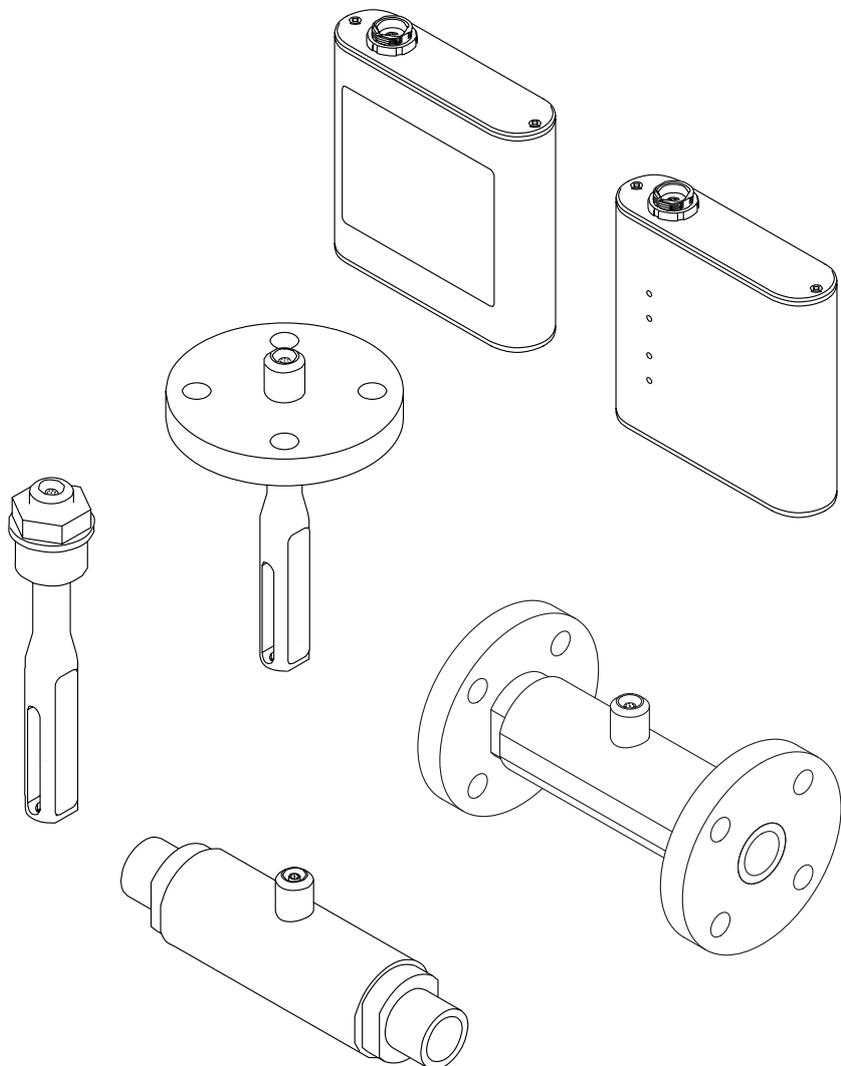


# Operating Instructions

## Teqwave F/I

## Modbus TCP

Measuring device with acoustic surface wave technology



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

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# 1 About this document

## 1.1 Document function

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

## 1.2 Symbols

### 1.2.1 Safety symbols

#### **DANGER**

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

#### **WARNING**

This symbol alerts you to a 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.

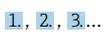
#### **NOTICE**

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

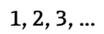
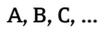
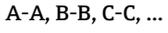
### 1.2.2 Electrical symbols

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>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>
	<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.

### 1.2.3 Symbols for certain types of information

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.
	Notice or individual step to be observed.
	Series of steps.
	Result of a step.
	Help in the event of a problem.
	Visual inspection.

### 1.2.4 Symbols in graphics

Symbol	Meaning
	Item numbers
	Series of steps
	Views
	Sections
	Hazardous area
	Safe area (non-hazardous area)
	Flow direction

## 1.3 Documentation

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

- *W@M Device Viewer* ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): Enter the serial number from nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

 Detailed list of the individual documents along with the documentation code  
→  75

### 1.3.1 Standard documentation

Document type	Purpose and content of the document
Technical Information	<p><b>Planning aid for your device</b></p> <p>The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.</p>
Sensor Brief Operating Instructions	<p><b>Guides you quickly to the 1st measured value - Part 1</b></p> <p>The Sensor Brief Operating Instructions are aimed at specialists with responsibility for installing the measuring device.</p> <ul style="list-style-type: none"> <li>▪ Incoming acceptance and product identification</li> <li>▪ Storage and transport</li> <li>▪ Installation</li> </ul>
Transmitter Brief Operating Instructions	<p><b>Guides you quickly to the 1st measured value - Part 2</b></p> <p>The Transmitter Brief Operating Instructions are aimed at specialists with responsibility for commissioning, configuring and parameterizing the measuring device (until the first measured value).</p> <ul style="list-style-type: none"> <li>▪ Product description</li> <li>▪ Installation</li> <li>▪ Electrical connection</li> <li>▪ Operation options</li> <li>▪ System integration</li> <li>▪ Commissioning</li> <li>▪ Diagnostic information</li> </ul>
Description of Device Parameters	<p><b>Reference for your parameters</b></p> <p>The document provides a detailed explanation of each individual parameter in the Expert operating menu. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.</p> <p>The document provides Modbus-specific information for each individual parameter in the Expert operating menu.</p>

### 1.3.2 Supplementary device-dependent documentation

Additional documents are supplied depending on the device version ordered: Always comply strictly with the instructions in the supplementary documentation. The supplementary documentation is an integral part of the device documentation.

## 1.4 Registered trademarks

### Modbus®

Registered trademark of SCHNEIDER AUTOMATION, INC.

## 2 Basic safety instructions

### 2.1 Requirements for the personnel

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

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

The operating personnel must fulfill the following requirements:

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

### 2.2 Designated use

#### 2.2.1 Application and fluids

Only use the measuring device described in these Operating Instructions to measure the concentration of liquids.

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 fluids 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 Other risks

##### **WARNING**

**Hot fluids can present a burn hazard.**

- ▶ In the case of high 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.

## 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.

### Conversions to the device

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

- ▶ If, despite this, modifications are required, consult with Endress+Hauser.

### Repair

To ensure continued operational safety and reliability,

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

## 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. .

## 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:

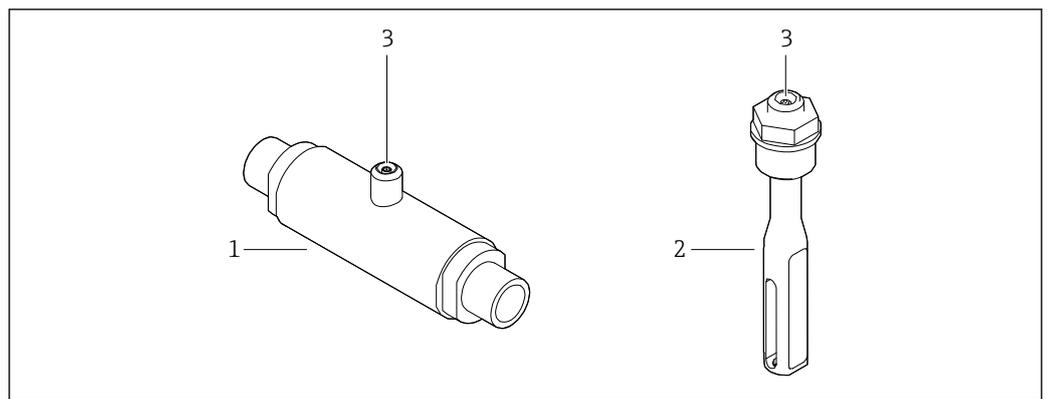
- "Teqwave F" sensor
- "Teqwave I" sensor

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



1 Sensor versions

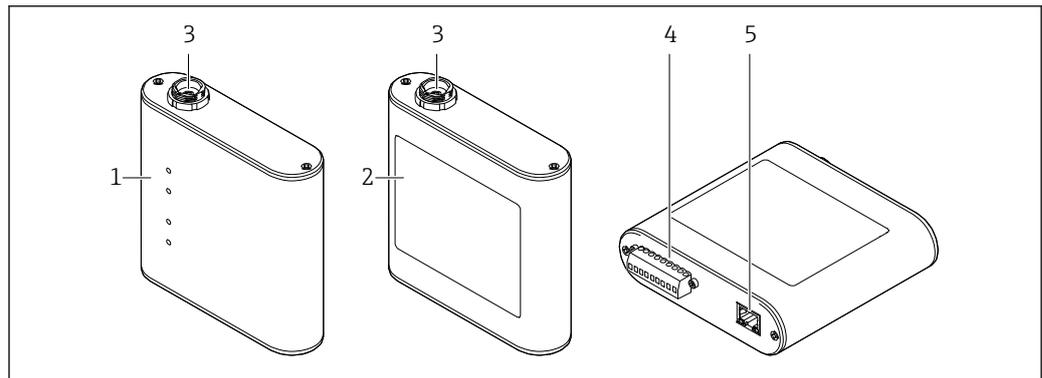
1 "Teqwave F" sensor

2 "Teqwave I" sensor

3 Push-pull connection for connecting to the transmitter

A0035451

### 3.1.2 Transmitter



A0035452

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 → 67.

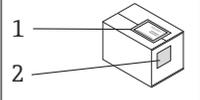
If you require a concentration app that is not already listed in the Applicator, Endress+Hauser requires a sample of the fluid to create the concentration app. Every transmitter can use a maximum of 25 concentration apps.

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 Incoming acceptance and product identification

### 4.1 Incoming acceptance

Is the order code on the delivery note (1) identical to the order code on the product sticker (2)?		<input type="checkbox"/>
Is the measuring device undamaged?	<input type="checkbox"/>	
Do the nameplate data match the ordering information on the delivery note?	<input type="checkbox"/>	
Is a CD-ROM provided with the "Tegwave Viewer" software?	<input type="checkbox"/>	
Is a CD-ROM provided with the Technical Documentation (depends on device version) and documents?	<input type="checkbox"/>	

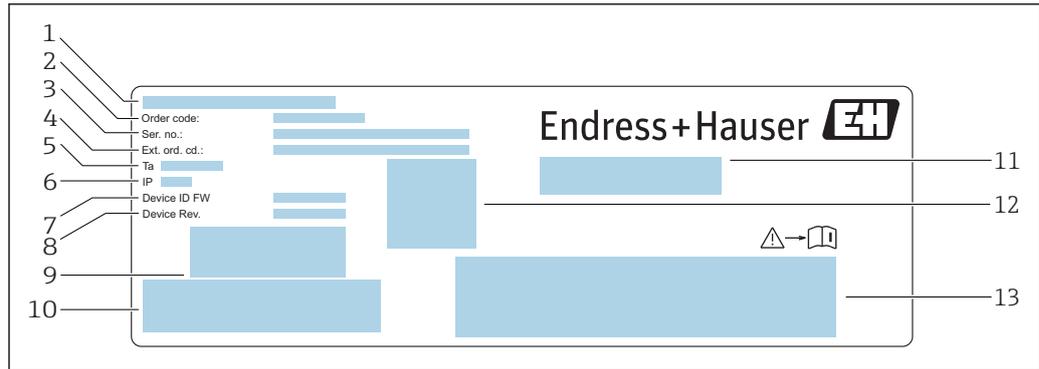
-  ■ If one of the conditions is not satisfied, contact your Endress+Hauser Sales Center.
- Depending on the device version, the CD-ROM might not be part of the delivery! The Technical Documentation is available via the Internet or via the *Endress+Hauser Operations App*, see the "Product identification" section .

### 4.2 Product identification

The measuring device can be identified in the following ways:

- Using the nameplate specifications on the transmitter
- Using the order code with a breakdown of the device features on the delivery note
- By entering the serial numbers from the nameplates in W@M Device Viewer ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): all the information about the measuring device is displayed
- By entering the serial numbers from the nameplates into the Endress+Hauser Operations App or by scanning the 2-D matrix code (QR code) on the measuring device with the Endress+Hauser Operations App: all the information about the measuring device is displayed

### 4.2.1 Nameplate



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 3 Example of a nameplate on a transmitter

- 1 Place of manufacture
- 2 Order code
- 3 Serial number (Ser. no.)
- 4 Extended order code (Ext. ord. cd.)
- 5 Permitted ambient temperature ( $T_a$ )
- 6 Degree of protection
- 7 Firmware version (Device ID FW) ex-works
- 8 Device version (Device Rev.) ex-works
- 9 Barcode for internal use
- 10 Barcode for internal use
- 11 Name of the measuring device
- 12 2D matrix code with serial number
- 13 Space for approvals and certificates

### 4.2.2 Symbols on the measuring device

Symbol	Meaning
	<b>WARNING</b> This symbol alerts you to a life-threatening situation. Failure to avoid this situation can result in serious or fatal injury.
 <small>A0011194</small>	<b>Reference to documentation</b> Refers to the corresponding measuring device documentation.
 <small>A0035455</small>	<b>Signal ground connection</b> A terminal that can be used as the ground contact for the digital input.
 <small>A0035456</small>	<b>Relay output connection</b> A terminal that can be used as a relay output.

## 5 Storage and transport

### 5.1 Storage conditions

Observe the following notes for storage:

- store in the original packaging to ensure protection from shock
- protect from direct sunlight to avoid unacceptably high surface temperatures
- store in a dry and dust-free place
- do not store outdoors

Storage temperature →  73.

### 5.2 Transporting the product

- Transport the measuring device to the measuring point in the original packaging.
- Do not remove protective covers or caps installed on process connections.

### 5.3 Packaging disposal

All packaging materials are environmentally friendly and 100 % recyclable: box in accordance with European Packaging Directive 94/62EC; recyclability is confirmed by the affixed RESY symbol.



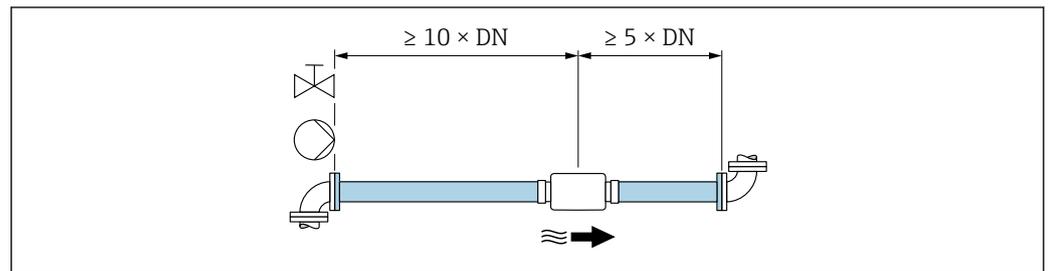
**NOTICE****Measurement result is not representative**

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:



6 Inlet and outlet runs

A0035458

## 6.2 Mounting the measuring device

### 6.2.1 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**

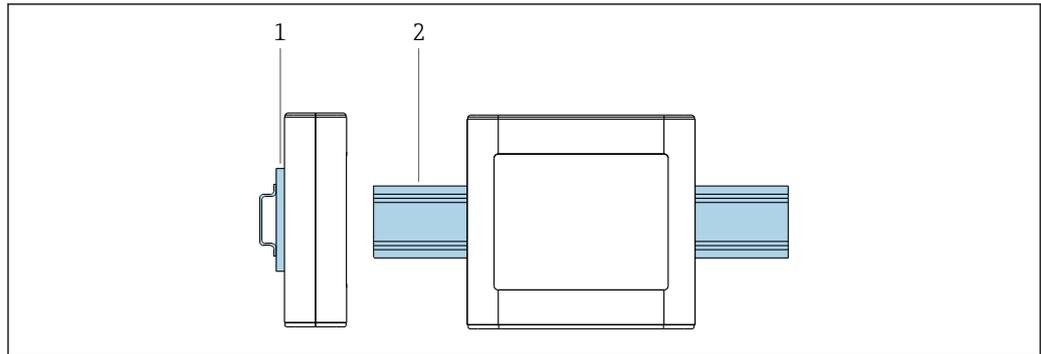
Twisting the sensor when tightening the threaded joints can damage the sensor.

- ▶ 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 → 16.

**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 → 16.

## 6.2.2 Mounting the transmitter



A0035459

### 7 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.

## 6.3 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 → 68</li> </ul>	<input type="checkbox"/>
Installation	Notes
Is there a sufficient distance between the sensor and the next pipe elbow? → 16	<input type="checkbox"/>
Teqwave I: Is the active sensor area fully immersed in the liquid? → 16	<input type="checkbox"/>
If installing Teqwave I in a pipe: Is the black dot on the process connection aligned with the flow direction? → 68	<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? → 68	<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"/>

## 7 Electrical connection

**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.

### 7.1 Connecting requirements

#### 7.1.1 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>	

#### 7.1.2 Terminal assignment

Terminal	Assignment	
V+	<b>V<sub>in</sub></b> 24 V DC	Supply voltage
V-		
+	<b>out</b> 0 to 10 V; 4 to 20 mA	Analog output
-		
0	<b>output</b> selection	Digital input
1		
⊥		Signal ground

Terminal	Assignment	
	<b>alarm</b> max. 50 V, 1 A	Relay output
		

### 7.1.3 Requirements for supply unit

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

## 7.2 Connecting the measuring device

### **⚠ 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.

### 7.2.1 Connecting the connecting cable

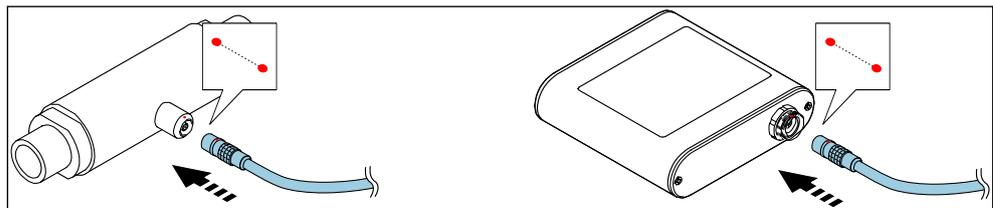
Connect the sensor to the transmitter only using the connecting cable supplied.

#### **NOTICE**

**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).



 8 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.

 Red dots on the connectors indicate the position.

### 7.2.2 Connecting the 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.

Connect the supply voltage cables to the transmitter via screw terminals, terminal assignment →  21.

### 7.2.3 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 → 19.

#### 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 → 26.

### 7.2.4 Ensuring potential equalization

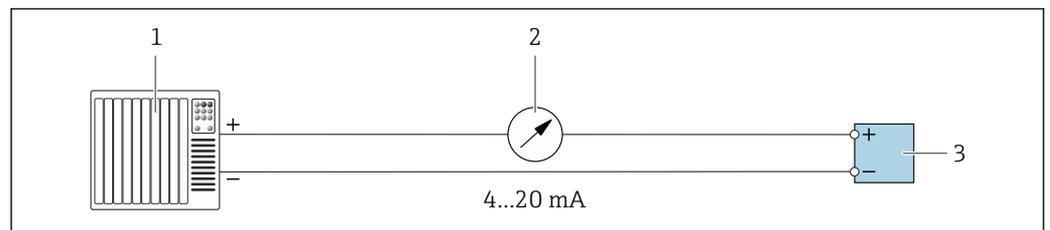
The measuring device must be included in the potential equalization. The transmitter and sensor are connected to the same potential via the connecting cable. This potential must be current-free.

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

## 7.3 Special connecting instructions

### 7.3.1 Connecting examples

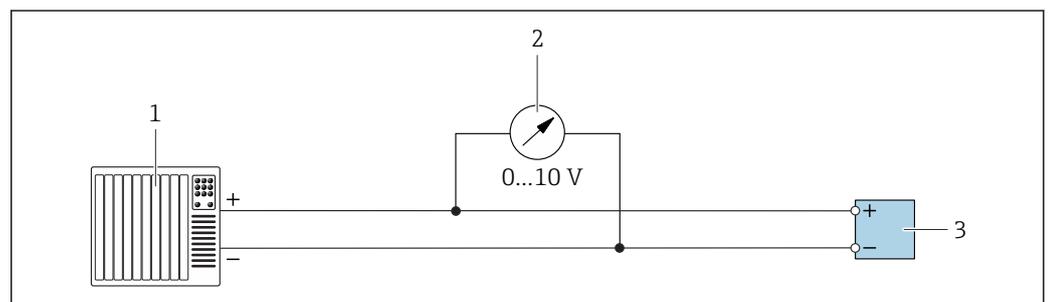
#### Current output 4 to 20 mA



 9 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

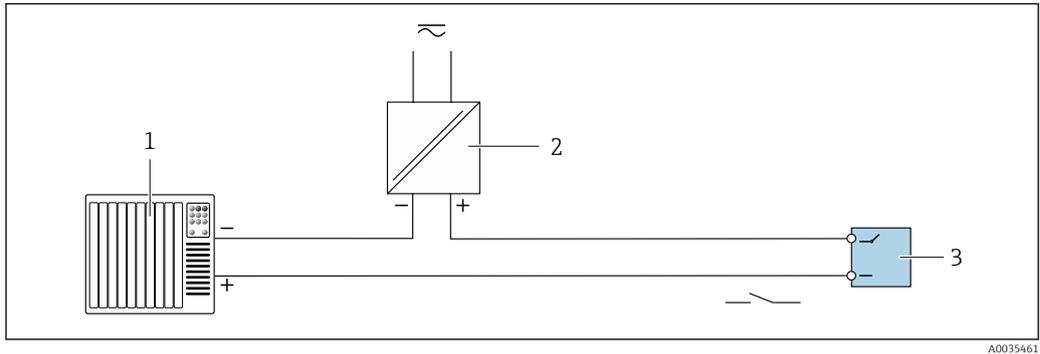
#### Voltage output 0 to 10 V



 10 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



11 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:

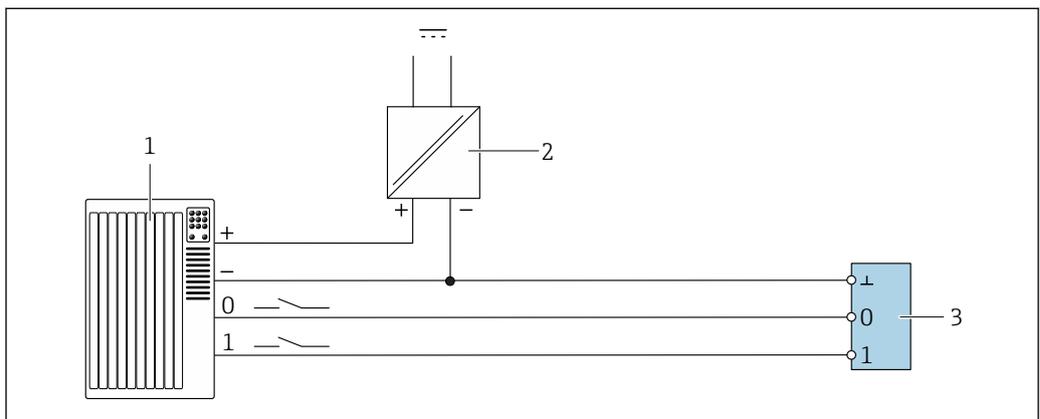
Active analog output	Digital input "0"	Digital input "1"
Channel 1	Open	Open
Channel 2	Ground	Open
Channel 3	Open	Ground
Channel 4	Ground	Ground

#### 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.



12 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.

## 7.4 Post-connection check

Are the cables and measuring device undamaged (visual inspection)?	<input type="checkbox"/>
Do the cables used comply with the requirements ?	<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"/>

## 8 Operating options

### 8.1 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

### 8.2 Access to the measuring device via the local display

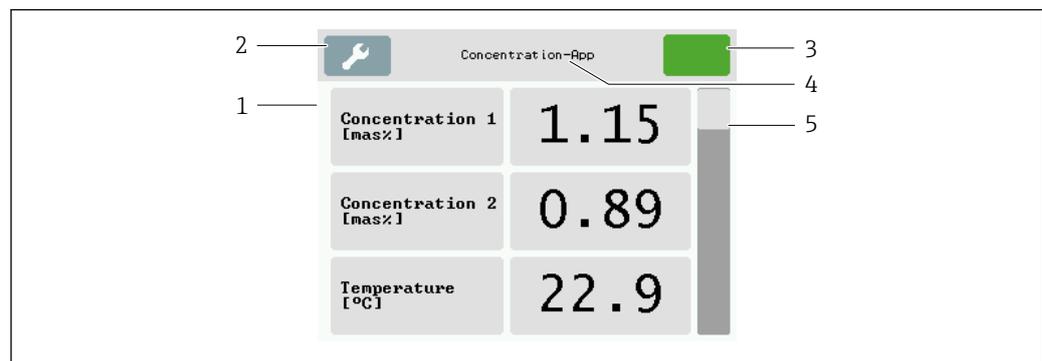
If you are using the transmitter with a touch screen, it is possible to access the measuring device via the transmitter touch screen and via the "Teqwave Viewer" operating tool.

Functions supported by the transmitter with a touch screen:

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

#### 8.2.1 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

13 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 to see all the measured variables.

### Functions of the display and operating elements

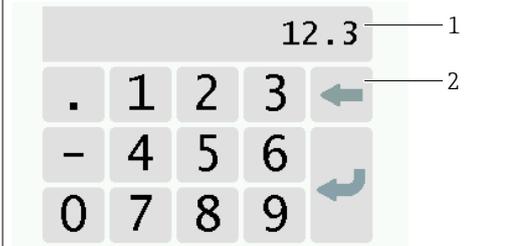
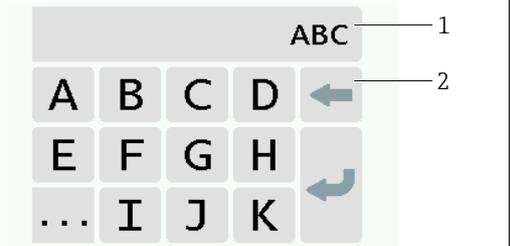
Button	Description
	<b>Settings menu</b> Opens the settings.
	<b>Navigation</b> Navigate between the menus or submenus.
	<b>Status indication</b> Indicates the current status, and navigation to more detailed status messages in text format.
	<b>Concentration app name or operational display button</b> 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
	
<p>1 Display area for the entered values</p> <p>2 Input mask</p> <p style="text-align: right;"><small>A0035468</small></p>	<p>1 Display area for the entered values</p> <p>2 Input mask</p> <p style="text-align: right;"><small>A0035469</small></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.

**8.2.2 LED status indication (transmitter with LED status indication)**

For a description, see "Diagnostics information for transmitter with LED status indication" →  56.

**8.3 Access to the measuring device via the operating tool**

The transmitter with LED status indication can only be configured using the "Teqwave Viewer" operating tool. If the transmitter with a touch screen is used, the transmitter can be operated both via the touch screen and via the Viewer tool. The range of functions of the "Teqwave Viewer" operating tool varies depending on the software package installed.

*Supported functions:*

Included in the scope of supply: Teqwave Viewer V2.1 – basic package	Order code for "Application package", option EP: Teqwave Viewer V2.1 – Viewer with interface for data download
<ul style="list-style-type: none"> <li>▪ Live display and graphic visualization of measured variables</li> <li>▪ Save graph</li> <li>▪ Manage concentration apps on the transmitter</li> <li>▪ Device configuration</li> <li>▪ Switch between multiple transmitters</li> <li>▪ Self-test</li> </ul>	<ul style="list-style-type: none"> <li>▪ Live display and graphic visualization of measured variables</li> <li>▪ Save graph</li> <li>▪ Manage concentration apps on the transmitter</li> <li>▪ Device configuration</li> <li>▪ Switch between multiple transmitters</li> <li>▪ Self-test</li> <li>▪ Read saved measured values</li> <li>▪ Offline analysis with graphic visualization of the measured values</li> <li>▪ Measured data logging and export function</li> </ul>

### 8.3.1 System requirements

#### Computer hardware

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

#### Computer software

<b>Recommended operating system</b>	Microsoft Windows 7 or higher.
-------------------------------------	--------------------------------

#### Computer settings

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

### 8.3.2 Software installation

#### Installing the "Teqwave Viewer" operating tool

1. Close all applications.
2. Insert the CD-ROM supplied into the drive.
3. Double click the "setup.exe" file to start the installation.
4. Follow the instructions in the installation window.

### 8.3.3 Establishing a connection between the transmitter and Viewer

#### Configuring the Internet protocol of the computer

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

 For transmitters with LED status indication: The transmitter IP address is located on the nameplate. The subnet mask default setting is 255.0.0.0. It is possible to change the network settings as soon as a connection to the Viewer has been established.

#### Viewing and configuring the network settings

*Navigation using transmitter with touch screen*

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

- 6. Settings menu → "Network settings" → "Gateway"
- 7. Settings menu → "Network settings" → "DHCP"

*Navigation using the Viewer*

- 1. Menu "Teqwave Transmitter" → "Network settings" → "IP address"
- 2. Menu "Teqwave Transmitter" → "Network settings" → "Subnet mask"
- 3. Menu "Teqwave Transmitter" → "Network settings" → "Gateway"
- 4. Menu "Teqwave Transmitter" → "Network settings" → "Switch DHCP status"

 The operating tool communicates the settings to the transmitter as soon as the "Send (parameters)" button is clicked.

*Parameter overview with brief description*

Parameter	Description	Selection/entry/display	Factory setting
Network status (transmitter)	Displays the current connection status.	<ul style="list-style-type: none"> <li>■ Static IP address</li> <li>■ DHCP</li> <li>■ Not connected</li> </ul>	-
System name (transmitter)	Enter the name or NetBIOS name of the transmitter where it can be reached in the network.	Any sequence of letters and characters, max. 15 characters.	LSC [transmitter serial number]
MAC address (transmitter)	Displays the physical network address of the device.	Byte-wise notation, colon-separated	Depends on the transmitter
IP address	Enter the IP address. <ul style="list-style-type: none"> <li> The transmitter IP address assigned at the factory is indicated on the transmitter nameplate.</li> <li>■ The network settings of the computer must be configured with a static IP address in the same address range.</li> </ul>	Character string with the following format: 192.168.1.xyz	192.168.1.212
Subnet mask	Use one of the predefined values for the subnet mask of the transmitter or enter a new value.	<ul style="list-style-type: none"> <li>■ 255.255.255.0</li> <li>■ 255.255.0.0</li> <li>■ 255.0.0.0</li> <li>■ Character string with the following format: w.x.y.z</li> </ul>	255.255.255.0

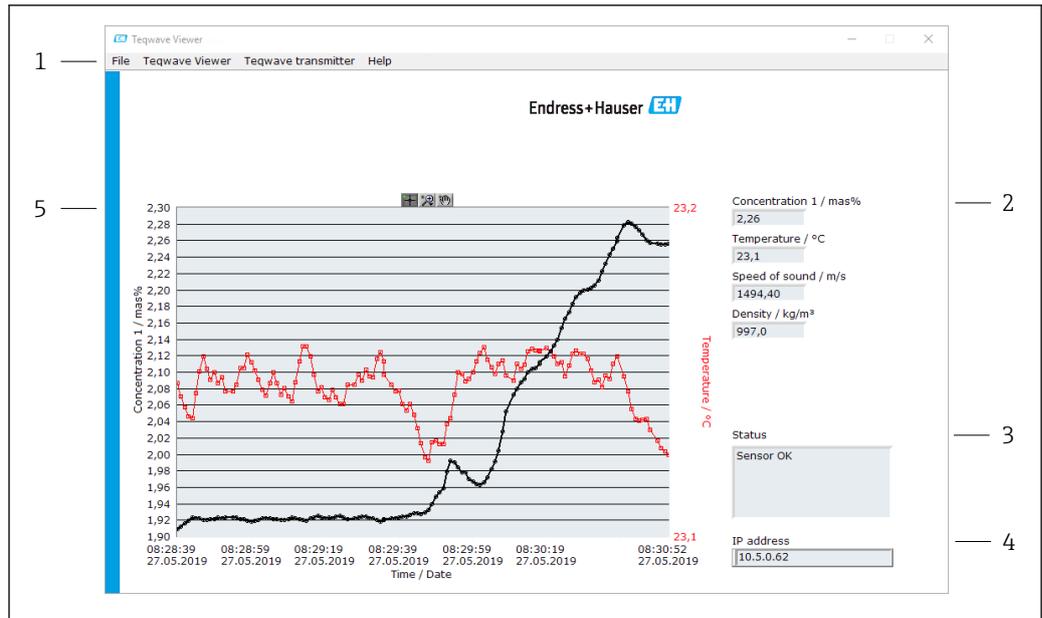
Parameter	Description	Selection/entry/display	Factory setting
Gateway	Enter the IP address for a gateway in the local network.	Character string with the following format: w.x.y.z	0.0.0.0
DHCP (transmitter) Switch DHCP status (Viewer)	<p>Enable DHCP to allow the DHCP server to automatically assign the IP address for the transmitter.</p> <p> The function is only available if the transmitter has a "system name" (also known as the "NetBIOS name"). Otherwise, the Viewer cannot find the transmitter in the network. The system name is set by default when the device is delivered.</p>	Enable or disable the function	The function is disabled

*Establishing a connection with the transmitter*

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

**8.3.4 User interface**

Different functions are enabled or disabled in the menus depending on the license purchased (Teqwave Viewer (basic package) or Teqwave Viewer (with interface for data download)). Disabled functions are grayed out and cannot be selected. The central element on the home screen is a graph that displays the selected measured variables over the time period. To the right of the graph, the user interface also shows all the measured variables, the sensor status and the IP address of the transmitter.



A0035470-EN

14 User interface

- 1 Menu bar
- 2 Measured variable display
- 3 Status indication
- 4 IP address
- 5 Graph

Menu bar

Menu	Description
File	Functions for starting and stopping measured value transmission and for saving the graph.
Teqwave Viewer	Functions that are required to configure the operating tool.
Teqwave Transmitter	Functions that are required to configure the transmitter and function for accessing another transmitter.
Help	Information about the system and manual.

8.3.5 General control and operating elements

Button	Description
 <p>A0035492-EN</p>	<p><b>OK</b> button</p> <p>Confirm or exit the function.</p>
 <p>A0035493-EN</p>	<p><b>Apply</b> button</p> <p>Accept entries or send entries to transmitter.</p>
 <p>A0035494-EN</p>	<p><b>Cancel</b> button</p> <p>Cancel the operation.</p>

Button	Description
 <p style="text-align: right; font-size: small;">A0035495-EN</p>	<p><b>Close button</b> Exit the function.</p>
 <p style="text-align: right; font-size: small;">A0035496</p>	<p><b>Active button</b> Enable function or parameter. A bright-green arrow indicates that functions and parameters are enabled.</p>
 <p style="text-align: right; font-size: small;">A0035497</p>	<p><b>Inactive button</b> Disable function or parameter. A dark-green arrow indicates that functions and parameters are disabled.</p>

## 9 System integration

### 9.1 Overview of device description files

*Current version data for the device*

<b>Firmware version</b>	2.2.zz	<ul style="list-style-type: none"> <li>▪ On title page of the Operating Instructions</li> <li>▪ On nameplate</li> <li>▪ On local display: settings</li> <li>▪ Via "Teqwave Viewer" operating tool: Help → Version.</li> </ul>
<b>Release date of firmware version</b>	07.2019	
<b>License key</b>		<ul style="list-style-type: none"> <li>▪ On final inspection report (provided with the transmitter)</li> <li>▪ On delivery note (included in the delivery)</li> <li>▪ If additional functions are purchased subsequently: in the service e-mail and on the CD</li> <li>▪ Read via the "Teqwave Viewer" operating tool: Help → Version.</li> </ul>

 For an overview of the different firmware versions for the device →  62.

### 9.2 Modbus TCP information

#### 9.2.1 General settings for the Modbus interface

<b>Communication</b>	Modbus communication protocol
<b>Protocol</b>	TCP protocol
<b>Port</b>	502

#### Function codes

The function code determines which read or write actions the Modbus protocol performs.

*The measuring device supports the following function codes:*

Code	Name	Description	Application
0x04	Read Input Registers	Master reads one or more Modbus registers from the device.	Read process variables with read access Example: read concentration A

#### Register information

Register name	Data type	Register address	Length
Concentration A	IEEE754 32bit	0x0000:0x0001	2
Concentration B	IEEE754 32bit	0x0002:0x0003	2
Temperature / K	IEEE754 32bit	0x0010:0x00011	2
Speed of sound / m/s	IEEE754 32bit	0x012:0x0013X	2

Register name	Data type	Register address	Length
Density / kg/m <sup>3</sup>	IEEE754 32bit	0x0014:0x0015	2
Dispersion	IEEE754 32bit	0x001A:0x001B	2
System status	32bit unsigned	0x0050:0x0051	2

 While values are transmitted in "big-endian" format during Modbus communication, in line with specifications, the content of the registers is saved in "little-endian" format for performance reasons. The sequence of the received bytes must be reversed to convert between big-endian and little-endian format.

*Example: read concentration A*

The result is a floating point number in the format IEEE754 32bit. The value is saved in two consecutive addresses, with the first address containing the least significant word (lower part of the mantissa) and the second address containing the most significant word (sign, exponent and upper part of the mantissa).

*To get the concentration, the following data must be sent for a query to the transmitter IP address via port 502:*

Send to transmitter: 04 0000 0002		Reply from transmitter: 04 04 F37F CE41	
04:	Function: Read Input Registers (0x04)	04:	Function: Read Input Registers (0x04)
0000:	Start address: 0x0000	04:	Number of consecutive bytes: 0x04
0002:	Number of registers to be read (16-bit): 0x0002	F37F CE41:	Floating point number in IEEE754 format (little-endian)

Result:

- Word 1, register address 0x0000, least significant word: 0xF37F
- Word 2, register address 0x0001, most significant word: 0xCE41

Little-endian to big-endian conversion:

- Word 1, register address 0x0000, least significant word: 0x7FF3
- Word 2, register address 0x0001, most significant word: 0x41CE

The result is: 0x41CE 7FF3 → 25.812475 (IEEE754 format; big-endian).

## 10 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.

### 10.1 Function check

Before commissioning the measuring device:

- ▶ Make sure that the post-installation and post-connection checks have been performed.
  - "Post-installation check" checklist →  18
  - "Post-connection check" checklist →  23

### 10.2 Switching on the measuring device

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

After a successful startup, the local display switches automatically from the 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

### 10.3 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

### 10.4 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.

### 10.4.1 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"

*Parameter overview with brief description*

Parameter/function	Procedure	Selection/input	Factory setting
Select concentration app (transmitter) Manage concentration apps (Viewer)	<b>Transmitter</b> Tap the desired concentration app to select it. If the selected concentration app is inactive, tap the <b>Activate application</b> button to activate the concentration app.  <b>Viewer</b> Select the desired concentration app by selecting "concentration apps" from the dropdown menu. If the selected concentration app is inactive, tap the <b>Activate</b> button to activate the app.	Concentration app 1-n	Concentration app 1

### 10.4.2 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.

*Parameter overview with brief description*

Parameter/function	Procedure	Selection/input	Factory setting
Concentration 1-2 Offset (transmitter) Concentration 1-2/ [unit] (Viewer)	Enter the value for the concentration offset.   Access to the offset setting is only possible for the active concentration app. However, the settings are kept if the user switches concentration app.	Floating-point number with sign	0.00

### 10.4.3 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**

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

**Navigation using the Viewer**

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

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

*Parameter overview with brief description*

Parameter	Procedure	Selection/input	Factory setting
Concentration 1-2	Select the unit for concentration.	Depends on the selected concentration app	Depends on the selected concentration app
Temperature	Select the unit for temperature.	<ul style="list-style-type: none"> <li>■ °C</li> <li>■ °F</li> <li>■ K</li> </ul>	°C
Density	Select the unit for density.	<ul style="list-style-type: none"> <li>■ g/cm<sup>3</sup></li> <li>■ kg/m<sup>3</sup></li> <li>■ g/l</li> </ul>	kg/m <sup>3</sup>

**10.4.4 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.

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Analog channel 1-4	<p>Select the measured variable or special function to be output at the analog output.</p> <p> If <b>No analog output</b> is selected, the analog interface is set to 0 V or 2 mA. The presentation on the display continues to run normally.</p> <p>▪ If <b>Suspend measurement</b> is selected, the measuring device stops and all the measured values and the system status suspend. If necessary, the <b>Suspend time</b> function can be used to specify a delay for switching the function on and off.</p>	<ul style="list-style-type: none"> <li>▪ Concentration 1-2</li> <li>▪ Temperature</li> <li>▪ Speed of sound</li> <li>▪ Density</li> <li>▪ Dispersion</li> <li>▪ Deactivated analog output</li> <li>▪ Suspend measurement</li> </ul>	Concentration 1
Current/Voltage	Select the type of signal of the analog interface.	<ul style="list-style-type: none"> <li>▪ Current (4 to 20 mA)</li> <li>▪ Voltage (0 to 10 V)</li> </ul>	Current (4 to 20 mA)
Analog output settings	<p>Behavior of the interface if the measuring range is breached (value over-range/under-range).</p> <p> If <b>0V/2mA exceeding limits</b> is selected, an error value is displayed.</p> <p>▪ If <b>Min/Max exceeding limits</b> is selected, the value output is limited to the specified limit value →  38.</p>	<ul style="list-style-type: none"> <li>▪ 0V/2mA exceeding limits</li> <li>▪ Min/Max exceeding limits</li> </ul>	0 V/2 mA exceeding limits
Suspend time (s)	<p>Enter the suspend time in seconds until the measured values are recorded if the Suspend measurement function is active.</p> <p> If a <b>suspend time (s)</b> is entered and the <b>Suspend measurement</b> function is selected simultaneously in the <b>Analog channel 1-4</b> parameter and activation is via the digital input, the <b>Suspend measurement</b> is delayed by the configured time.</p>	Positive integer 0 to 10000 s	0 s
Test signal	<p><b>Transmitter</b> Enter the current or voltage value for simulation. Output the test signal with <b>Activate / Deactivate</b>.</p> <p><b>Viewer</b> A new window appears as soon as the <b>Test signal</b> button is pressed. Enter the current or voltage value for simulation. Output the test signal with the <b>Test signal</b> button.</p> <p> A new window appears as soon as the <b>Test signal</b> button is pressed. Enter the current or voltage value for simulation. Output the test signal with the <b>Test signal</b> button.</p>	Floating-point number with sign	0.0

### 10.4.5 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.

#### Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Measuring range Max	Enter the upper limit for the selected measured variable or 20 mA current/10 V voltage, while paying attention to the measuring range limits →  68 and the concentration app data sheet.	Positive decimal	<ul style="list-style-type: none"> <li>■ Concentration 1-2: 100.00</li> <li>■ Temperature: 120.0</li> <li>■ Speed of sound: 2000.00</li> <li>■ Density: 1500.00</li> </ul>
Measuring range Min	Enter the lower limit for the selected measured variable or 4 mA current/0 V voltage, while paying attention to the measuring range limits →  68 and the concentration app data sheet.	Positive decimal	<ul style="list-style-type: none"> <li>■ Concentration 1-2: 0.00</li> <li>■ Temperature: 0.0</li> <li>■ Speed of sound: 500.00</li> <li>■ Density: 500.00</li> </ul>
Decimal places	Select the number of decimal places for the value of the measuring range.	<ul style="list-style-type: none"> <li>■ 0</li> <li>■ 1</li> <li>■ 1 ±0.5</li> <li>■ 2</li> <li>■ 2 ±0.5</li> <li>■ 3</li> <li>■ 3 ±0.5</li> <li>■ 4</li> </ul>	<ul style="list-style-type: none"> <li>■ Concentration 1-2: 2</li> <li>■ Temperature: 1</li> <li>■ Speed of sound: 2</li> <li>■ Density: 1 ±0.5</li> </ul>

### 10.4.6 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"

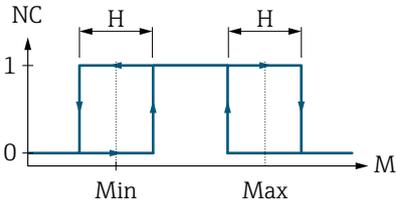
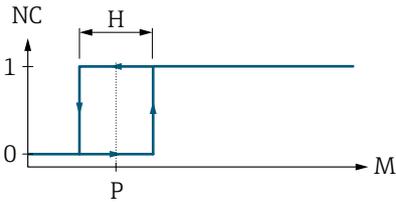
2. Settings menu → "Application parameters" → "Relay output" → "Settings" → "Select measured value" → "Switch point Max"/"Switch point Min" or "Switch point"
3. Settings menu → "Application parameters" → "Relay output" → "Settings" → "Select measured value" → "Hysteresis"
4. Settings menu → "Application 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.

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Output mode	<p>Select the mode for the switch point definition.</p> <p> If <b>Range mode</b> is selected, enter the upper and lower limit to define the switch points.</p>  <p> <b>15</b> Example: Relay output configured in the range mode as an NC contact</p> <p>NC Normally closed          0 Closed relay          1 Open relay          M Measured value          Min Switch point Min          Max Switch point Max          H Hysteresis</p> <p> If <b>Trigger mode</b> is selected, enter the value to define the switch point.</p>  <p> <b>16</b> Example: Relay output configured in the trigger mode as an NC contact</p> <p>NC Normally closed          0 Closed relay          1 Open relay          M Measured value          P Switch point          H Hysteresis</p>	<ul style="list-style-type: none"> <li>▪ Range mode</li> <li>▪ Trigger mode</li> </ul>	Range mode
Switch point	<p><i>Prerequisite:</i>  <b>Trigger mode</b> is selected in the <b>Output mode</b> parameter.                  Set the value at which the relay changes its switch status, while paying attention to the measuring range limits →  68 and the concentration app data sheet.</p>	Positive decimal	<ul style="list-style-type: none"> <li>▪ Concentration 1-2: 50.00</li> <li>▪ Temperature: 60.00</li> <li>▪ Speed of sound: 1500.00</li> <li>▪ Density: 1000.00</li> </ul>
Switch point Max	<p><i>Prerequisite:</i>  <b>Range mode</b> is selected in the <b>Output mode</b> parameter.                  Set the upper limit at which the relay changes its switch status, while paying attention to the measuring range limits →  68 and the concentration app data sheet.</p>	Positive decimal	<ul style="list-style-type: none"> <li>▪ Concentration 1-2: 100.00</li> <li>▪ Temperature: 120.00</li> <li>▪ Speed of sound: 2000.00</li> <li>▪ Density: 1500.00</li> </ul>

Parameter	Procedure	Selection/input	Factory setting
Switch point Min	<p><i>Prerequisite:</i>  <b>Range mode</b> is selected in the <b>Output mode</b> parameter.                      Set the lower limit at which the relay changes its switch status, while paying attention to the measuring range limits → 68 and the concentration app data sheet.</p>	Positive decimal	<ul style="list-style-type: none"> <li>■ Concentration 1-2: 0.00</li> <li>■ Temperature: 0.00</li> <li>■ Speed of sound: 500.00</li> <li>■ Density: 500.00</li> </ul>
Hysteresis	<p>Enter the tolerance value for the switch points.</p> <p> Entering a hysteresis prevents the relay from switching back and forth around the upper and lower limits. The unit for the hysteresis is identical to the unit of the measured variable.</p>	Positive decimal	0.00
NC contact/NO contact	Select the switching behavior of the relay.	<ul style="list-style-type: none"> <li>■ NC contact</li> <li>■ NO contact</li> </ul>	NC contact
Output	Select the measured variable to which the relay output should react.	<ul style="list-style-type: none"> <li>■ Concentration 1-2</li> <li>■ Temperature</li> <li>■ Speed of sound</li> <li>■ Density</li> <li>■ Dispersion</li> <li>■ No relay output (can only be selected via the transmitter)</li> </ul>	Temperature

### 10.4.7 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.

## Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Display settings	<p><b>Transmitter</b> Tap the measured variable to show or hide it on the transmitter's operational display.</p> <p><b>Viewer</b> Under <b>Display</b>, use the options <b>Yes</b> or <b>No</b> to choose which transmitter measured variables are displayed or not.</p>	<ul style="list-style-type: none"> <li>▪ Concentration 1-2</li> <li>▪ Temperature</li> <li>▪ Speed of sound</li> <li>▪ Density</li> <li>▪ Dispersion</li> </ul>	All the measured variables are displayed.
View (transmitter)	Choose how many measured variables are shown on the transmitter's operational display.	<ul style="list-style-type: none"> <li>▪ 3 elements</li> <li>▪ 5 elements</li> <li>▪ 7 elements</li> </ul>	3 elements
Averaging	<p>Select averaging across a number of measuring points for the selected measured variable.</p> <p>Example of averaging for the "Density" measured variable</p> <ul style="list-style-type: none"> <li>▪ User entry: 5.</li> <li>▪ Output: averaging across 5 measuring points or over a period of 0.5 s (measuring frequency = 10 Hz)</li> </ul> <p> The concentration is still calculated using the non-averaged measured values.</p>	Positive integer 1-1000	1
Kalman filter	<p>Apply the Kalman filter for enabling the temperature by activating the function.</p> <p> When the Kalman filter is enabled, the measuring device uses surface wave information, in addition to the measured value of the integrated temperature chip, for temperature measurement. This allows the sensor to follow variations in temperature more quickly. However, the sensor then needs more time to reach the stationary full scale value.</p>	Enable/disable the function	The function is disabled

### 10.4.8 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"

## Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
Brightness	Enter screen brightness.  If the screensaver is enabled, the value entered here must be greater than the minimum value for the screensaver.	20 to 100 %	100 %
User time	Enter the current, local time.  The user time is used in the measurement chart and to save the measured values.	Entry format HH:MM:SS	The current time is set.
User date	Enter the current date.	Entry format: DD.MM.YY	The current date is set.
Deactivated	Tap the option to activate/deactivate the screensaver.  The display is unlocked by entering the unlock password. This function protects the entire measuring device from unauthorized access or modification. To only protect settings, select Settings → User settings → Unlock password → Settings.	Enable/disable the function	The function is disabled.
Brightness	Enter the brightness for the background lighting after the screensaver has been activated.  The value must be less than the value specified for normal screen brightness.	20 to 100 %	100 %
Start after	Set the time that passes until the display reduces the brightness or the display lock is activated.	Depends on the time unit selected <ul style="list-style-type: none"> <li>▪ 30 to 7 200 s or</li> <li>▪ 1 to 120 min or</li> <li>▪ 1 to 2 h</li> </ul>	10 s
Time unit	Set the time unit.  The value is automatically converted if the unit is changed.	<ul style="list-style-type: none"> <li>▪ Seconds</li> <li>▪ Minute &lt;s&gt;</li> <li>▪ Hour &lt;s&gt;</li> </ul>	Seconds
Lock display	Enable or disable the display lock.	Enable or disable the function	The function is disabled
Unlock password	Enter the unlock password to unlock the display.	4-digit character string or numerical sequence	LSC2
App	To prevent an unauthorized concentration app change, enter the password and enable the function. When you tap the <b>Password</b> button the text editor opens. You can enter the password here. Tap the <b>Activate/Deactivate</b> button to activate or deactivate the password.  To protect the entire system from being used and modified, activate the display lock under Settings → User settings → Screensaver → Display turn off → Lock display.	<ul style="list-style-type: none"> <li>▪ 4-digit character string or numerical sequence</li> <li>▪ Enable/disable the function</li> </ul>	LSC2
Settings	To prevent access to the settings (apart from the <b>Select concentration app function</b> ), enter the password and enable the function. When you tap the <b>Password</b> button the text editor opens. You can enter the password here. Tap the <b>Activate/Deactivate</b> button to activate or deactivate the password.  To protect the entire system from being used and modified, activate the display lock under Settings → User settings → Screensaver → Display turn off → Lock display.	<ul style="list-style-type: none"> <li>▪ 4-digit character string or numerical sequence</li> <li>▪ Enable/disable the function</li> </ul>	LSC2

### 10.4.9 Configuring the failsafe mode

The menus **Diagnosis** (transmitter with a 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 actions"
2. Menu "Teqwave Transmitter" → "View filter" → "Change in" → Select measured variable
3. Menu "Teqwave Transmitter" → "View filter" → "Process disturbance" → "Switch point"

Parameter overview with brief description

Parameter	Procedure	Selection/input	Factory setting
View options (transmitter) Filter options/filter actions (Viewer)	Select filter options and arrangements to enable or disable them.	Filter options: <ul style="list-style-type: none"> <li>■ Enable measuring</li> <li>■ Enable calibration</li> <li>■ Stationarity</li> </ul> Filter actions: <ul style="list-style-type: none"> <li>■ Hide measured value</li> <li>■ Background coloring</li> <li>■ Hold measured value</li> </ul>	The "Enable measuring" and "Enable calibration" options are enabled. The "Stationarity" option is disabled.
Change in concentration 1 to 2 [unit]	Specify the limit value for the maximum permissible speed at which concentration can change. Enable or disable the function using the button.  If the measuring unit is changed, the unit is changed according to the "change in" setting, but the value entered is not converted.	0.01 to 100[unit]	100 [unit] The function is disabled.
Change in temperature °C/min (°F/min; °K/min)	Specify the limit value for the maximum permissible speed at which the temperature can change. Enable or disable the function using the button.  If the measuring unit is changed, the unit is changed according to the "change in" setting, and the value entered is converted.	0.01 to 100 °C/min (K/min) or 0.018 to 180 °F/min	1.5 °C/min The function is enabled.
Change in speed of sound (m/s)/s	Enter the limit value for the maximum permissible speed at which the speed of sound can change. Enable or disable the function using the button.	0.01 to 100 (m/s)/s	100 (m/s)/s The function is disabled.
Change in density [unit]	Enter the limit value for the maximum permissible speed at which the density can change. Enable or disable the function using the button.  If the measuring unit is changed, the unit is changed according to the "change in" setting, and the value entered is converted.	0.01 to 100 (kg/m3)/s or (g/l)/s 0.00001 to 0.10 (g/cm3)/s	100 (kg/m3)/s The function is disabled.
Change in dispersion 1/s	Enter the limit value for the maximum permissible speed at which the dispersion can change. Enable or disable the function using the button.	0.01 to 100 1/s	100 1/s The function is disabled.
Switch point	Set the trigger value for process disturbances (dispersion).  Transmitter Enable or disable the function using the Enable / Disable button.  Viewer Enable or disable the function using the <b>Process disturbance</b> button.   <ul style="list-style-type: none"> <li>■ If the speed of sound and temperature are used for concentration measurement, do not exceed the value of 1. If the density is used, apply 0.25 as the switch point.</li> <li>■ If the measured dispersion is greater than the configured switch point, the measuring device does not display the concentration any more.</li> </ul>	0.01 to 1	0.3 The function is disabled.

## 10.5 Advanced settings

The measuring device supports the performance of a field calibration.

### 10.5.1 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 →  35.

#### 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"

#### Performing field calibration with a fluid

 To perform a field calibration, it is necessary to fill the measuring device with a fluid or immerse it in a fluid.

1. Create a reference calibration point via the function "Settings" → "Application parameters" → "Field calibration" → "Manage calibration points" → "Add new calibration point".
  - ↳ The transmitter displays the following message: "Values are being recorded. Please wait until the process has finished". When the process has been completed successfully, the "Manage calibration points" menu displays the recorded calibration point. Up to two calibration points can be recorded. If a two-point calibration is performed, Endress+Hauser recommends recording two different states of the liquid. Different states can be different temperatures or concentrations. The process conditions must remain constant here. If necessary, remove a calibration point with the "Delete calibration point" function to make it possible to record a new calibration point.
2. Enter the nominal concentration values in the fields "Settings" → "Application parameters" → "Field calibration" → "Manage calibration points" → "Target concentration 1-2".
3. Recalculate the calibration data via the function "Settings" → "Application parameters" → "Field calibration" → "Calculate calibration data". Two options are available. Select "Adjust input values" to correct the speed of sound and the density. This is recommended if external factors affect the speed of sound or density (e.g. pressure or salinization). Select "Adjust output values" to correct the concentration 1-2.
  - ↳ If the process is completed successfully, the message "Process successful" appears briefly on the screen. The "Field calibration" menu then displays the calibration data.
4. Apply the field calibration via the function "Settings" → "Application parameters" → "Field calibration" → "Apply calibration".
  - ↳ Corrected measured value display.
5. Check the measured values.

## 10.6 Application package "Viewer with interface for data download"

### 10.6.1 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.

### 10.6.2 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.

### 10.6.3 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 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 measured values, see → 51.

### 10.6.4 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 s, there is enough space in the memory for about 7.5 years.

### 10.6.5 Specifying the storage interval

A storage interval of between 10 to 7200 s 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.

*Parameter overview with brief description*

Parameter	Procedure	Selection/input	Factory setting
Storage interval (s)	<p>Select the time interval in which the measured values are written to the internal memory.</p> <p> The function only applies if the <b>Viewer (with interface for data download)</b> application package is installed.</p>	Positive integer 10 to 7 200 s	60 s

# 11 Operation

## 11.1 Adjusting the operating language

Operating language settings →  34.

## 11.2 Configuring the local display

Local display settings →  42.

## 11.3 Reading measured values via the local display

All the current measured values can be read via the **operational display** of the transmitter with a touch screen. Once a measured variable is selected, the local display switches to the graph display. The graph shows the development of the selected measured variable over time. The graph display format can be adjusted.

### 11.3.1 Adjusting the graph display format

*Navigation using transmitter with touch screen*

1. "Select measured variable" → "Graph settings button" → "Time axis"
2. "Select measured variable" → "Graph settings button" → "Y axis" → "Maximum value [unit]"
3. "Select measured variable" → "Graph settings button" → "Y axis" → "Minimum value [unit]"
4. "Select measured variable" → "Graph settings button" → "Y axis" → "Auto scale"

*Parameter overview with brief description*

Parameter	Procedure	Selection/input	Factory setting
Time axis	Select the period shown on the X-axis.	<ul style="list-style-type: none"> <li>■ 1 minute</li> <li>■ 10 minutes</li> <li>■ 1 hour</li> <li>■ 4 hours</li> <li>■ 12 hours</li> <li>■ 1 day</li> <li>■ 1 week</li> <li>■ 1 month</li> <li>■ 3 months</li> </ul>	1 minute
Maximum Value [unit]	Enter the maximum value to be displayed on the Y axis.	Floating-point number with sign	<ul style="list-style-type: none"> <li>■ Concentration: depends on the selected concentration app.</li> <li>■ Temperature: 120 °C (248 °F)</li> <li>■ Speed of sound: 2 000.00</li> <li>■ Density: 1.500 kg/m<sup>3</sup> (3.306 lb/ft<sup>3</sup>)</li> <li>■ Dispersion: 1</li> </ul>
Maximum Value [unit]	Enter the minimum value to be displayed on the Y axis.	Floating-point number with sign	<ul style="list-style-type: none"> <li>■ Concentration: depends on the selected concentration app.</li> <li>■ Temperature: 0 °C (32 °F)</li> <li>■ Speed of sound: 500.00</li> <li>■ Density: 500 kg/m<sup>3</sup> (1 102.311 lb/ft<sup>3</sup>)</li> <li>■ Dispersion: 0</li> </ul>
Auto scale	Select to enable or disable auto scaling of the graph.	Enable/disable the function	The function is enabled

### 11.3.2 Graph tools

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

### 11.4 Reading measured values via the operating tool

The Viewer presents the measured data in graph and text form on the home page. The **Live Viewer** mode is automatically activated once the transmitter is connected.

 Following an analysis of the data offline, the "Teqwave Viewer" → "Live Viewer" menu allows users to switch to the Live View.

#### 11.4.1 Adjusting the graph display format

*Navigation using the Viewer*

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

*Parameter overview with brief description*

Parameter	Procedure	Selection/input	Factory setting
Time axis	Select the period shown on the X-axis.	<ul style="list-style-type: none"> <li>■ 1 minute</li> <li>■ 3 minutes</li> <li>■ 5 minutes</li> <li>■ 10 minutes</li> <li>■ 30 minutes</li> <li>■ 1 hour</li> <li>■ 6 hours</li> <li>■ 12 hours</li> <li>■ 1 day</li> <li>■ 7 days</li> <li>■ 30 days</li> <li>■ 90 days</li> </ul>	5 minutes
Y-axis 1	Select measured variables to be displayed on the left-side axis.	Depends on the measured variables enabled and the selected concentration app: <ul style="list-style-type: none"> <li>■ Concentration 1</li> <li>■ Concentration 2</li> <li>■ Temperature</li> <li>■ Speed of sound</li> <li>■ Density</li> <li>■ Dispersion</li> </ul>	Concentration 1

Parameter	Procedure	Selection/input	Factory setting
Y-axis 2	Select measured variables to be displayed on the right-side axis.	<ul style="list-style-type: none"> <li>■ Concentration 1</li> <li>■ Concentration 2</li> <li>■ Temperature</li> <li>■ Speed of sound</li> <li>■ Density</li> <li>■ Dispersion</li> </ul>	Temperature
Time interval in seconds	Specify the display rate (in seconds) for retrieving the values from the transmitter.	Positive decimal	1 s

### 11.4.2 Graph tools

The mouse wheel can be used to zoom through the graph and (if available) to move the time axis left/right by pressing the mouse wheel to left/right..

 The graph tools only work when the auto scale function is switched off →  50.

Button	Description
 <small>A0035501</small>	<b>Cursor position</b> Only for the "Read memory" function: select the cursor position in the graph for the desired measured value display.
 <small>A0035502</small>	<b>Selecting the zoom function</b> Open and use options to zoom in (enlarge view) and zoom out (reduce view) of the chart. <ul style="list-style-type: none"> <li>■ <b>Rectangle zoom:</b> Press and hold the left mouse button and drag the rectangle over the area you wish to zoom into.</li> <li>■ <b>X-axis zoom:</b> Press and hold the left mouse button and drag over the desired area of the X axis.</li> <li>■ <b>Y-axis zoom:</b> Press and hold the left mouse button and drag over the desired area of the Y axis.</li> <li>■ <b>Adjust automatically:</b> Click the icon to automatically adjust the graph.</li> <li>■ <b>Magnify:</b> Click the desired point to zoom into the graph.</li> <li>■ <b>Reduce:</b> Click the desired point to zoom out of the graph.</li> </ul>
 <small>A0035508</small>	<b>Y-axis position function</b> Move the position of the Y-axis up or down.

### 11.4.3 Switching auto scale on and off

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

### 11.4.4 Clearing the graph

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

## 11.5 Accessing measured data via the operating tool

 The "Viewer with interface for data download" application package must be enabled to be able to access the **Single measurement**, **Start recording** and **Stop recording** menu items. Otherwise the menu items are grayed out and cannot be selected.

The Viewer records measured values and provides functions to retrieve the measured data.

### 11.5.1 Saving the current measuring point to a .csv file

1. Select the menu "Tegwave Viewer" → "Single measurement".
  - ↳ The "Specify path" window opens.
2. Select the file where the measuring point is to be saved. Either create a new or select an existing .csv file on the computer. The measuring point will be saved to this file.
  - ↳ The new measuring point is appended to the end of the file. Existing values are retained.

### 11.5.2 Recording the measuring points

1. Select the menu "Tegwave Viewer" → "Start recording".
  - ↳ The "Specify path" window opens.
2. Select the file where the measuring points are to be saved. Either create a new or select an existing .csv file on the computer. The measuring point will be saved to this file.
  - ↳ A green indicator appears above the measured values on the startup screen. The new measuring points are appended to the end of the file. Existing values are retained.

### 11.5.3 Stop recording

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

## 11.6 Loading measured values in the Graph View

The Viewer allows users to retrieve measured data saved earlier with the **Open data** function. These can be measured data that were retrieved from the transmitter or recorded by the Viewer.

### 11.6.1 Loading the measured data

1. Select the menu "Tegwave Viewer" → "Open data".
  - ↳ The "Specify path" window opens.
2. Select the desired file and click "OK" to confirm.
  - ↳ The Viewer interrupts the Live View and displays the selected data.

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

## 11.7 Reading the device memory and saving measured data

-  The "Viewer with interface for data download" application package must be enabled to be able to access the **Read memory** and **Save read data** menu items. Otherwise the menu item is grayed out and cannot be selected.
- If the volume of data is large, data readout takes a large amount of time. For this reason, it is advisable to regularly call up the data on the data memory and save the data externally.

The Viewer can read out and delete measured data recorded during the operation of the transmitter with the **Read memory** function. The Viewer saves the data with the **Save read** data function.

### 11.7.1 Reading measured data from the transmitter

1. Select the menu "Teqwave Transmitter" → "Read memory".
  - ↳ The "Saved files" window opens.
2. From the drop-down menu, select the concentration app for data read-out.
  - ↳ One file is saved on the transmitter per concentration app.
3. Click the "Read" button.
  - ↳ The Viewer displays the progress bar. This indicates the volume of data already downloaded. As soon as the download process is finished, the progress bar closes automatically and the Viewer displays the measured data in the graph format. Following an analysis of the data offline, the "Teqwave Viewer" → "Live Viewer" menu allows users to switch to the Live View.

### 11.7.2 Saving the read measured data to a .csv file

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

1. Select the menu "Teqwave Transmitter" → "Save read data".
  - ↳ The "Specify path" window opens.
2. Select the path and file name for saving the measured data.
3. Click the "OK" button to confirm.
  - ↳ The Viewer saves the measured data to a .csv file.

### 11.7.3 Deleting saved measured data from the transmitter

#### NOTICE

#### Loss of data

Once data are deleted they cannot be restored.

- ▶ Read out and save data before deleting them from the transmitter.

1. Select the menu "Teqwave Transmitter" → "Read memory".
  - ↳ The "Saved files" window opens.
2. From the drop-down menu, select the concentration app with the data that are to be deleted.
3. Click the "Delete" button.
  - ↳ The message "Do you really want to delete the data?" appears on the screen.
4. Select "Yes" to confirm.
  - ↳ The Viewer deletes the measured data of the selected concentration app from the transmitter's memory.

## 11.8 Managing concentration apps

The Viewer can manage concentration apps on the connected transmitter via the **Manage concentration apps** function. This function allows users to get an overview of all the concentration apps installed on the transmitter, load new concentration apps onto the transmitter and activate them, and delete concentration apps that are no longer needed from the transmitter.

### 11.8.1 Adding a concentration app to the transmitter

 Concentration apps are 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 concentration app file to automatically check whether there is authorization to enable the concentration app on the connected transmitter.

1. Open the "Teqwave Transmitter" → "Manage concentration apps" menu.
  - ↳ A new window appears.
2. Click the "Add" button.
  - ↳ The "Specify path" window opens.
3. Select the concentration app file. Concentration app files are in lmf format.
4. Click the "OK" button to add new concentration apps to the transmitter.

### 11.8.2 Deleting a concentration app from the transmitter

 **■** If an active concentration app is deleted, a new concentration app must be activated. Otherwise the system stops calculating the concentration of the liquid.  
**■** If concentration apps that have been deleted from the transmitter are to be used again, they must be installed on the transmitter again from the CD-ROM.

1. Open the "Teqwave Transmitter" → "Manage concentration apps" menu.
  - ↳ A new window appears.
2. Select the concentration app to be deleted from the "concentration apps" drop-down menu.
3. Click the "Delete" button.
  - ↳ The message "Do you really want to delete the data?" appears on the screen.
4. Select "Yes" to confirm.
  - ↳ The Viewer deletes the concentration app from the transmitter.

## 11.9 Replacing the transmitter

For establishing a connection, see →  27.

## 11.10 Updating the firmware

Firmware updates must be installed via the Viewer. The updates are available in the Download Area of the Endress+Hauser web site: [www.endress.com](http://www.endress.com) → Downloads.

Specify the following details:

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

*Navigation*

Menu "Teqwave Transmitter" → "Update Transmitter"

Updating the firmware

#### **NOTICE**

#### **Damage to the measuring device**

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

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

1. Open the menu "Teqwave Transmitter" → "Update transmitter".
  - ↳ The "Specify path" window opens.
2. Select the .lcu file.
3. Click "OK" to run the update.
  - ↳ The transmitter runs the update. Once the update process is completed, the status LED is lit green (transmitter with LED status indication) or the touch screen (transmitter with a touch screen) shows the operational display.

## 12 Diagnostics and troubleshooting

### 12.1 General troubleshooting

#### 12.1.1 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.

#### 12.1.2 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.

#### 12.1.3 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.

Problem	Possible causes	Remedial action
	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>
	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>

### 12.1.4 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>

## 12.2 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.

LED	Signal	Meaning
	Flashes	<p>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:</p> <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	<p>Sensor error. Read exact error code with the Viewer. The following errors are possible:</p> <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>

### 12.3 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.
	"Process disturbance detected, dispersion > [limit value]"	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 → 16.</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 [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.
	"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.

Signal color	Diagnostic message	Description	Measures
		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.
	"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 → 16.</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>

## 12.4 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 → 20.
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 s.
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.	-
8	0x00000100	Process disturbance detected	The measured dispersion is greater than the configured switch point.	<ul style="list-style-type: none"> <li>▪ Remove air bubbles and/or particles.</li> <li>▪ Take recommended mounting position into consideration → 16.</li> </ul>

Bit	Hexadecimal	Diagnostic message	Description	Measures
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 → 16.</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>

### 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.

## 12.5 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 "Tegwave Transmitter" → "Display filter" → "Process disturbance" → "Switch point"

## 12.6 Checking the sensor

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

*Navigation using the Viewer*

Menu "Teqwave Transmitter" → "Sensor testing"

### NOTICE

#### Incorrect test result

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

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

1. Call up the menu "Teqwave Transmitter" → "Sensor testing".
  - ↳ A message appears with information on the preparatory steps. If using the "Teqwave I" sensor, immerse the sensor fully in a vessel containing distilled or completely deionized water. If using the "Teqwave F" sensor, fill the sensor completely with distilled or completely deionized water.
2. Click "OK" to confirm the message.
  - ↳ View in the Viewer changes to the Test View. If the temperature of the liquid and sensor is stable, the message "The temperature is stable. Start sensor testing?" appears after approximately three minutes.
3. Click "OK" to confirm the message.
  - ↳ The sensor test begins. The test result appears in the form of a test report after a few seconds.
4. Click "OK" to save the test report as an image file (.bmp) on the computer.
  - ↳ The "Specify path" window opens.
5. Select the path and file name for saving the .bmp file.
6. Click the "OK" button to confirm.
  - ↳ The Viewer saves the test report.
7. Check the test report. If the test values are outside the tolerance range, the sensor may need to be adjusted. In such cases, please contact your Endress+Hauser Sales Center. Permitted deviations for the speed of sound:  $\pm \leq 0.5$  m/s and for the density:  $\pm \leq 3.0$  kg/m<sup>3</sup>.

## 12.7 Resetting the measuring device to factory default settings

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

 Apps/packages are not affected by the factory reset.

### 12.7.1 Restoring factory settings via a transmitter with a touch screen

1. Select Settings menu → "Application parameters".

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

### 12.7.2 Restoring factory settings via the Viewer

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

## 12.8 Device information

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

Navigation using transmitter with touch screen

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

*Navigation using the Viewer*

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

*Parameter overview with brief description*

Parameter	Description	Display	Factory setting
Teqwave Viewer (Viewer)	Displays the current version of the Teqwave Viewer.	Character string with the format: v.x.y.zz	-
Version (transmitter) Hardware (transmitter)	Displays the installed device firmware version and device revision.	Character string with the following format: x.y.z	-
Serial number sensor (Viewer)	Displays the serial number of the sensor.  Can also be found on the nameplate of the sensor.	Max. 11-digit numerical value	-
Serial number transmitter (Viewer)	Displays the serial number of the transmitter.  Can also be found on the nameplate of the transmitter.	Max. 12-digit numerical value	-
MAC address	Displays the MAC address of the transmitter.	Byte-wise notation, colon separated	-
License key (Viewer)	Displays the license key currently used.	32-digit number sequence, consisting of 4 groups, separated by a hyphen	-
Status	Displays the device status encoded for the Service Department.	Max. 5-digit character string	-

## 12.9 Firmware history

Date	Firmware version	Order code for "Firmware Version"	Changes	Documentation type	Documentation
12.2017	2.1.zz	Option 78	Original firmware	Operating Instructions	BA01823D/06/EN/01.17
07.2019	2.2.0 (Teqwave Transmitter)	Option 78	<ul style="list-style-type: none"> <li>▪ Support of 3rd generation displays</li> <li>▪ Revision of the on-screen keyboard layout</li> <li>▪ Optimizing the behavior of the Kalman filter (temperature)</li> <li>▪ Increase of the minimum display brightness</li> <li>▪ Various bug fixes</li> </ul>	Operating Instructions	BA01823D/06/EN/02.19
	2.1.2 (Teqwave Viewer)		<ul style="list-style-type: none"> <li>▪ Possibility of scrolling/zooming in the graph with read out data</li> <li>▪ Prevention of multiple readouts when retrieving measured value files (UPD data transmission)</li> <li>▪ Storage of the viewer settings in the local folder (availability ensured after Windows Update)</li> <li>▪ Verification of concentration apps (Imf files) before transfer to transmitter (license key, completeness/ validity of file)</li> <li>▪ Various bug fixes</li> </ul>		

 It is possible to flash the firmware to the current version or the previous version via the "Teqwave Viewer" operating tool →  53.

## 13 Maintenance

### 13.1 Maintenance tasks

No special maintenance work is required.

#### 13.1.1 Exterior cleaning

When cleaning the exterior of the measuring device, always use cleaning agents that do not corrode the material or the seals.

#### 13.1.2 Interior cleaning

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

##### **NOTICE**

##### **Damage to the sensor**

Unsuitable cleaning agents or tools can damage the sensor.

- ▶ Do not use pigs to clean the pipe.
- ▶ Use an oil-free cleaning agent that does not form a film to clean the sensor. Gently clean the surface using a soft brush.
- ▶ Do not damage the sensor.
- ▶ Never use cleaning agents that can corrode the material.

### 13.2 Endress+Hauser services

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

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

## 14 Repair

### 14.1 General notes

#### 14.1.1 Repair and conversion concept

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

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

#### 14.1.2 Notes for repair and conversion

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

- ▶ Use only original Endress+Hauser spare parts.
- ▶ Carry out the repair according to the Installation Instructions.
- ▶ Observe the applicable standards, federal/national regulations, Ex documentation (XA) and certificates.
- ▶ Document every repair and each conversion and enter them into the *W@M* life cycle management database.

### 14.2 Spare parts

 Measuring device serial number:  
Can be read out via the **Serial number** parameter in the **Device information** submenu.

### 14.3 Endress+Hauser services

Endress+Hauser offers a wide range of services.

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

### 14.4 Return

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

1. Refer to the website for more information:  
<http://www.endress.com/support/return-material>
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

### 14.5 Disposal

#### 14.5.1 Removing the measuring device

1. Switch off the device.

**⚠ WARNING****Danger to persons from process conditions.**

- ▶ Beware of hazardous process conditions such as pressure in the measuring device, high temperatures or aggressive fluids.
2. Carry out the mounting and connection steps from the "Mounting the measuring device" and "Connecting the measuring device" sections in reverse order. Observe the safety instructions.

### 14.5.2 Disposing of the measuring device

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

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

Observe the following notes during disposal:

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

## 15 Accessories

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

### 15.1 Device-specific accessories

#### 15.1.1 About the transmitter

Accessories	Description
<b>Transmitter</b> <ul style="list-style-type: none"> <li>▪ LED status indication</li> <li>▪ Touch screen</li> </ul>	<b>Transmitter for replacement or storage.</b> The serial number of the current transmitter must be specified when ordering. On the basis of the serial number, device-specific data in the replaced device can also be used in the new transmitter. Order number: DK9BXX
<b>Connecting cable between sensor and transmitter</b>	The following cable lengths are available (order code for "Cable, sensor connection"): <ul style="list-style-type: none"> <li>▪ Option B: 1 m (3 ft)</li> <li>▪ Option D: 2 m (6 ft)</li> <li>▪ Option E: 5 m (15 ft)</li> <li>▪ Option F: 10 m (30 ft)</li> </ul> Order number: XPD0047

### 15.2 Communication specific accessories

Accessories	Description
<b>Concentration app</b>	<b>Data record for integrating new fluids into the measuring device.</b> The concentration apps are available on the CD-ROM. A list of the available concentration apps and measuring ranges is provided in the Applicator →  67. 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. Endress+Hauser provides the concentration app as a file in lmf format. Every transmitter can use a maximum of 25 concentration apps. Order number: DK9500

### 15.3 Service-specific accessories

Accessories	Description
Applicator	<p>Software for selecting and sizing Endress+Hauser measuring devices:</p> <ul style="list-style-type: none"> <li>▪ Choice of measuring devices for industrial requirements</li> <li>▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, flow velocity and accuracy.</li> <li>▪ Graphic illustration of the calculation results</li> <li>▪ Determination of the partial order code, administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.</li> </ul> <p>Applicator is available:</p> <ul style="list-style-type: none"> <li>▪ Via the Internet: <a href="https://portal.endress.com/webapp/applicator">https://portal.endress.com/webapp/applicator</a></li> <li>▪ As a downloadable DVD for local PC installation.</li> </ul>
W@M	<p>W@M Life Cycle Management</p> <p>Improved productivity with information at your fingertips. Data relevant to a plant and its components is generated from the first stages of planning and during the asset's complete life cycle.</p> <p>W@M Life Cycle Management is an open and flexible information platform with online and on-site tools. Instant access for your staff to current, in-depth data shortens your plant's engineering time, speeds up procurement processes and increases plant uptime.</p> <p>Combined with the right services, W@M Life Cycle Management boosts productivity in every phase. For more information, visit <a href="http://www.endress.com/lifecyclemanagement">www.endress.com/lifecyclemanagement</a></p>

## 16 Technical data

### 16.1 Application

The measuring device is suitable for measurement of the concentration of liquids only.

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

### 16.2 Function and system design

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Measuring principle      Concentration measurement using acoustic surface waves.

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Measuring system      For information on the structure of the device, see "Product description" →  11.

### 16.3 Input

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Measured variables      **Direct measured variables**

- Temperature
- Speed of sound

**Derived measured variables**

- Concentration
- Dispersion
- Density

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Measuring range	<b>Concentration</b>	As per concentration app data sheet, maximum 0 to 100 %
	<b>Speed of sound</b>	600 to 2 000 m/s
	<b>Temperature</b>	Concentration app data sheet, maximum 0 to 100 °C (+32 to +212 °F)
	<b>Density</b>	0.7 to 1.5 g/cm <sup>3</sup>

---

Input signal      **Digital input**

<b>Function</b>	Choice of analog channel 1 to 4; inputs "0" and "1" are connected to ground.
<b>Version</b>	Open and ground. Do not connect external voltage to these terminals.

### 16.4 Output

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Output signal      **Ethernet (Modbus protocol)**

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

<b>Function</b>	Can be configured as a current output or voltage output, as required
<b>Version</b>	Galvanically isolated
<b>Open-circuit voltage</b>	DC 15.5 V
<b>Suspend time</b>	Configurable: 0 to 10 000 s
<b>Assignable measured variables</b>	<ul style="list-style-type: none"> <li>▪ Off</li> <li>▪ On</li> <li>▪ Concentration 1-2</li> <li>▪ Temperature</li> <li>▪ Speed of sound</li> <li>▪ Dispersion</li> <li>▪ Density (optional)</li> <li>▪ Suspend measurement</li> </ul>
<b>Current output</b>	4 to 20 mA
<b>Maximum output value</b>	20 mA
<b>Load</b>	0 to 500 $\Omega$
<b>Resolution</b>	1.5 $\mu$ A
<b>Voltage output</b>	0 to 10 V
<b>Maximum output value</b>	10 V
<b>Load</b>	> 750 $\Omega$
<b>Resolution</b>	1 mV

**Relay output**

<b>Function</b>	Relay output
<b>Version</b>	Relay output, galvanically isolated
<b>Maximum switching capacity</b>	AC/DC 50 V, 1 A
<b>Switching behavior</b>	<ul style="list-style-type: none"> <li>▪ NC contact</li> <li>▪ NO contact</li> </ul>
<b>Assignable functions</b>	<ul style="list-style-type: none"> <li>▪ Off</li> <li>▪ On</li> <li>▪ Limit value (can be configured as a range or trigger value, as required): <ul style="list-style-type: none"> <li>▪ Concentration 1 to n</li> <li>▪ Temperature</li> <li>▪ Speed of sound</li> <li>▪ Dispersion</li> <li>▪ Density</li> </ul> </li> </ul>

Signal on alarm

Breakdown information and failsafe mode of the outputs are configurable →  43.**Ethernet (Modbus protocol)**

<b>Status bit</b>	Diagnostics information via status bits
-------------------	---

**Current output 4 to 20 mA / voltage output 0 to 10 V**

<p><b>Failsafe mode</b></p>	<p>The breakdown information displayed in the event of a breach of the measuring range (over-range/under-range) can be configured in the <b>Analog output settings</b> parameters:</p> <ul style="list-style-type: none"> <li>■ Failure value for measured variable if the "0 V/2 mA exceeding limits" option is selected: 2 mA or 0 V</li> <li>■ Limit value for measured variable if the "Min/Max exceeding limits" option is selected: 4 to 20 mA or 0 to 10 V</li> </ul> <p>The breakdown information displayed in the event of a breach of the calibration range (over-range/under-range) can be configured in the <b>Display filter</b> parameter:</p> <ul style="list-style-type: none"> <li>■ Failure value for measured variable if the "Calibration range" option is selected: 2 mA or 0 V</li> <li>■ If the measuring device exceeds or drops below the temperature calibration range, a failure value is also displayed for the concentration measured variable if it is active.</li> </ul> <p>The breakdown information displayed if the process is not stationary (stationarity) can be configured in the <b>Display filter</b> parameter: Failure value for the <b>concentration measured variable if the "Enable stationarity" option is selected</b>: 2 mA or 0 V</p> <p>The breakdown information to be displayed if the rate of change exceeds the limit value can be configured in the <b>Change in [measured variable]</b> parameter. If the function is enabled: Failure value for the <b>concentration</b> measured variable: 2 mA or 0 V</p> <p>In the event of interference influences (dispersion) above the limit value: Failure value for the <b>concentration</b> measured variable: 2 mA or 0 V</p> <p>If there is not enough liquid or the sensor is defective: Failure value for all measured variables: 2 mA or 0 V</p>
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**Relay output**

<p><b>Failsafe mode</b></p>	<p>If the temperature measurement range is exceeded or undershot: For the <b>concentration</b> measured variable: the current status is held.</p> <p>If the temperature calibration range is exceeded or undershot: For the <b>concentration</b> measured variable: the current status is held.</p> <p>The breakdown information to be displayed if the process is not stationary (stationarity) can be configured in the <b>Display filter</b> parameter. If the "Enable stationarity" option is selected: For the <b>concentration</b> measured variable: the current status is held.</p> <p>The breakdown information to be displayed if the rate of change exceeds the limit value can be configured in the <b>Change in [measured variable]</b> parameter. If the function is enabled: For the <b>concentration</b> measured variable: the current status is held.</p> <p>In the event of interference influences (dispersion) above the limit value: For the <b>concentration</b> measured variable: the current status is held.</p> <p>If there is not enough fluid: Measured value for all measured variables with the exception of temperature: 0 Switch status as per the setting for the switching threshold or switch point ("Operating Instructions" document, "Configuring the switch output" section).</p> <p>If there is a sensor defect: Measured value for all measured variables: 0 Switch status as per the setting for the switching threshold or switch point ("Operating Instructions" document, "Configuring the switch output" section).</p>
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**Local display (transmitter with touch screen)**

<p><b>Color coding</b></p>	<p>Color field signalizes measuring and device errors ("Operating Instructions" document, "Diagnostics information on local display and in operating tool" section)</p>
<p><b>Plain text display</b></p>	<p>Information on the cause</p>

**Local display (transmitter with LED)**

<b>Light emitting diodes (LED)</b>	Status indication with four light emitting diodes ("Operating Instructions" document, "Diagnostics information for transmitter with LED status indication" section)  The LEDs indicate the following information: <ul style="list-style-type: none"> <li>▪ Supply voltage active</li> <li>▪ Error-free measuring system</li> <li>▪ Device alarm/error has occurred</li> <li>▪ Problem with connection to the sensor</li> </ul>
------------------------------------	--

**"Teqwave Viewer" operating tool**

<b>Color coding</b>	Color field signals measuring and device errors ("Operating Instructions" document, "Diagnostics information on local display and in operating tool" section)
<b>Plain text display</b>	Information on the cause

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

Protocol-specific data	<b>Protocol</b>	Modbus Applications Protocol Specification V1.1
	<b>Response times</b>	Typically 10 to 50 ms
	<b>Device type</b>	Slave
	<b>Function codes</b>	0×04: Read Input Registers
	<b>Modbus data transmission</b>	Little endian
	<b>Data access</b>	Each measured variable can be accessed via Modbus (Ethernet).

**16.5 Power supply**

Terminal assignment      →  19

Supply voltage	<b>Transmitter</b>	24 V <sub>DC</sub> (18 to 35 V)
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 The power unit must be tested to ensure it meets safety requirements (e.g. PELV, SELV).

Power consumption	<b>Transmitter</b>	Max. 4 W
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Current consumption	<b>Transmitter</b> maximum switch-on current	6 A
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Power supply failure      The configuration and recorded data are retained in the device memory.

Electrical connection      →  19

Potential equalization      →  21

Terminals	<b>Terminal type</b>	Screw terminals
	<b>Conductor cross-section</b>	0.129 to 1.31 mm <sup>2</sup> (16 to 26 AWG)

Cable specification →  19

## 16.6 Performance characteristics

Max. measured error	<b>Speed of sound</b>	±2 m/s (±6.56 ft/s)
	<b>Temperature</b>	±0.5 K
	<b>Density</b>	±0.01 g/cm <sup>3</sup>

**Accuracy** **Accuracy of concentration measurement**  
 The measuring device can achieve an accuracy of up to 0.01 %. The accuracy depends on the concentration app. Detailed information on the accuracy is provided in the data sheet.

**Reaction time**  **Influence of medium temperature**  
 The response time of the temperature measurement depends on the heat transfer from the fluid to the steel. Activation of the Kalman filter accelerates the response time. An erratic change in the temperature generates an error message. It is possible to set a threshold for displaying the error.

**Influence of variations in the fluid temperature** If the fluid temperature changes quickly (>1.5 °C/min (34.7 °F/min)), the measured error can be greater than specified in the "Max. measured error" section.

**Influence of vibrations** The measured error can be greater than specified in the "Max. measured error" section as a result of mechanical or acoustic vibrations in the 0.8 to 2.0 MHz range.

**Influence of ambient temperature** **Current/voltage output**

<b>Temperature coefficient</b>	100 µV/°C (µV/°F) or ±1 µA/°C (µA/°F)
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**Influence of air bubbles** Air bubbles and particles are disturbance factors when measuring with acoustic surface waves. The recommended installation positions and the "Dispersion" diagnostic information largely prevent incorrect measurement results caused by air bubbles or particles.

## 16.7 Installation

Chapter "Mounting requirements" →  16

## 16.8 Environment

Ambient temperature range	<b>Sensor</b>	0 to +50 °C (+32 to +122 °F)
	<b>Transmitter</b>	0 to +50 °C (+32 to +122 °F)

Storage temperature 0 to +50 °C (+32 to +122 °F)

Degree of protection

<b>Sensor</b>	IP 68 with cable plugged in
<b>Transmitter</b>	IP 40

Electromagnetic compatibility (EMC)

- As per IEC/EN 61326-1
  - Complies with emission limit for industry as per EN 55011 (Class A)
- For details, refer to the Declaration of Conformity.

## 16.9 Process

Medium temperature range

**Sensor**  
0 to +100 °C (+32 to +212 °F)

Nominal pressure

**Sensor**  
Max. 16 bar (232 psi) at 20 °C (68 °F)

Flow velocity

Max. 5 m/s (16.4 ft/s).

## 16.10 Mechanical construction

Design, dimensions



For the dimensions and installation lengths of the device, see the "Technical Information" document, "Mechanical construction" section.

Weight

**Transmitter**

<b>Weight of transmitter</b>	0.34 kg (0.8 lb)
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**"Teqwave F" sensor**

DN [mm (in)]	Flange [kg (lb)]	External thread [kg (lb)]	Internal thread [kg (lb)]
8 (3/8")	1.85 (4.08)	0.45 (0.99)	0.45 (0.99)
15 (1/2")	2.0 (4.4)	0.6 (1.3)	0.6 (1.3)
25 (1")	4.0 (8.8)	1.4 (3.1)	1.4 (3.1)

**"Teqwave I" sensor**

Installed length [mm (in)]	Flange [kg (lb)]	External thread [kg (lb)]
180 (7") Order code for "Insertion Length, Insertion Tube Material", option AS	1.52 (3.35)	0.42 (0.93)
500 (20") Order code for "Insertion Length, Insertion Tube Material", option BS	1.70 (3.75)	0.61 (1.35)

Materials

**Transmitter housing**

<b>Housing</b>	Anodized aluminum
<b>Window material</b>	Glass plate
<b>Terminal connection</b>	Polybuteneterephthalate (PBT)
<b>Ethernet interface</b>	<ul style="list-style-type: none"> <li>▪ Socket: ferrite</li> <li>▪ Contact housing: thermoplastic</li> <li>▪ Contacts: 100 % tin with nickel coating, gold-plated</li> </ul>
<b>Push-pull connection</b>	<ul style="list-style-type: none"> <li>▪ Socket: brass, nickel-plated</li> <li>▪ Contact housing: polyetheretherketone (PEEK)</li> <li>▪ Contacts: brass, gold-plated</li> </ul>

**Sensor housing**

Stainless steel, 1.4571 (V4A) / 316Ti

**Connecting cable**

<b>Cable, external material</b>	Polyurethane as per DIN EN 60811-2-1 (oil-resistant, halogen-free)
<b>Connector</b>	<ul style="list-style-type: none"> <li>▪ Socket: brass, nickel-plated</li> <li>▪ Contact housing: polyetheretherketone (PEEK)</li> <li>▪ Contacts: brass, gold-plated</li> </ul>

Process connections

**"Teqwave F" sensor**

- Flange, EN 1092-1 (DIN 2501), PN 16
- External thread
- Internal thread

**"Teqwave I" sensor**

- Flange, EN 1092-1 (DIN 2501), PN 16
- External thread

## 16.11 Operability

Local operation

**Via display module**

Two display modules are available:

- Order code for "Display, operation", option A "LED status indication"
- Order code for "Display, operation", option B "3.5" TFT touch display"

Supported operating tools

Operation via "Teqwave Viewer" Windows Desktop operating tool.

Reliable operation

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

Languages

Can be operated in the following languages:

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

## 16.12 Certificates and approvals

CE mark	The device meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
RCM-tick symbol	The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".
Other standards and guidelines	<ul style="list-style-type: none"> <li>■ EN 60529 Degrees of protection provided by enclosures (IP code)</li> <li>■ EN 61010-1 Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements</li> <li>■ IEC/EN 61326-1 Electromagnetic compatibility (EMC requirements)</li> <li>■ RoHS and EN 50581 Restriction of hazardous substances in electric and electronic devices.</li> </ul>

## 16.13 Application packages

Application packages are available for the device to expand the device functions, depending on user needs. The application packages can be ordered with the device or subsequently from Endress+Hauser. The Endress+Hauser Sales Center can provide detailed information on the relevant order code. The product page on the Endress+Hauser website [www.endress.com](http://www.endress.com) also contains additional information on the order code.

Package	Description
<b>Viewer with interface for data download</b> Order code for "Application package", option EP	<b>Retrieval and storage of measured values.</b> The application package allows users to retrieve measured data saved in the internal device memory. In addition, the measured data can be saved in a text file which can be imported into a database. Order number: DK9501

## 16.14 Accessories

 Overview of accessories available for order → 

## 16.15 Documentation

-  For an overview of the scope of the associated Technical Documentation, refer to the following:
- *W@M Device Viewer* ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): Enter the serial number from nameplate
  - *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

Standard documentation	Document type	Documentation code
	Technical Information	TIO1381D
	Brief Operating Instructions	KA01371D

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