permanent connection to the "Teqwave Viewer" operating tool is disconnected after a few days.	Internet protocol has been changed.	Check the configuration of the Internet protocol and correct if necessary.
	Measuring device is connected to multiple operating tools.	For a permanent connection, only establish one single connection.
Error message when running the "Read memory" function.	Network connection was interrupted.	Ensure uninterruptible network connection.
After reading out the memory, measured values from 1904 appear in the graph.	Communication error or device memory defective.	<ol style="list-style-type: none"> <li>1. Restart the transmitter. In doing so, disconnect it from the supply voltage for at least 30 s.</li> <li>2. Read the memory again.</li> <li>3. If the error persists, contact Endress+ Hauser Service.</li> </ol>
After reading out the memory, all the measured values are displayed with the value zero.	Communication error or device memory defective.	<ol style="list-style-type: none"> <li>1. Restart the transmitter. In doing so, disconnect it from the supply voltage for at least 30 s.</li> <li>2. Read the memory again.</li> <li>3. If the error persists, contact Endress+ Hauser Service.</li> </ol>

## 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: <ul style="list-style-type: none"> <li>▪ <b>Measuring range limits exceeded/undershot:</b> At least one of the measured variables has breached the configured permitted range.</li> <li>▪ <b>Calibration range limits exceeded/undershot:</b> At least one of the measured variables (temperature or concentration) has breached the applicable calibration range.</li> <li>▪ <b>Change in temperature too high:</b> The change in the temperature of the liquid has exceeded the limit value saved in the transmitter. Wait until the liquid is stable again.</li> <li>▪ <b>Change in concentration too high:</b> The change in the concentration of the liquid has exceeded the limit value saved in the transmitter. Wait until the liquid is stable again.</li> </ul>
Sensor error	Lit red	Sensor error. Read exact error code with the Viewer. The following errors are possible: <ul style="list-style-type: none"> <li>▪ <b>No liquid present:</b> Ensure that there is sufficient bubble-free liquid in the sensor.</li> <li>▪ <b>No sensor connected:</b> Make sure that the sensor is connected to the transmitter via the connecting cable.</li> </ul>

## 8.3 Diagnostics 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 fluid 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 fluid concentration.

Signal color	Diagnostic message	Description	Measures
	"Process disturbance detected, dispersion >   <i>limit value</i>  "	The measured dispersion is greater than the configured switch point.	<ol style="list-style-type: none"> <li>1. Remove air bubbles and/or particles.</li> <li>2. Take recommended mounting position into consideration →  10.</li> </ol>
	"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 fluid concentration.
	"Measuring range   <i>measured variable</i>   < ;   <i>measured variable</i>   >:"	The measured value is above or below the specified measuring range limits.	Select a measured value that is within the measuring range limits.
	"Calibration   <i>measured variable</i>   < ;   <i>measured variable</i>   >:"	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 data storage faulty"	Buffer battery is discharged.	<ol style="list-style-type: none"> <li>1. Supply voltage to the transmitter for a few hours.</li> <li>2. Then start the transmitter again.</li> <li>3. If the error persists, contact Endress+Hauser Service.</li> </ol>
Red	"No liquid present"	No liquid present.	Ensure that there is sufficient liquid in the sensor.
		Sensor is fouled.	Make sure the sensor is free from dirt and deposit build-up.
		Air bubbles or particles in the liquid.	Remove air bubbles and/or particles.
		Communication error	Restart the transmitter. In doing so, disconnect it from the supply voltage for at least 30 s.
	"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 damaged.	Check connecting cable and connections for damage.
		Communication error	Restart the transmitter. In doing so, disconnect it from the supply voltage for at least 30 s.

Signal color	Diagnostic message	Description	Measures
	"Temperature chip faulty"	Sensor is defective.	Contact Endress+Hauser Service.
	"Sensor memory faulty"	Sensor is defective.	Contact Endress+Hauser Service.
	"System is starting"	Measuring device is initializing.	Contact Endress+Hauser Service.
	"Process disturbance"	The value measured for the dispersion is greater than 1.	<ol style="list-style-type: none"> <li>1. Remove air bubbles and/or particles.</li> <li>2. Take recommended mounting position into consideration → 10.</li> <li>3. If the error persists, contact Endress+Hauser Service.</li> </ol>
	"Sensor configuration failed"	Missing calibration.	Contact Endress+Hauser Service.
	"System error"	Communication error between internal processors.	<ol style="list-style-type: none"> <li>1. Restart the transmitter.</li> <li>2. If the error persists, contact Endress+Hauser Service.</li> </ol>

## 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 → 15.
1	0x00000002	No liquid	No liquid present.	Ensure that there is sufficient liquid in the sensor.
			Sensor is fouled.	Make sure the sensor is free from dirt and deposit build-up.
			Air bubbles or particles in the liquid.	Remove air bubbles and/or particles.
			Communication error	Restart the transmitter. In doing so, disconnect it from the supply voltage for at least 30 sec.
2	0x00000004	Temperature chip is faulty	Sensor is defective.	Contact Endress+Hauser Service
3	0x00000008			
4	0x00000010	Sensor memory faulty	EEPROM in the sensor is damaged.	Contact Endress+Hauser Service.
7	0x00000080	System starting	Measuring device is initializing.	-

Bit	Hexadecimal	Diagnostic message	Description	Measures
8	0x00000100	Process disturbance detected	The measured dispersion is greater than the configured switch point.	<ol style="list-style-type: none"> <li>1. Remove air bubbles and/or particles.</li> <li>2. Take recommended mounting position into consideration → 10</li> </ol>
9	0x00000200	Process disturbance	The value measured for the dispersion is greater than 1.	<ol style="list-style-type: none"> <li>1. Remove air bubbles and/or particles.</li> <li>2. Take recommended mounting position into consideration → 10.</li> <li>3. If the error persists, contact Endress+Hauser Service.</li> </ol>
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.	<ol style="list-style-type: none"> <li>1. Restart the transmitter.</li> <li>2. If the error persists, contact Endress+Hauser Service.</li> </ol>

## 8.5 Diagnostics 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 does not display the concentration any more. 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" → "Display filter" → "Process disturbance" → "Switch point"





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