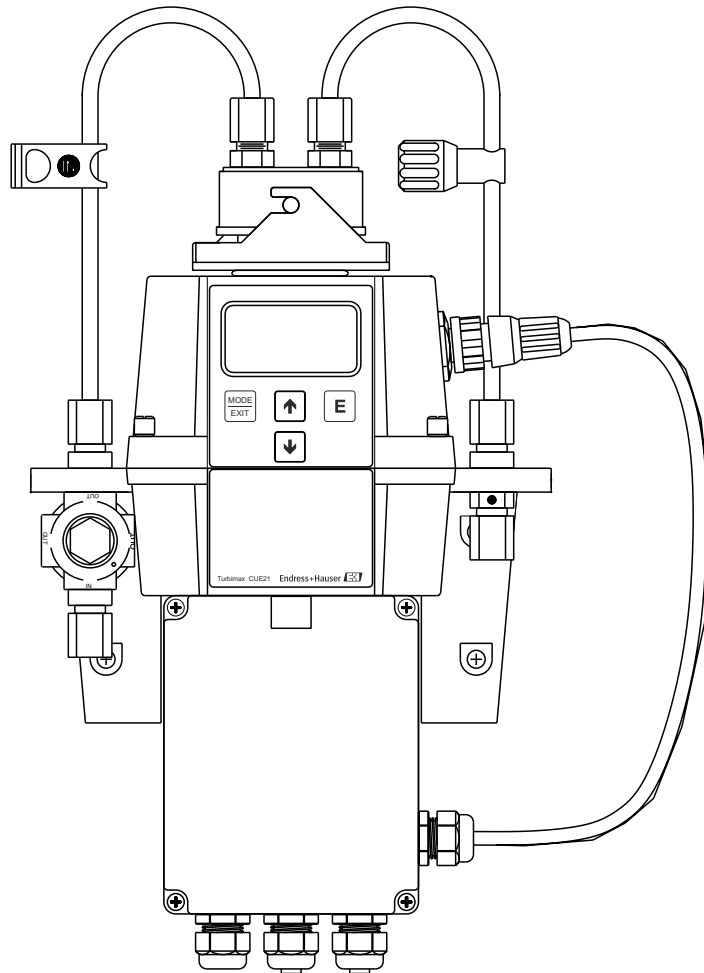


# Operating Instructions

## Turbimax CUE21 / CUE22

Turbidimeter for online measurement






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# 1 Document information

## 1.1 Safety information

Structure of information	Meaning
 <b>DANGER</b> <b>Causes (/consequences)</b> Consequences of non-compliance (if applicable) ► Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation <b>will</b> result in a fatal or serious injury.
 <b>WARNING</b> <b>Causes (/consequences)</b> Consequences of non-compliance (if applicable) ► Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation <b>can</b> result in a fatal or serious injury.
 <b>CAUTION</b> <b>Causes (/consequences)</b> Consequences of non-compliance (if applicable) ► Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
<b>NOTICE</b> <b>Cause/situation</b> Consequences of non-compliance (if applicable) ► Action/note	This symbol alerts you to situations which may result in damage to property.


## 1.2 Symbols

Symbol	Meaning
	Additional information, tips
	Permitted or recommended
	Not permitted or not recommended
	Reference to device documentation
	Reference to page
	Reference to graphic
	Result of a step

## 2 Basic safety instructions

### 2.1 Requirements for personnel

- Installation, commissioning, operation and maintenance of the measuring system may be carried out only by specially trained technical personnel.
- The technical personnel must be authorized by the plant operator to carry out the specified activities.
- The electrical connection may be performed only by an electrical technician.
- The technical personnel must have read and understood these Operating Instructions and must follow the instructions contained therein.
- Measuring point faults may be repaired only by authorized and specially trained personnel.

 Repairs not described in the Operating Instructions provided may only be carried out directly by the manufacturer or by the service organization.

### 2.2 Designated use

The turbidimeters from the Turbimax CUE21 / CUE22 series are designed for online measurement of turbidity in process water and drinking water.

The infrared device CUE21 meets the design criteria for turbidity measurement specified by ISO 7027 and DIN 27027.

The white light device CUE22 meets the design criteria specified by US EPA 180.1.

Use of the device for any purpose other than that described, poses a threat to the safety of people and of the entire measuring system and is therefore not permitted.

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

### 2.3 Workplace safety

As the user, you are responsible for complying with the following safety conditions:

- Installation guidelines
- Local standards and regulations

#### **Electromagnetic compatibility**

- The product has been tested for electromagnetic compatibility in accordance with the applicable European standards for industrial applications.
- The electromagnetic compatibility indicated applies only to a product that has been connected in accordance with these Operating Instructions.

## 2.4 Operational safety

1. Before commissioning the entire measuring point, verify that all connections are correct. Ensure that electrical cables and hose connections are undamaged.
2. Do not operate damaged products, and safeguard them to ensure that they are not operated inadvertently. Label the damaged product as defective.
3. If faults cannot be rectified:  
Take the products out of operation and safeguard them to ensure that they are not operated inadvertently.

## 2.5 Product safety

The product is designed 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. The relevant regulations and European standards have been observed.

## 3 Incoming acceptance and product identification

### 3.1 Incoming acceptance

1. Verify that the packaging is undamaged.
  - ↳ Notify your supplier of any damage to the packaging.  
Keep the damaged packaging until the matter has been settled.
2. Verify that the contents are undamaged.
  - ↳ Notify your supplier of any damage to the delivery contents.  
Keep the damaged products until the matter has been settled.
3. Check the delivery for completeness.
  - ↳ Check it against the delivery papers and your order.
4. Pack the product for storage and transportation in such a way that it is protected against impact and moisture.
  - ↳ The original packaging offers the best protection.  
The permitted ambient conditions must be observed (see "Technical data").

If you have any questions, please contact your supplier or your local sales center.

### 3.2 Product identification

#### 3.2.1 Nameplate

The nameplate provides you with the following information on your device:

- Manufacturer identification
- Order code
- Extended order code
- Serial number
- Ambient and process conditions
- Safety information and warnings

 Compare the data on the nameplate with your order.

#### 3.2.2 Product identification

##### Product page

[www.endress.com/cue21](http://www.endress.com/cue21)

[www.endress.com/cue22](http://www.endress.com/cue22)

##### Interpreting the order code

The order code and serial number of your product can be found in the following locations:

- On the nameplate
- In the delivery papers

##### Obtaining information on the product

1. Go to the product page for your product on the Internet.
2. In the navigation area on the right-hand side, select "Check your device features" under "Device support".
  - ↳ An additional window opens.

3. Enter the order code from the nameplate into the search field.
  - ↳ You will receive information on each feature (selected option) of the order code.

### 3.3 Scope of delivery

The scope of delivery comprises:

- 1 turbidimeter Turbimax CUE21 or CUE22
- 1 field terminal box
- 1 packet of desiccant
- 1 tubing kit including
  - 1 shutoff clamp
  - 1 flow controller
  - 2 connecting tubes with fittings for flow-through assembly
  - 1 vent screw for drain tube (used in pressurized systems)
- 1 Operating Instructions BA00395C



If you have any questions, please contact your supplier or your local sales center.

### 3.4 Certificates and approvals

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the **CE** mark.

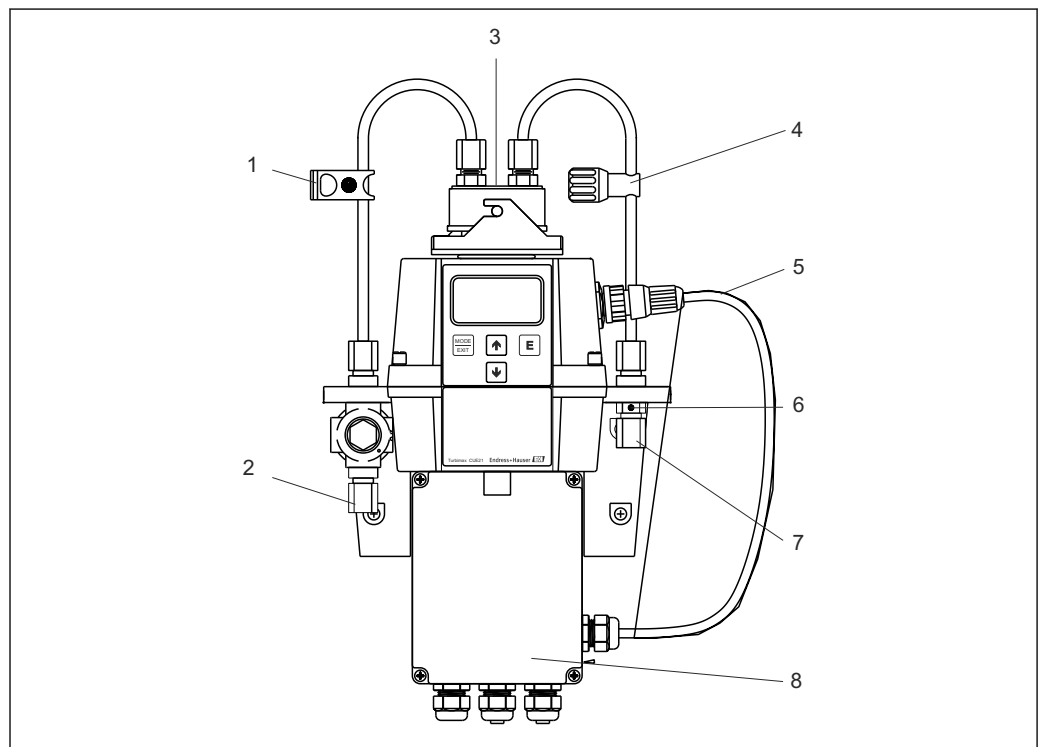
## 4 Installation

### 4.1 Installation requirements

#### 4.1.1 Measuring system

A complete measuring system comprises:

- Turbimax turbidimeter with installed cuvette and desiccant pouch
- Connecting tube with
  - fittings for flow-through assembly
  - Shutoff clamp
  - Flow controller
  - Vent screw for drain tube (in pressurized systems)
- Sensor interconnect cable



A0025595

☒ 1 Turbimax CUE21 (example)

1 Shutoff clamp

2 Connection for intake tube <sup>1)</sup>

3 Flow assembly

4 Flow controller

5 Sensor interconnect cable

6 Vent for drain tube

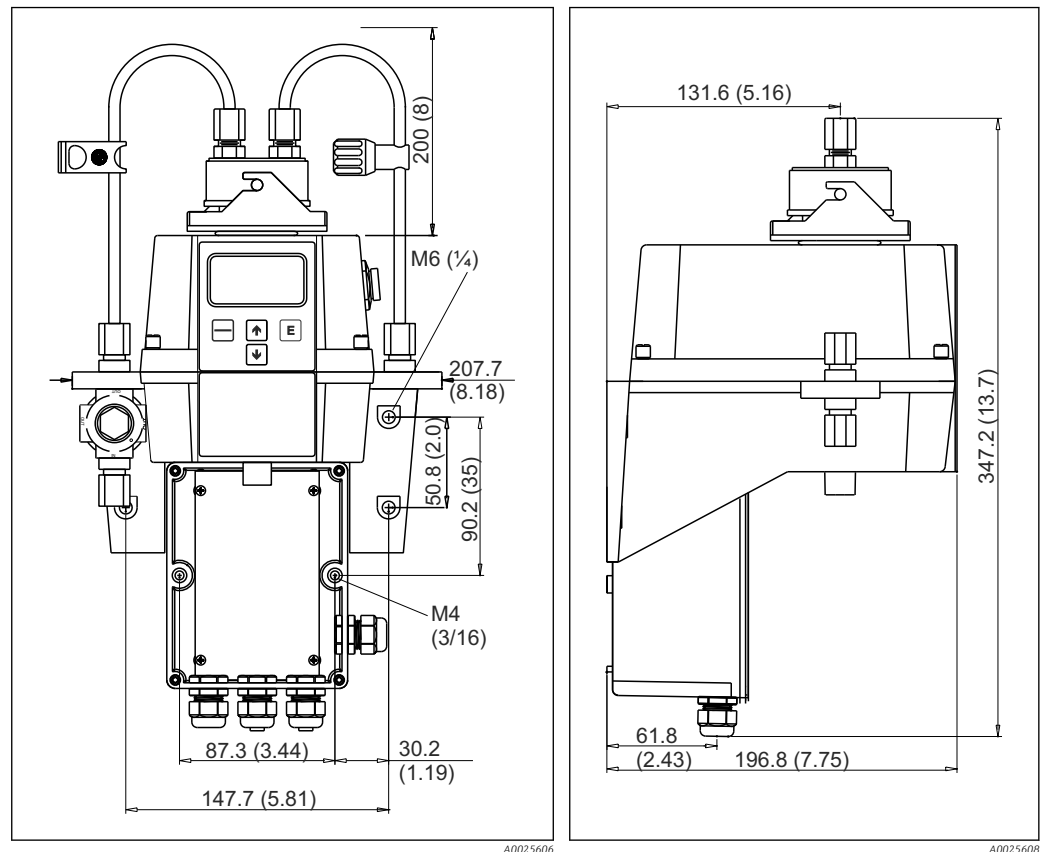
7 Connection for drain tube <sup>1)</sup>

8 Terminal box

1) OD 8 mm (0.31 inch), ID 4.75 mm (3/16 inch)



## 4.1.2 Mounting dimensions



2 Mounting dimensions - front view  
Dimensions in mm (inch)

3 Mounting dimensions - lateral view

## 4.2 Mounting the measuring device

### 4.2.1 Wall mounting

The device is designed for wall mounting. If wall mounting is not practicable, the device can be mounted on any suitable level surface.

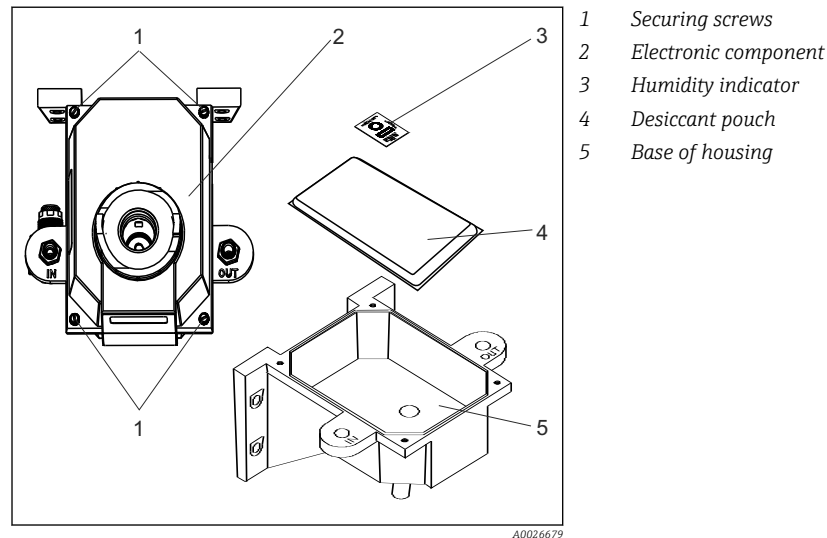
- Ensure that the temperature does not exceed the maximum permitted operating temperature range (0 to 50 °C (32 to 122 °F)).
- Leave approx. 20 cm (8 inch) of free space above the device to ensure that there is sufficient room for calibration and cuvette maintenance. (→ 2)
- Mount the device as close as possible to the sampling point to ensure fast response times (within 2 to 3 m (6 to 10 ft)).

1. Drill mounting holes for the M4 mounting screws to install the field terminal box.
2. Drill mounting holes for the M6 mounting screws to install the device housing on top of the terminal box.
3. Mount the terminal box.
4. Mount the rest of the device on top of the terminal box.

### 4.2.2 Installing the desiccant pouch


The device is equipped with a continuous vapor purge system. A replaceable desiccant pouch in the lower portion of the instrument dries the air. System heat is used to warm the

air. A fan located inside the device ensures that heated air circulates continuously around the optical path and the flow-through cuvette.



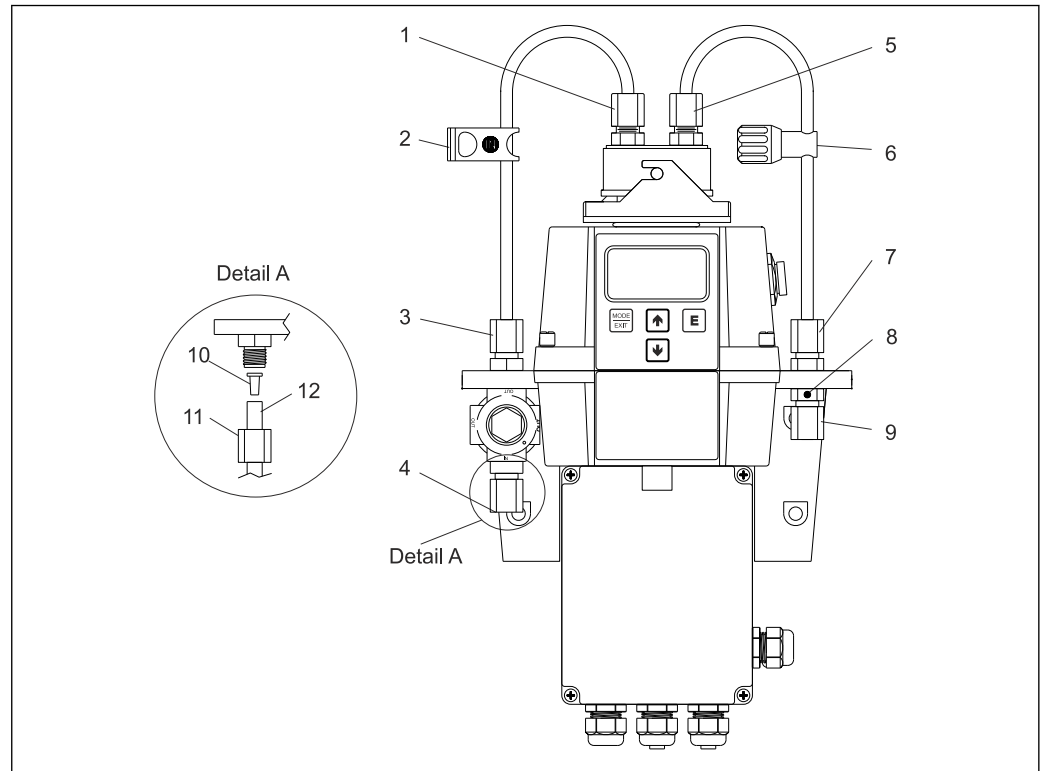
#### 4 Installing the desiccant pouch

1. Unscrew the four corner screws (item 1).
2. Remove the electronic component of the device (item 2).
3. Open the bag protecting the desiccant pouch (item 4), and place the pouch with the humidity indicator (item 3) in the base of the housing (item 5).
  - ↳ Ensure that you install the desiccant pouch immediately after opening the bag to prevent premature degradation of the desiccant.
4. Return the electronic component of the device to its original position.
5. Tighten the four corner screws.

 To prevent premature saturation of the desiccant, it is recommended that you keep the measurement chamber covered at all times.

### 4.2.3 Plumbing the measuring device

- The device requires only a very low overpressure in the flow assembly to operate, approx. 0.069 bar (1 psi).
- The flow controller is rated for a maximum overpressure of 13.8 bar (200 psi).
- The minimum flow rate for the flow-through cuvette is 100 ml/min to 1 l/min (0.026 to 0.26 US gal/min).
- The maximum permitted medium temperature is 50 °C (122 °F).



A0025699

- |   |                            |    |                           |
|---|----------------------------|----|---------------------------|
| 5 | Recommended plumbing       | 7  | Connection for drain tube |
| 1 | Connection for intake tube | 8  | Vent for drain tube       |
| 2 | Shutoff clamp              | 9  | Connection for drain tube |
| 3 | Connection for intake tube | 10 | Use                       |
| 4 | Connection for intake tube | 11 | Nut                       |
| 5 | Connection for drain tube  | 12 | Tubing (not supplied)     |
| 6 | Flow controller            |    |                           |

**i** The device is equipped for plumbing using tubing with OD 8 mm (0.31 inch), ID 4.75 mm (3/16 inch). If the device is going to be exposed to sunlight, opaque tubing should be used to prevent algae growth.

### Plumbing the device

1. Push the shutoff clamp (item 2) over one of the supplied tubes.
2. Connect the tube to the upper part of the intake tubing connection (item 3) and to the connection on top of the device (item 1).
3. Push the flow controller (item 6) over the second tube supplied.
4. Connect the tube to the upper part of the drain tubing connection (item 7) and to the connection on top of the device (item 5).
5. Connect a tube with an internal diameter of 4.75 mm (3/16 inch) to the lower part of the intake tubing connection (item 4) to supply the sensor with a reliable sample flow.
6. Connect a tube with an internal diameter of 4.75 mm (3/16 inch) to the lower part of the drain tubing connection (item 9) to route the sensor drain to a suitable drain on site.
  - ↳ The vent in the drain tube (item 8) allows for pressure compensation, thus helping to prevent bubble formation in the cuvette.
7. If your CUE21 / CUE22 is integrated in a high-pressure system, insert the 6:32 seal screw provided into the vent hole and tighten it.

### 4.3 Post-installation check

1. After mounting, check all the connections to ensure they are secure and leak-tight.
2. Check all cables and hoses for damage.
3. Check whether the cables are routed such that they are free from electromagnetic interference influences.

## 5 Electrical connection

**⚠ WARNING**

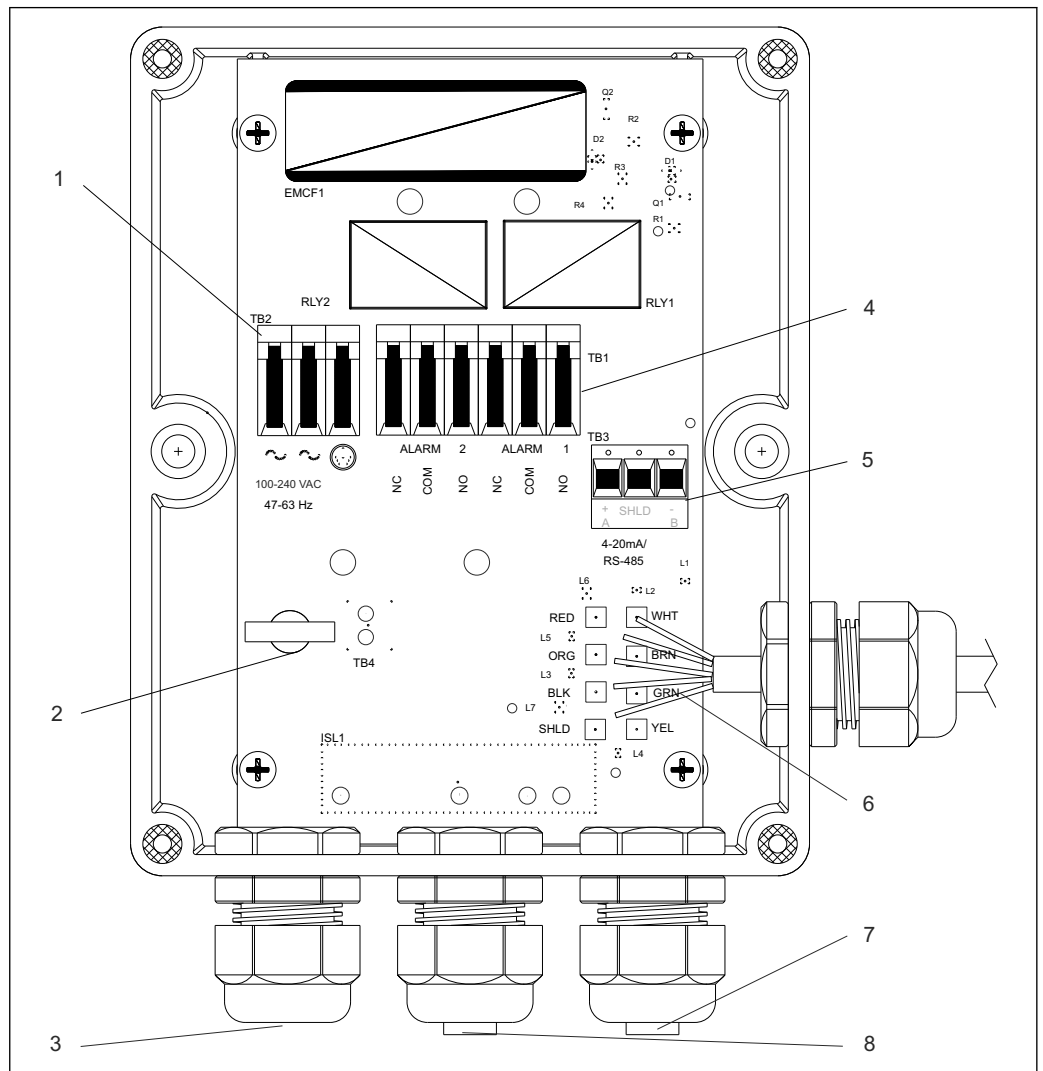
**Device is live**

Incorrect connection may result in injury or death.

- ▶ The electrical connection may be performed only by an electrical technician.
- ▶ The electrical technician must have read and understood these Operating Instructions and must follow the instructions contained therein.
- ▶ **Prior** to commencing connection work, ensure that no voltage is present on any cable.

### 5.1 Connection requirements

- ▶ The device is equipped with a power supply of 100 to 240 V AC, 47 to 63 Hz. Before connecting the device, verify that the line voltage matches these specifications.
- ▶ Place a circuit breaker upstream from the mains connection to facilitate maintenance work.



- |   |                                   |   |                                   |
|---|-----------------------------------|---|-----------------------------------|
| 6 | Field terminal box                | 5 | 4 to 20 mA / RS485 terminal strip |
| 1 | Terminal strip, power supply      | 6 | Sensor wiring                     |
| 2 | Power cable strain relief         | 7 | 4 to 20 mA / RS485 cable gland    |
| 3 | Power cable gland                 | 8 | Alarm cable gland                 |
| 4 | Alarm terminal strip, 240 VA, 2 A |   |                                   |

A0025701

## 5.2 Connecting RS-485 cables

The digital RS-485 half-duplex (2-wire) interface operates with differential levels that are not susceptible to electrical interference. That is why cable lengths of up to 914 m (3000 ft) can be used. The last device on each bus may require terminating with a 120-ohm resistor to eliminate signal reflection on the line.

- ▶ Do not run the RS-485 cables in the same conduit as the power cable.

**i** If you are using the device in a process control system without galvanically isolated inputs, you must use a passive barrier e.g. RB223 (see "Accessories") to connect the CUE21/22.

## 5.3 Connecting relays

The relays for alarm 1 and alarm 2 are mechanical relays rated at 240 V AC and 2 A.

- ▶ Please note that the relays are labeled NO (Normally Open), NC (Normally Closed) and C (Common).

The alarm relays are configured to be "fail-safe" i.e. under normal operating conditions, the device is supplied with current and is not in an alarm condition. How these alarm relays function is described in the "Configuring the alarms" section.

## 5.4 Connecting the current output

The 4-20 mA output is supplied by a 15 V DC power source and can operate recording devices with loads of up to 600  $\Omega$ . This output is isolated from line power and earth ground.

- ▶ Do not run the analog current cables in the same conduit as the power cable.

How this output works is described in the "Selecting the output" section.

## 5.5 Ensuring the degree of protection

Only the mechanical and electrical connections which are described in these instructions and which are necessary for the required, designated use, may be carried out on the device delivered.

- ▶ Exercise care when carrying out the work.

Otherwise, the individual types of protection (Ingress Protection (IP), electrical safety, EMC interference immunity) agreed for this product can no longer be guaranteed due, for example, to covers being left off or cable (ends) which are loose or insufficiently secured.

## 5.6 Post-connection check

Device condition and specifications	Notes
Is there any external damage to the device and cables?	Visual inspection

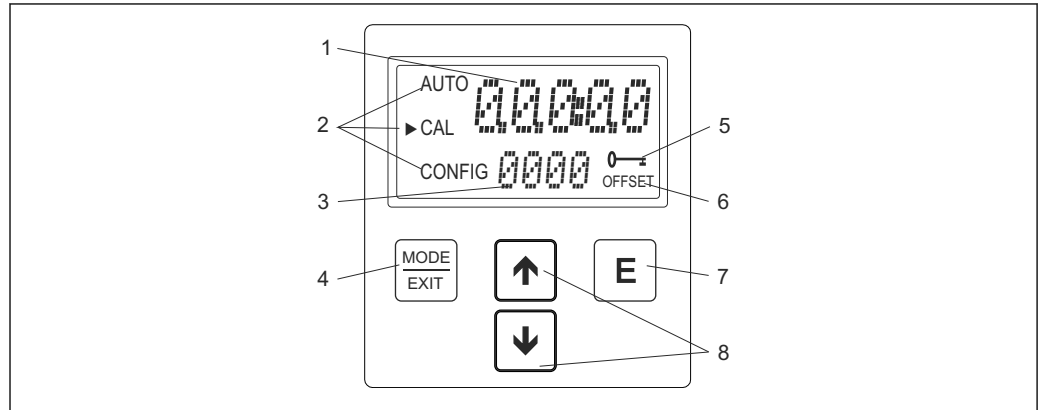
Electrical connection	Notes
Are the installed cables strain-relieved and not twisted?	Visual inspection
Cable run without loops and cross-overs?	
Is the cable type run completely isolated at the point of installation?	Power cables / signal lines
Are all the screws terminals properly tightened?	

Electrical connection	Notes
Are all cable entries mounted, tightened and leak-tight?	For lateral cable entries, make sure the cables loop downwards to allow water to drip off
Are the PE distributor blocks grounded (if present)?	Grounding is carried out at the point of installation.

## 6 Operation options

### 6.1 Overview

#### 6.1.1 Display and operating elements



A0025727

- |   |                                                                                         |   |                                      |
|---|-----------------------------------------------------------------------------------------|---|--------------------------------------|
| 1 | Displays turbidity value and user guidance during configuration                         | 5 | Icon indicates use of an access code |
| 2 | Indicates operating mode: AUTO (measurement), CAL (calibration), CONFIG (configuration) | 6 | Indicates OFFSET mode                |
| 3 | Displays error message and user guidance                                                | 7 | Confirms a selected option or mode   |
| 4 | Switches between modes                                                                  | 8 | Keys used to change settings         |

#### 6.1.2 Key functions

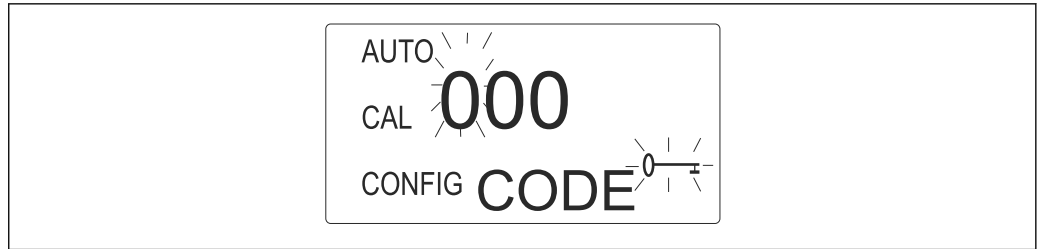
	Switches between the operating modes of the device: CAL, CONFIG and AUTO (measurement)
	Confirms the highlighted or selected option or mode
	Scrolls up through the menu. Increases numerical values.
	Scrolls down through the menu. Decreases numerical values.

## 6.2 Operating concept


### 6.2.1 Access code

The device is equipped with a security feature. An access code protects it from unintentional or undesired changes to the configuration and to the calibration data. The access code can be enabled in the configuration mode.






A0026267

 7 Access protection enabled: Prompt to enter code

- ▶ If access protection is enabled:  
Enter the code 333.
  - ↳ You can access the CAL or CONFIG menus.  
The access code cannot be changed.

## 6.2.2 Menu structure

The device has three operating modes that can be selected using the  key:

- **AUTO**  
Standard operating mode for displaying current measured values
- **CAL**  
Calibration mode for performing calibration procedures
- **CONFIG**  
Setup mode for configuring customer-specific settings



### Configuration menu (CONFIG)

The configuration menu is split into several submenus. The following submenus are available:

- Output selection
- RS-485 port configuration
- Alarm configuration
- Security access configuration
- Offset configuration
- Advanced settings

The extended settings are grouped together to prevent them from being modified accidentally:

- Response speed
- Displayed resolution
- LCD backlight brightness
- Displayed units
- Ultrasonic cleaning
- RS485 parameters
- Desiccant alarm

 For a detailed explanation of the submenus, see the "Instrument configuration" section. (→  19)

## 7 Commissioning

### 7.1 Function check

- ▶ Verify that all connections are correct.
- ▶ In particular, verify that all tubes are firmly attached and are not leaking.
- ▶ Ensure that the supply voltage is within the permitted range of 100 to 240 V AC!

### 7.2 Switching on the measuring device

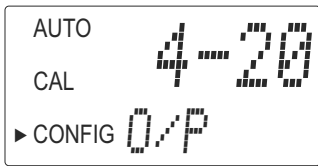
Familiarize yourself with the operation of the device prior to switching it on. To do so, read the "Basic safety instructions" and "Operation" sections in particular.

1. Switch on the power supply to the device.
2. Wait until the device has warmed up (typically 45 to 60 minutes when commissioning the device for the first time).
  - ↳ When a continuous process stream is flowing through the device, the device will output the turbidity level measured in the sample to the LC display. In addition, the equivalent signal is output on the analog (4-20 mA) or digital output, depending on the options selected.
3. Configure the device according to your needs.

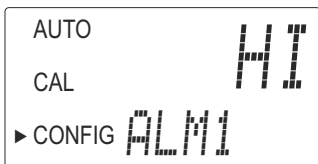
## 8 Operation

### 8.1 Configuring the measuring device

#### 8.1.1 Selecting the output


Function	Options	Info
Output (O/P) 	<ul style="list-style-type: none"> <li>▪ 4-20</li> <li>▪ 485</li> <li>▪ OFF</li> </ul>	
4-20		
4 mA value	0 to 1000 NTU	Set the lower turbidity limit value (LOLM) that corresponds to the 4 mA output level.
20 mA value	0 to 1000 NTU	Set the upper turbidity value (UPLM) that corresponds to the 20 mA output level.
485		
Baud	<ul style="list-style-type: none"> <li>▪ 1200</li> <li>▪ 2400</li> <li>▪ 4800</li> <li>▪ 9600</li> <li>▪ 19200</li> </ul>	Set the correct baud rate for operation of the I/O port.
Addr	1 ... 255	Select the desired device address.
MBUS	<ul style="list-style-type: none"> <li>▪ ASCII</li> <li>▪ RTU</li> </ul>	Select ASCII or RTU.

#### 8.1.2 Configuring the alarms

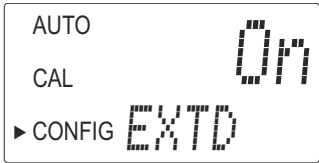
Function	Options	Info
Alarm 1 (ALM1) 	<ul style="list-style-type: none"> <li>▪ HI</li> <li>▪ LO</li> <li>▪ OFF</li> </ul>	
Set point (S/P)	0 to 1000 NTU	Set the desired alarm set point.
Delay on (DLY <sub>o</sub> )	1 to 30 s	Set the desired number of seconds for the "Delay on" function.
Delay off (DLY <sub>o</sub> *)	1 to 30 s	Set the desired number of seconds for the "Delay off" function.
Alarm 2 (ALM2)	<ul style="list-style-type: none"> <li>▪ HI</li> <li>▪ LO</li> <li>▪ OFF</li> </ul>	
Set point (S/P)	0 to 1000 NTU	Set the desired alarm set point.

Function	Options	Info
Delay on (DLY <sub>o</sub> )	1 to 30 s	Set the desired number of seconds for the "Delay on" function.
Delay off (DLY <sub>o</sub> ')	1 to 30 s	Set the desired number of seconds for the "Delay off" function.


### 8.1.3 Access code

Function	Options	Info
Alarm 1 (ALM1) 	<ul style="list-style-type: none"> <li>▪ On</li> <li>▪ OFF</li> </ul>	If the security feature is switched on to restrict access, you are required to enter an access code if you wish to switch from AUTO to a different operating mode. The only valid code is 333. This code cannot be changed.


### 8.1.4 Advanced settings

Function	Options	Info
Extended settings (EXTD) 	<ul style="list-style-type: none"> <li>▪ On</li> <li>▪ OFF</li> </ul>	Switch on the "Extended settings" function to access the configuration of the following options: <ul style="list-style-type: none"> <li>▪ Response speed</li> <li>▪ Displayed resolution</li> <li>▪ LCD backlight brightness</li> <li>▪ Units</li> <li>▪ Ultrasonic cleaning</li> <li>▪ RS-485 parameters</li> <li>▪ Desiccant alarm</li> </ul>

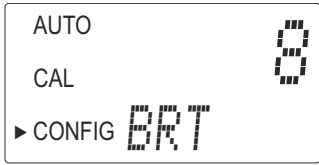
#### Response speed

Function	Options	Info
Response speed (RESP) 	1 to 100 % Factory setting: 10	Select the desired response speed for the NTU values that are displayed and output. Select the lowest speed (highest number) to avoid displaying the effects of air and other anomalies. Select the highest speed if there are rapid changes taking place in the process that require monitoring. The displayed number is a relative speed. The approximate response time (in seconds) is calculated by multiplying the displayed number by 5.

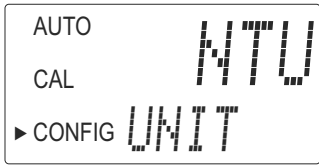
#### Displayed resolution

Function	Options	Info
Resolution (RES) 	1 to 0.0001 Factory setting: 0.01	For readings below 10 NTU the device can display values with a resolution of up to four digits to the right of the decimal point.

### LCD backlight brightness

Function	Options	Info
LCD backlight brightness (BRT) 	1 to 10 Factory setting: 8	Adjust the backlighting for the display if necessary.

### Units

Function	Options	Info
Units (UNIT) 	<ul style="list-style-type: none"> <li>▪ NTU</li> <li>▪ FNU</li> </ul> Factory setting: NTU	Select the desired unit for displaying the turbidity level: NTU (Nephelometric Turbidity Units) or FNU (Formazin Nephelometric Units).

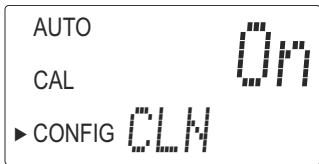
### Ultrasonic cleaning

The "Ultrasonic cleaning" option is used for continuous cleaning of the flow-through cuvette. It is not intended to clean cuvettes that are already dirty, or to replace manual cleaning entirely. However, this system will increase the cleaning intervals dramatically. To operate correctly, the use of a cuvette with an ultrasonic transducer is required. The system transmits an ultrasonic frequency through a spring to a piezo transducer that is joined to the base of the flow-through cuvette. The cuvette's detection system works only in AUTO mode.

The system can detect the following error conditions:


- Incorrect cuvette installed
- Error has occurred in the transducer
- Transducer not making contact with the spring

If an error has occurred, the message "CLN" appears in the lower part of the display. The alarms are set and 2mA is sent to the current output. The ultrasonic cleaning function is switched on as standard. After a cuvette has been inserted, the message "Dry" appears for a duration of 30 minutes in the lower part of the display. During this time, the desiccant removes residual moisture from the ultrasonic transducer and no ultrasonic cleaning takes place. At the same time, the error message "CLN" is reset and appears only after the 30 minutes have elapsed.

Function	Options	Info
Ultrasonic cleaning (CLN) 	<ul style="list-style-type: none"> <li>▪ On</li> <li>▪ OFF</li> </ul> On	The ultrasonic cleaning function can be turned off if desired.

### RS-485 parameters

Using basic programs, such as the Hilgraeve HyperTerminal (included in most Microsoft Windows software packages), the Turbimax can provide basic communication functions. You could also use Visual Basic or other programs. The standard communication parameters are: 8 bits, no parity and 1 stop bit. You can modify these parameters using the following menus. They will appear only if RS-485 was selected as the output (→ 19).

Function	Options	Info
Bits (BITS) 	<ul style="list-style-type: none"> <li>▪ 7</li> <li>▪ 8</li> </ul> Factory setting: 8	Select the required number of data bits for your communication software.
Parity (PRTY)	<ul style="list-style-type: none"> <li>▪ nOnE</li> <li>▪ ODD</li> <li>▪ E</li> </ul> Factory setting: nOnE	Select the required parity bit for your communication software.
Stop	<ul style="list-style-type: none"> <li>▪ 1</li> <li>▪ 2</li> </ul> Factory setting: 1	Select the required stop bit for your communication software.

### Sample communication

The master computer requests a report from the Turbimax.

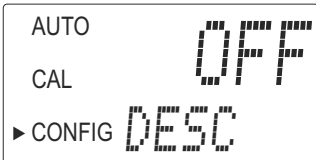
- To this end, the master transmits the following to the Turbimax:
  - Byte #1 the initial character ":" in ASCII or "3A" Hex
  - Byte #2 the address of the Turbimax being queried
  - Byte #3, 4 "CR LF" in ASCII or "0D 0A" in Hex
- The Turbimax responds with:
  - The same initial character ":" in ASCII or "3A" Hex
  - Its address
  - The display value for the turbidity content
  - The unit

Communication would proceed as follows:

- ▶ The master computer requests a report from address 1: : **1 CRLF**
  - ↳ The Turbimax, which is located at address 1, responds with: : **001 0.0249 NTU**

### Desiccant alarm

If the humidity detector in the Turbimax indicates that the humidity of the internal environment may lead to condensation, the device outputs the warning DESC. If desired, the desiccant warning can activate the alarms and send 2 mA to the current output.

Function	Options	Info
Desiccant alarm (DESC) 	<ul style="list-style-type: none"> <li>▪ OFF</li> <li>▪ On</li> </ul> Factory setting: OFF	Select "On" to activate the alarms as soon as the desiccant can no longer fulfil its function.

## 8.2 Instrument calibration

The device was calibrated and tested prior to leaving the factory. Therefore, it is possible to use it directly out of the box. Under normal conditions, recalibration is recommended at least once every three months.<sup>1)</sup>

### Types of calibration

#### ■ Complete three-point calibration

This calibration is used if accuracy is required across the entire measuring range of the device, from 0.02 to 1000 NTU (CUE21) or 0.02 to 100 NTU (CUE22). If accuracy is required only in the range below 10.0 NTU, e.g. for drinking water, calibration may also be performed using only a 10.0 NTU and 0.02 NTU calibration standard.

#### ■ Offset

This method of calibration can be used if accuracy is required only in the immediate vicinity of the turbidity value of the sample.



- The relay contacts remain in the last valid condition while the device is in calibration mode.
- The device has a timeout function which causes it to revert automatically to AUTO mode after 15 minutes of inactivity.
- During calibration, the fan located inside the device is switched off in order to extend the service life of the desiccant. The fan is switched on during calibration countdowns and after the device returns to AUTO mode or after five minutes (whichever comes first). It is recommended that the measurement chamber be kept covered during calibration and that the flow-through cuvette be inserted immediately after calibration to prevent premature saturation of the desiccant.

### 8.2.1 Calibrations standards

To achieve the specified level of accuracy across the entire measuring range of the device, we recommend the following calibration standards:

- 0.02 NTU
- 10.0 NTU
- 1000 NTU (CUE21)  
100 NTU (CUE22)

These calibrations standards are more stable than formazin and have a shelf life of 12 months. Prior to calibration, verify the expiry dates to ensure that these calibration standards have not expired. If you are using formazin to calibrate the device, ensure that a fresh formazin stock solution is used so that the specified accuracy is achieved.



- A shelf life of 12 months is guaranteed for the 10.0 NTU calibration standard only if it is stored in the plastic bottle. Once it is transferred to a glass cuvette, it must be used for calibration immediately and then disposed of.

### 8.2.2 Indexing cuvettes

To achieve the highest possible level of accuracy and to allow for normal scratches and signs of wear and tear on the cuvette glass when calibrating, we recommend that the cuvettes be indexed. Calibration standards and standard kits purchased from Endress+Hauser are supplied with indexing rings

The following steps allow repeatable indexing of calibration standards:

1. Shut off the flow using the shutoff clamp provided.
2. Remove the flow assembly with the flow-through cuvette.
3. Insert the calibration standard while the device is in AUTO mode.

1) The EPA recommends that online turbidimeters be calibrated using a calibration standard at least once every three months if they are used for EPA reporting.

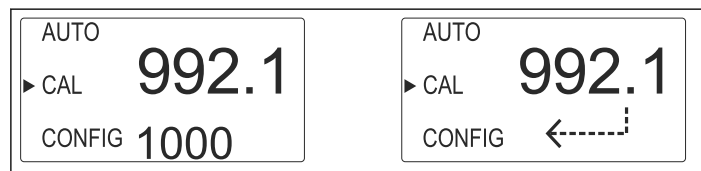
4. Slowly rotate the calibration standard inside the optical path one complete revolution (360°).
  - ↳ While rotating the standard slowly, observe the measured value. Locate the position at which the lowest reading is displayed.
5. With the calibration standard positioned at the point with the lowest reading, install the indexing ring over the cap on the calibration standard. Make sure that the pointer of the indexing ring faces directly forward.

When using the standards in future, always insert them in such a way that the pointer of the indexing ring faces forward. Slowly rotate the calibration standard back and forth by approx. 5° to find the lowest value. The calibration standard is now indexed and ready for use.

### 8.2.3 Three-point calibration

#### First calibration point

1. Press the MODE/EXIT key until the calibration function is displayed.
  - ↳ The arrow appears beside "CAL". The lower part of the display alternates between 1000 (CUE21) or 100 (CUE22) (the value of the requested calibration standard) and ←-----┘. The upper part of the display shows the current measured value.



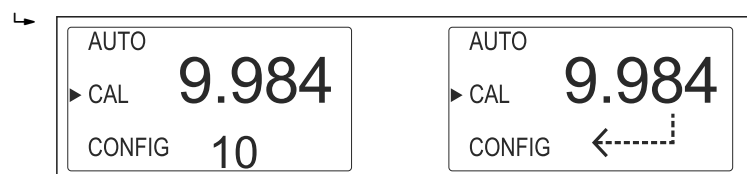
If you wish to perform a two-point calibration for drinking water, press the  $\square$  key to bypass the 1000 NTU or 100 NTU and to proceed with the second calibration point.

2. If the flow assembly with the flow-through cuvette has not yet been removed, remove it now.
3. Insert the requested calibration standard (1000 NTU or 100 NTU) so that the pointer of the indexing ring faces directly forward.
4. Find the lowest measured value by rotating the standard slowly back and forth by 5°.
  - ↳ Leave the standard in the position with the lowest reading.
5. Press the  $\square$  key to accept the calibration.
  - ↳ In the lower part of the display, the stabilization time for this calibration step is counted down.

#### Second calibration point


1. The lower part of the display alternates between 10 and ←-----┘, thereby requesting the 10.0 NTU calibration standard.

If the display does not alternate between 10 and ←-----┘, press the  $\square$  or  $\square$  key until the specified information appears.




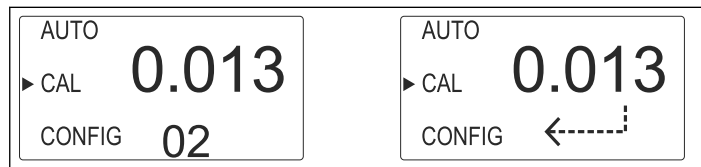
2. Insert the requested calibration standard so that the pointer of the indexing ring faces directly forward.




3. Find the lowest measured value by rotating the standard slowly back and forth by 5°.
  - ↳ Leave the standard in the position with the lowest reading.
4. Press the  key to accept the calibration.
  - ↳ In the lower part of the display, the stabilization time for this calibration step is counted down.

### Third calibration point

The lower part of the display alternates between 02 and , thereby requesting the 0.02 NTU calibration standard.



1. Insert the requested calibration standard so that the pointer of the indexing ring faces directly forward.
2. Find the lowest measured value by rotating the standard slowly back and forth by 5°.
  - ↳ Leave the standard in the position with the lowest reading.
3. Press the  key to accept the calibration.
  - ↳ In the lower part of the display, the stabilization time for this calibration step is counted down.

When calibration is complete, the device returns to AUTO mode.

### 8.2.4 Offset

In certain instances, it can be useful to use an offset instead of a three-point calibration. However, an offset cannot be used in lieu of regular calibration. Using this method, the device will provide accurate turbidity values only in the immediate vicinity of the sample value and not for the entire measuring range.

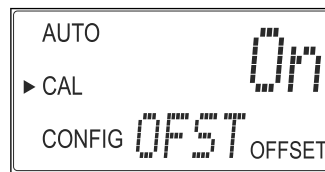


The OFFSET icon is illuminated as soon as an offset is used. The maximum offset is 1.00 NTU. If the device deviation is greater than 1 NTU, a full calibration is recommended.

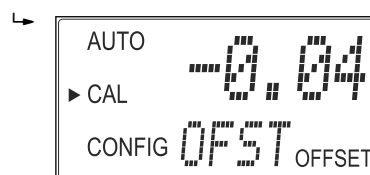
#### Configuring the offset

1. Take a sample of the process medium that is being monitored by the device, and record the turbidity values reported by the device.
2. Measure the turbidity of the sample using a laboratory turbidimeter (e.g. Turbimax CUE23 / CUE24).
3. Compare the turbidity value reported by the device to the value measured in the lab.
  - ↳ If the values are very close, no offset adjustment is required and the procedure can be stopped at this point.
  - ↳ If the values differ substantially (but by less than 1 NTU), continue the procedure to configure an offset.
4. Select the offset function by pressing the MODE/EXIT key until the arrow appears next to CONFIG.

5. Press the  $\square$  key until OFST is displayed in the lower line.
  - ↳ At this point, the upper line of the display indicates the operating status of the offset function. If the function is switched off, switch it on by pressing  $\uparrow$  or  $\downarrow$ .



6. The offset is the difference between the NTU value measured by the device and the value measured by the lab device. **Example:** CUE21 / CUE22 measures 0.016 NTU, while the lab device calculates a value of 0.012 NTU for the same sample. Entering an offset of -0.04 results in the CUE21 / CUE22 also displaying 0.012 NTU. Select the desired offset value using the  $\uparrow$  or  $\downarrow$  keys. Press the  $\square$  key to accept the value.



This completes offset configuration. The device is still in configuration mode (CONFIG). Press the MODE/EXIT key to return to AUTO mode.

## 9 Diagnostics and troubleshooting

### 9.1 General troubleshooting

#### 9.1.1 Troubleshooting instructions

The device performs continuous diagnostic monitoring. Any errors are displayed in a queue in the bottom line of the display.

The Turbimax provides three levels of fault detection:

- **Warning**

A warning is simply a message on the display indicating that a problem exists. No alarms are activated. If, for example, the desiccant alarm function is disabled and the desiccant becomes saturated, the warning DESC will appear on the display.

- **Error**

An error indicates a fault or a problem that can usually be corrected by the operator. This includes, for example, a lamp outage (LAMP) or an incorrect calibration (CAL). If an error occurs, both alarm relays are activated and the current output is maintained at 2 mA. While the device continues to display values, you should not rely on these values as their accuracy is not known.

- **Failure**

A failure is a system fault. This is a problem that cannot be corrected by the operator. The unit must be returned to the factory for service. These failures consist of failures in the CPU, A/D, EEPROM or other devices internal to the instrument. If a failure occurs, the device will not function properly and will display the message FAIL in the bottom line of the display. Both alarm relays are activated and the current output is maintained at 2 mA.

#### 9.1.2 Process-related errors

Error	Possible cause	Tests or remedial action
Display values are higher than expected	Bubbles in solution	Ensure that vent in drain tube is open and not obstructed (→ 10)
	Condensate or leaky cuvette	Check flow-through cuvette for condensate or leaks
	Flow-through cuvette dirty	Clean cuvette (→ 29).
	Device is no longer correctly calibrated	Recalibrate device (→ 23)
Display values are incorrect	Bubbles in solution	see above
	Debris in flow-through cuvette	Remove debris from cuvette
Display values are lower than expected	Device is no longer correctly calibrated	Recalibrate device (→ 23)
Upper part of display flashing	Sample has exceeded permitted range	Check sample. Turbidity of sample may be too high to be read by the device.

### 9.2 Diagnostic information on local display

Diagnostic message	Possible cause	Tests or remedial action
MA	4 to 20 mA loop is open	Check wiring (→ 13, → 19).
DESC	Desiccant pouch saturated	Replace desiccant pouch (→ 30).
LAMP	Lamp failed	Have lamp replaced. Contact sales office.

Diagnostic message	Possible cause	Tests or remedial action
FLOW	Sample flow has stopped	Restore flow
CLN	Ultrasonic transducer in flow-through cuvette not making contact	Rotate the flow-through cuvette slightly to improve the connection. If the problem persists, replace the cuvette.
	Flow-through cuvette removed	Insert flow-through cuvette
FAIL	Major system fault	Contact sales office.
DRY	Drying period	Disappears automatically after a period of 30 minutes.

## 10 Maintenance

Take all the necessary precautions in time to ensure the operational safety and reliability of the entire measuring system.

### NOTICE

#### Effects on process and process control

- ▶ When carrying out any work on the system, take into account possible repercussions for process control or the process itself.
- ▶ For your own safety, only use genuine accessories. With genuine parts, the function, accuracy and reliability are also ensured after maintenance work.

### 10.1 Cleaning the flow-through cuvette

The cuvettes should always be clean and free of marks and scratches.

1. Clean the inside of the cuvette using a cleaning solution.
2. Rinse the cuvette several times using distilled or deionized water.
3. If external dirt or scratches cannot be removed:  
Replace the cuvette. To do so, read the next section.

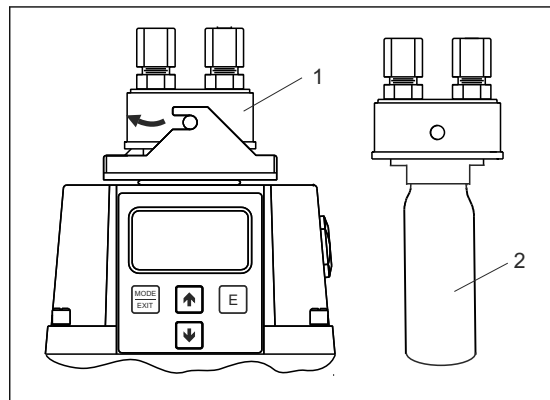
### 10.2 Replacing the flow-through cuvette

#### NOTICE

#### Moisture on the cuvette or transducer

High risk of damage to sensor electronics or transducer

- ▶ Check the cuvette prior to installation. It must be completely dry.



#### 8 Replacing the cuvette

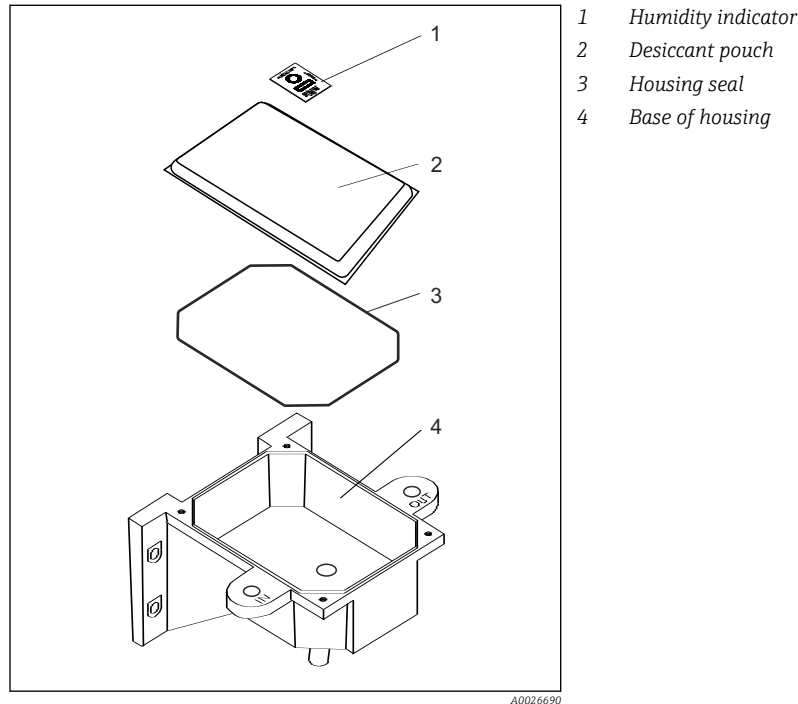
- 1 Flow assembly
- 2 Cuvette

1. Shut off flow at the Turbimax using the shutoff clamp provided.
2. Remove the flow assembly (item 1) from the device.
3. Unscrew the old cuvette (item 2).
4. Verify that the new cuvette is clean, dry and free of scratches or other marks.  
Carefully screw the cuvette into the flow assembly making sure not to leave fingerprints on the cuvette.
5. Insert the cuvette with the flow assembly into the device and lock the flow assembly.  
↳ After inserting the clean cuvette, the message "DRY" is displayed during the drying phase.

### 10.3 Replacing the desiccant pouch

Correct use of the desiccant supplied is essential in maintaining the performance of the device. In addition, the housing seal must be maintained to guarantee the standard service life of the desiccant. Inspect this seal each time the desiccant pouch is replaced.

Replace the desiccant when the device outputs a desiccant alarm (DESC).



#### 9 Replacing desiccant

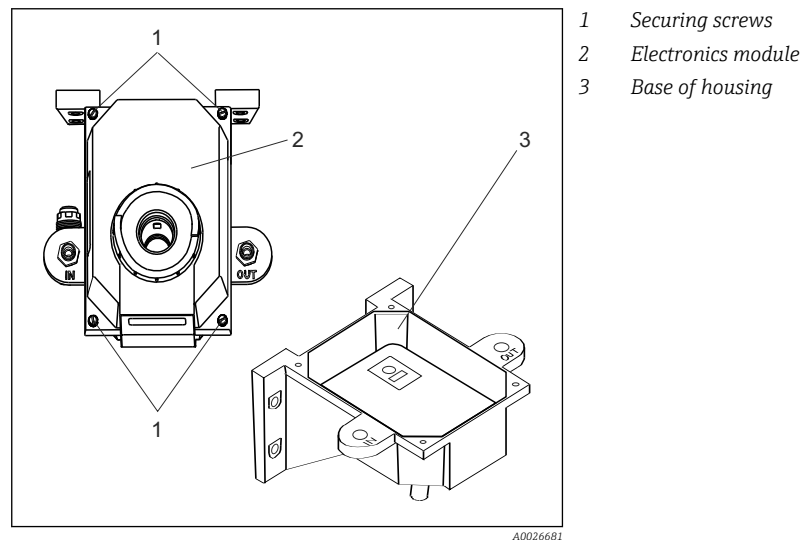
1. Switch off the power supply to the device.
2. Unscrew the four corner screws (item 1).
3. Remove the device's electronic component.
4. Remove the used desiccant pouch (item 2).
5. Check the housing seal (item 3) on the base of the housing.
  - ↳ Replace it if necessary.
6. Open the bag protecting the new desiccant pouch and place the desiccant pouch and the humidity indicator (item 1) in the base of the housing (item 4).
  - ↳ Ensure that you install the desiccant pouch immediately after opening the bag to prevent premature degradation of the desiccant.
7. Return the electronic component of the device to its original position.
8. Tighten the four corner screws.
9. Switch the power supply to the device back on.
  - ↳ The device starts up. Wait for initialization.
10. To speed up detection of the new desiccant, the device must be reset. This is done by removing the sensor interconnect cable from the device for 2 seconds and then reconnecting it.

## 11 Repairs

### 11.1 Spare parts

Description and contents	Order number
Electronic service module for CUE21, infrared	71030103
Electronic service module for CUE22, white light	71030104
Terminal box CUE21 / CUE22	71030105
Desiccant with indicator card, refill pack	51518578
Tubing kit including: <ul style="list-style-type: none"> <li>▪ 1 shutoff clamp</li> <li>▪ 1 flow controller</li> <li>▪ 2 connecting tubes with fittings for flow assembly</li> <li>▪ Vent for drain tube</li> </ul>	51518579
Replacement cuvette with ultrasonic transducer for use of the ultrasonic cleaning function	51518576
Pressure regulator for CUE21/22	71085512

### 11.2 Replacing the electronics module



#### 10 Replacing the electronics module

1. Unscrew the four corner screws (item 1).
2. Remove the electronics module (item 2) from the housing base (item 3).
3. Place the new electronics module on the housing base.
4. Secure using the four screws.

### 11.3 Replacing the lamp

The lamps in the device have an operating life of approx. 10 years.

Should the lamp need to be replaced, please contact your sales office.

## 11.4 Return

The product must be returned if repairs or a factory calibration are required, or if the wrong product was ordered or delivered. As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with medium.

To ensure swift, safe and professional device returns, please read the return procedures and conditions at [www.endress.com/support/return-material](http://www.endress.com/support/return-material).


## 11.5 Disposal

The device contains electronic components and must therefore be disposed of in accordance with regulations on the disposal of electronic waste.

Observe the local regulations.



## 12 Accessories

 The following are the most important accessories available at the time this documentation was issued. For accessories not listed here, please contact your service or sales office.

### 12.1 Calibration solutions

Calibration kit CUE21 / CUE23 / CUE24

- Complete measuring range:
  - 0.02 NTU
  - 10.0 NTU
  - 1000 NTU
- Order No.: 51518580

Calibration kit CUE22

- Complete measuring range:
  - 0.02 NTU
  - 10.0 NTU
  - 100 NTU
- Order No.: 71030102

### 12.2 Flow chamber

Flow chamber CUE21 / CUE22

- To suppress air bubbles
- Order no.: 51518575

### 12.3 Passive barrier

RB223

- Loop-powered passive barrier
- For galvanic isolation of active signal circuits (0 to 20 mA)
- Product Configurator on the product page: [www.endress.com/rb223](http://www.endress.com/rb223)

 Technical Information RB223, TI00132R

## 13 Technical data

### 13.1 Input

---

Measured variables      Turbidity

---

Measuring ranges	CUE21:	0 to 1000 NTU / FNU
	CUE22:	0 to 100 NTU / FNU

### 13.2 Output

---

Output signal              0/4 to 20 mA

---

Signal on alarm            Error current: 2 mA

---

Load                        max. 600  $\Omega$

---

Relay output	Switching voltage:	max. 240 VAC
	Switching current:	max. 2 A

---

Communication interface    Bi-directional RS-485, optional Modbus

---

Limit value and alarm functions	Setpoint adjustment:	
	CUE21	0 to 1000 NTU
	CUE22	0 to 100 NTU
	Alarm delay:	0 to 30 s

### 13.3 Power supply

---

Supply voltage              100 to 240 VAC, 47 to 63 Hz, 80 VA switching power supply

---

Overvoltage protection      Category II

---

Protection class            2

### 13.4 Performance characteristics

---

Response time              adjustable from 1 to 100 % (approx. 5 to 500 s)

---

Reference temperature      25 °C (77 °F)

Measured value resolution	0.0001 NTU (below 10 NTU)	
Maximum measured error	below 40 NTU:	$\pm 2$ % of display value or $\pm 0.02$ NTU - depending on which value is higher
	above 40 NTU:	$\pm 5$ % of display value
Repeatability	$\pm 1$ % of reading	

### 13.5 Environment

Ambient temperature	2 to 50 °C (36 to 120 °F)	
Storage temperature	-20 to +60 °C (0 to 140 °F)	
Humidity	0 to 95 %, non-condensating	
Altitude	<2000 m (6500 ft)	
Degree of protection	IP66	
Pollution degree	The product is suitable for pollution degree 2.	

### 13.6 Process

Process temperature	2 to 50 °C (36 to 120 °F)	
Process pressure	max. 13.78 bar (200 psi), controlled by integrated flow controller	
Flow	0.1 to 1 l/min (0.026 to 0.26 US gal/min)	

### 13.7 Mechanical construction

Dimensions	H x W x D:	347 x 208 x 197 mm (13.7 x 8.18 x 7.75 inch)
Weight	2.0 kg (4.4 lbs)	

## Materials

Housing:	ABS
Flow assembly:	Nylon
Cuvette:	Borosilicate glass
Cuvette seal:	Silicone
Fittings (assembly):	Polypropylene
Locking pins (assembly):	Stainless steel (AISI 304 or AISI 303)
Intake tubing:	Stainless steel (AISI 316)

## Light sources

CUE21:	Infrared LED, 860 nm
CUE22:	White light tungsten lamp, ~600 nm, 2250 K

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