# Operating Instructions **Turbimax CUE21 / CUE22**

Turbidimeter for online measurement





#### Turbimax CUE21 / CUE22

# Table of contents

| 1                               | Document information 3  |
|---------------------------------|---|
| 1.1<br>1.2                      | Safety information3Symbols3   |
| 2                               | Basic safety instructions 4   |
| 2.1<br>2.2<br>2.3<br>2.4<br>2.5 | Requirements for personnel4Designated use4Workplace safety4Operational safety5Product safety5 |
| 3                               | Incoming acceptance and product   |
|                                 | identification 6  |
| 3.1<br>3.2<br>3.3<br>3.4        | Incoming acceptance6Product identification6Scope of delivery7Certificates and approvals7      |
| 4                               | Installation 8  |
| 4.1<br>4.2<br>4.3               | Installation requirements8Mounting the measuring device9Post-installation check12             |
| 5                               | Electrical connection 13  |
| 5.1                             | Connection requirements   |
| 5.2<br>5.3                      | Connecting RS-485 cables 14<br>Connecting relays 14   |
| 5.4                             | Connecting the current output   |
| 5.5<br>5.6                      | Ensuring the degree of protection14Post-connection check14                                    |
| 6                               | Operation options 16  |
| 6.1<br>6.2                      | Overview16Operating concept16   |
| 7                               | Commissioning 18  |
| 7.1<br>7.2                      | Function check18Switching on the measuring device18   |
| 8                               | Operation 19  |
| 8.1<br>8.2                      | Configuring the measuring device  |
| 9                               | Diagnostics and troubleshooting 27  |
| 9.1<br>9.2                      | General troubleshooting 27<br>Diagnostic information on local display 27                      |
| 10                              | Maintenance 29  |
| 10.1                            | Cleaning the flow-through cuvette   |

| 10.2<br>10.3 | Replacing the flow-through cuvette Replacing the desiccant pouch | 29<br>30 |
|--------------|--|----------|
| 11           | Repairs  | 31       |
| 11.1         | Spare parts  | 31       |
| 11.2         | Replacing the electronics module                                 | 31       |
| 11.3         | Replacing the lamp   | 31       |
| 11.4         | Return   | 32       |
| 11.5         | Disposal   | 32       |
|              |  |          |
| 12           | Accessories  | 33       |
| 12.1         | Calibration solutions  | 33       |
| 12.2         | Flow chamber   | 33       |
| 12.3         | Dessive harrier  | 22       |
|              |  | 22       |
| 13           | Technical data   | 33<br>34 |

# 1 Document information

# 1.1 Safety information

| Structure of information  | Meaning  |  |
|---|--|--|
| ▲ DANGER<br>Causes (/consequences)<br>Consequences of non-compliance<br>(if applicable)<br>► Corrective action      | This symbol alerts you to a dangerous situation.<br>Failure to avoid the dangerous situation <b>will</b> result in a fatal or serious<br>injury. |  |
| ▲ WARNING     Causes (/consequences)     Consequences of non-compliance     (if applicable)     ► Corrective action | This symbol alerts you to a dangerous situation.<br>Failure to avoid the dangerous situation <b>can</b> result in a fatal or serious<br>injury.  |  |
| CAUTION     Causes (/consequences)     Consequences of non-compliance     (if applicable)     ► Corrective action   | This symbol alerts you to a dangerous situation.<br>Failure to avoid this situation can result in minor or more serious injuries.                |  |
| NOTICE         Cause/situation         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                           |
|--------|-----------------------------------|
| i      | Additional information, tips      |
|        | Permitted or recommended          |
|        | Not permitted or not recommended  |
| Ĩ      | Reference to device documentation |
|        | Reference to page                 |
|        | Reference to graphic              |
| 4      | 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.
- 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

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.

#### Installation 4

#### 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



- ₽ 1 Turbimax CUE21 (example)
- 1 Shutoff clamp
- 2 Connection for intake tube <sup>1)</sup>
- 3 Flow assembly
- 4 Flow controller
- 1) OD 8 mm (0.31 inch), ID 4.75 mm (3/16 inch)
- Sensor interconnect cable 5
- 6 Vent for drain tube 7
  - Connection for drain tube  $^{1)}$
  - 8 Terminal box



#### 4.1.2 Mounting dimensions

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

- Securing screws Electronic component
- Humidity indicator
- 4 Desiccant pouch
- Base of housing

- 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).





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

7

8

- 4 to 20 mA / RS485 cable gland
- Alarm cable gland

# 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.
- 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



## 6.1.2 Key functions

|                     | Switches between the operating modes of the device: CAL, CONFIG and AUTO (measurement) |
|---------------------|--|
| Ε                   | Confirms the highlighted or selected option or mode                                    |
| $\mathbf{\uparrow}$ | Scrolls up through the menu.<br>Increases numerical values.                            |
| $\checkmark$        | Scrolls down through the menu.<br>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.



- 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><li>4-20</li><li>485</li><li>OFF</li></ul>                                    |   |
| ► CONFIG     |   |   |
| 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> <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><li>ASCII</li><li>RTU</li></ul>   | Select ASCII or RTU.  |

# 8.1.2 Configuring the alarms

| Function                                  | Options                                     | Info  |
|---|---|---|
| Alarm 1 (ALM1)<br>AUTO<br>CAL<br>► CONFIG | <ul><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⊾)                           | 1 to 30 s                                   | Set the desired number of seconds for the "Delay on" function.  |
| Delay off (DLY▼)                          | 1 to 30 s                                   | Set the desired number of seconds for the "Delay off" function. |
| Alarm 2 (ALM2)                            | <ul><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 $_{\star}$ ) | 1 to 30 s | Set the desired number of seconds for the "Delay on" function.  |
| Delay off (DLY*)           | 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><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 |
| AUTO           |                                  | you wish to switch from AUTO to a different operating mode. The only valid code is 333. This           |
| CAL            |                                  | code cannot be changed.  |
|                |                                  |  |

# 8.1.4 Advanced settings

| Function                 | Options                          | Info   |
|--------------------------|----------------------------------|--|
| Extended settings (EXTD) | <ul><li>On</li><li>OFF</li></ul> | Switch on the "Extended settings" function to access the configuration of the following options: |
| AUTO                     |                                  | <ul><li>Response speed</li><li>Displayed resolution</li></ul>                                    |
| CAL                      |                                  | <ul><li>LCD backlight brightness</li><li>Units</li></ul>   |
| ► CONFIG                 |                                  | <ul><li>Ultrasonic cleaning</li><li>RS-485 parameters</li></ul>                                  |
|                          |                                  | <ul> <li>Desiccant alarm</li> </ul>  |

### Response speed

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

### **Displayed resolution**

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

#### LCD backlight brightness

| Function                       | Options                       | Info  |
|--------------------------------|-------------------------------|---|
| LCD backlight brightness (BRT) | 1 to 10<br>Factory setting: 8 | Adjust the backlighting for the display if necessary. |
| AUTO                           |                               |   |
| CAL 🛄                          |                               |   |
| ► CONFIG BRT                   |                               |   |

#### Units

| Function                                | Options  | Info   |
|---|--|--|
| Units (UNIT)<br>AUTO<br>CAL<br>► CONFIG | <ul> <li>NTU</li> <li>FNU</li> <li>Factory setting: NTU</li> </ul> | Select the desired unit for displaying the turbidity<br>level: NTU (Nephelometric Turbidity Units) or FNU<br>(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><li>On</li><li>OFF</li></ul> | The ultrasonic cleaning function can be turned off if desired. |
| AUTO                      | On                               |  |
| CAL <b></b>               |                                  |  |
| ► CONFIG                  |                                  |  |

#### 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 ( $\rightarrow \square$  19).

| Function      | Options                                      | Info   |
|---------------|--|--|
| Bits (BITS)   | • 7<br>• 8                                   | Select the required number of data bits for your communication software. |
| AUTO 🛄        | Factory setting: 8                           |  |
| CAL 🛄         |  |  |
| ► CONFIG BITS |  |  |
| Parity (PRTY) | <ul><li>nOnE</li><li>ODD</li><li>E</li></ul> | Select the required parity bit for your communication software.          |
|               | Factory setting:<br>nOnE                     |  |
| Stop          | • 1<br>• 2                                   | Select the required stop bit for your communication software.            |
|               | Factory setting: 1                           |  |

#### 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 gueried
  - Byte #3, 4 "CR LF" in ASCII or "OD OA" 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><li>OFF</li><li>On</li></ul> | Select "On" to activate the alarms as soon as the desiccant can no longer fulfil its function. |
| AUTO                   | Factory setting: OFF             |  |
| CAL                    |                                  |  |
|                        |                                  |  |

# 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 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.

<sup>1)</sup> 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.

| AUTO        | AUTO      |
|-------------|-----------|
| CAL 992.1   | CAL 992.1 |
| CONFIG 1000 | CONFIG <  |

If you wish to perform a two-point calibration for drinking water, press the  $\boxdot$  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 🗉 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 *constant*, thereby requesting the 10.0 NTU calibration standard.

If the display does not alternate between 10 and keeping the  $\boxdot$  or  $\boxdot$  key until the specified information appears.



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

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 E 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  $\leftarrow$ . 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 E 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 🗉 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 ① or ①.



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 ① or ① keys. Press the E 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 ( $\rightarrow \square 10$ ) |
|   | Condensate or leaky cuvette              | Check flow-through cuvette for condensate or leaks                                     |
|   | Flow-through cuvette dirty               | Clean cuvette ( $\rightarrow \square$ 29).   |
|   | Device is no longer correctly calibrated | Recalibrate device ( $\rightarrow \square 23$ )  |
| 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 ( $\rightarrow \square 23$ )  |
| 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<br>message | Possible cause            | Tests or remedial action   |
|-----------------------|---------------------------|--|
| MA                    | 4 to 20 mA loop is open   | Check wiring ( $\rightarrow \square 13, \rightarrow \square 19$ ). |
| DESC                  | Desiccant pouch saturated | Replace desiccant pouch ( $\rightarrow \square$ 30).               |
| LAMP                  | Lamp failed               | Have lamp replaced. Contact sales office.                          |

| Diagnostic<br>message | Possible cause   | Tests or remedial action  |
|-----------------------|--|---|
| FLOW                  | Sample flow has stopped  | Restore flow  |
| CLN                   | Ultrasonic transducer in flow-<br>through cuvette not making contact | Rotate the flow-through cuvette slightly to improve<br>the connection. If the problem persists, replace the<br>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).



- 2 Desiccant pouch
  - Housing seal
- 4 Base of housing



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.
- 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:<br><ul> <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



- Securing screws
- 2 Electronics module
- 3 Base of housing

- IO 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.

# 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

#### **Passive barrier** 12.3

#### 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

Technical Information RB223, TI00132R i

# 13 Technical data

# 13.1 Input

| Measured variables              | Turbidity  |  |  |  |  |  |  |  |  |
|---------------------------------|--|--|--|--|--|--|--|--|--|
| Measuring ranges                | CUE21:<br>CUE22:                                       | 0 to 1000 NTU / FNU<br>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 Ω   |  |  |  |  |  |  |  |  |
| Relay output                    | Switching voltage:<br>Switching current:               | max. 240 VAC<br>max. 2 A                   |  |  |  |  |  |  |  |
| Communication interface         | Bi-directional RS-485, c                               | ptional Modbus                             |  |  |  |  |  |  |  |
| Limit value and alarm functions | Setpoint adjustment:<br>CUE21<br>CUE22<br>Alarm delay: | 0 to 1000 NTU<br>0 to 100 NTU<br>0 to 30 s |  |  |  |  |  |  |  |
|                                 | 13.3 Power su  | ıpply                                      |  |  |  |  |  |  |  |
| Supply voltage                  | 100 to 240 VAC, 47 to                                  | 63 Hz, 80 VA switching power supply        |  |  |  |  |  |  |  |
| Overvoltage protection          | Category II  |  |  |  |  |  |  |  |  |
| Protection class                | 2  |  |  |  |  |  |  |  |  |
|                                 | 13.4 Perform   | ance characteristics                       |  |  |  |  |  |  |  |

| Response time         | adjustable from 1 to 100 % (approx. 5 to 500 s) |
|-----------------------|---|
| Reference temperature | 25 ℃ (77 °F)                                    |

| Measured value resolution | 0.0001 NTU (below 10 I      | 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:               | ±5 % of display value   |
| Repeatability             | ±1% of reading              |   |
|                           | 13.5 Environn               | nent  |
| 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-condensa     | ating   |
| Altitude                  | <2000 m (6500 ft)           |   |
| Degree of protection      | IP66                        |   |
| Pollution degree          | The product is suitable for | or 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 Mechani                | cal 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: CUE22: Infrared LED, 860 nm White light tungsten lamp, ~600 nm, 2250 K

# Index

# Α

| Access code         | 16<br>20 |
|---------------------|----------|
| Altitude            | 20<br>35 |
| Ambient temperature | 35       |

# С

| -                                 |    |
|-----------------------------------|----|
| Certificates and approvals        | 7  |
| Check                             |    |
| Function                          | 18 |
| Installation                      | 12 |
| Terminal                          | 14 |
| Cleaning the flow-through cuvette | 29 |
| Connection requirements           | 13 |

## D

| Degree of protection  |
|---|
| Desiccant pouch   |
| Installing  |
| Replacing   |
| Designated use  |
| Diagnosis   |
| Diagnostic information  |
| Display and operating elements  |
| Disposal  |
|   |
| <b>E</b><br>Electrical connection   |
| E Electrical connection   |
| E           Electrical connection         13           F           Flow         35  |
| E         Electrical connection       13         F         Flow       35         Function check       18                    |
| E         Electrical connection       13         F         Flow       35         Function check       18                    |
| E         Electrical connection       13         F         Flow       35         Function check       18         H       25 |
| E<br>Electrical connection  |

| I                             |
|-------------------------------|
| Incoming acceptance 6         |
| Installation                  |
| Check                         |
| Installation requirements     |
| Mounting the measuring device |
| Installation requirements     |
| Measuring system              |
| Mounting location             |
| L                             |
| Load                          |

## М

| 111                       |    |
|---------------------------|----|
| Maintenance               | 29 |
| Measured error            | 35 |
| Measured value resolution | 35 |
| Measured variables        | 34 |
| Measuring device          |    |
| Calibrating               | 23 |
| Configuring               | 19 |
|                           |    |

| Mounting          |
|-------------------|
| Operation options |
| Switching on      |
| Measuring ranges  |
| Menu structure    |

# N

| Nameplate | <br> | <br> |  |  |  |  |  |  |  |  | 6 |
|-----------|------|------|--|--|--|--|--|--|--|--|---|
|           |      |      |  |  |  |  |  |  |  |  |   |

# 0

| •                      |    |
|------------------------|----|
| Operating concept      | 16 |
| Operating keys 1       | 16 |
| Operation              |    |
| Configuring            | 19 |
| Menu structure         | L7 |
| Operation options      | 16 |
| Output signal          | 34 |
| Overvoltage protection | 34 |

## Ρ

| Pollution degree       | 35 |
|------------------------|----|
| Process pressure       | 35 |
| Process temperature    | 35 |
| Process-related errors | 27 |
| Product identification | 6  |

## R

| Reference temperature              | 34 |
|------------------------------------|----|
| Repairs                            | 31 |
| Repeatability                      | 35 |
| Replacing                          |    |
| Desiccant pouch                    | 30 |
| Electronics module                 | 31 |
| Flow through cuvette               | 29 |
| Light                              | 31 |
| Replacing the electronics module   | 31 |
| Replacing the flow-through cuvette | 29 |
| Response time                      | 34 |
| Return                             | 32 |

## S

| 5                   |
|---------------------|
| Safety information  |
| Safety instructions |
| Scope of delivery   |
| Signal on alarm     |
| Spare parts         |
| Storage temperature |
| Supply voltage      |
| Symbols             |
|                     |

#### **T** Te

| echnical data               |    |
|-----------------------------|----|
| Environment                 | 35 |
| Input                       | 34 |
| Mechanical construction     | 35 |
| Output                      | 34 |
| Performance characteristics | 34 |

| Power supply | 34<br>35 |
|--------------|----------|
| U            | 27       |
| Usage        | . 4      |

中国E+H技术销售 www.ainstru.com 电话: 18923830905 邮箱: sales@ainstru.com

