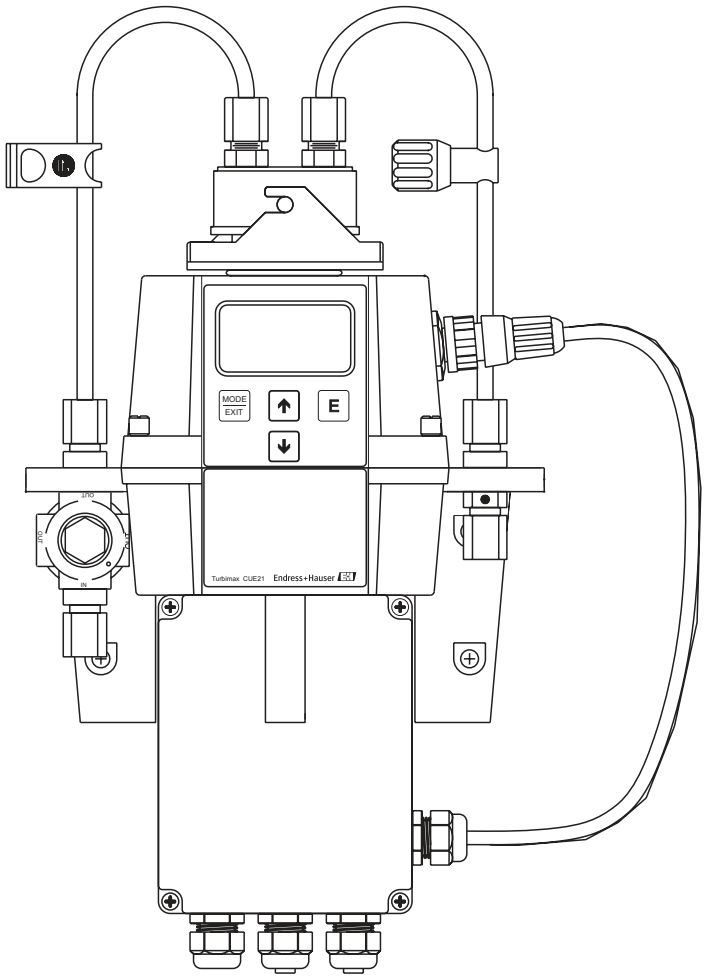
Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Operating Instructions

Turbimax CUE21 / CUE22

Turbidimeter for on-line measurement



BA395C/07/en/03.07
71001158

Endress+Hauser

People for Process Automation

Brief operating instructions

This explains how to use these Operating Instructions to commission your turbidimeter quickly and safely:

Safety instructions

→ Page 4 ff. General safety instructions and explanations of the safety icons are provided in the section in question.

→ Page 5 Specific safety instructions are provided at the appropriate position. Their level of importance can be seen from the icon: ⚠ Warning, ☝ Caution, ✎ Note.

▼

Installation

→ Page 9 The installation conditions, such as the dimensions of the device, are illustrated here.

→ Page 10 ff. Here, you can find all important steps for installing and plumbing the device.

▼

Wiring

→ Page 14 ff. Here, you can find the wiring diagrams and steps needed for the electrical connection of the device.

▼

Display and operating elements

→ Page 16 ff. Use this section to familiarize yourself with the operation of the device.

▼

Configuration

→ Page 18 ff. Here, you can find all the important steps for configuring your measuring point.

▼

Calibration

→ Page 24 ff. This section explains all necessary steps to calibrate the instrument.

▼

Maintenance

→ Page 28 ff. Here, you can find information on important maintenance activities, for example, cleaning the flow-through cuvette and replacing the desiccant pouch.

▼

Accessories

→ Page 30 ff. Here, you can find an overview of the accessories which can be supplied.

▼

Troubleshooting

→ Page 32 ff. If faults occur during operation, use the check lists to localize and remedy them.

→ Page 33 A list of available spare parts.

▼

Technical data

→ Page 36 Dimensions

→ Page 35 ff. Ambient and process conditions, weight, materials etc.

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1 Safety instructions

1.1 Designated use

The Turbimax CUE21 / CUE22 process turbidimeters have been designed for on-line measurement of the turbidity of process water and drinking water. The infrared light instrument, CUE21, meets the design criteria on turbidity measurement specified in ISO 7027 and DIN 27027. The white light instrument, CUE22, meets the design criteria specified by US EPA 180.1.

Any other use than the one described here compromises the safety of persons and the entire measuring system and is, therefore, not permitted.
The manufacturer is not liable for damage caused by improper or non-designated use.

1.2 Installation, commissioning and operation

Please note the following items:
- Installation, commissioning, operation and maintenance of the measuring system must only be carried out by trained technical personnel.
  The technical personnel must be authorized for the specified activities by the system operator.
- Electrical connection must only be carried out by a certified electrician.
- Technical personnel must have read and understood these Operating Instructions and must adhere to them.
- Before commissioning the entire measuring point, check all the connections for correctness. Ensure that electrical cables and hose connections are not damaged.
- Do not operate damaged products and secure them against unintentional commissioning. Mark the damaged product as being defective.
- Measuring point faults may only be rectified by authorized and specially trained personnel.
- If faults can not be rectified, the products must be taken out of service and secured against unintentional commissioning.
- Repairs not described in these Operating Instructions may only be carried out at the manufacturer's or by the service organization.

1.3 Operational safety

The measuring system has been designed and tested to the highest standards and left the factory in perfect functioning order.
Relevant regulations and European standards have been met.

As the user, you are responsible for complying with the following safety conditions:
- Installation instructions
- Local prevailing standards and regulations.

Immunity to interference
This instrument has been tested for electromagnetic compatibility in industrial use according to applicable European standards.
Protection against interference as specified above is valid only for an instrument connected according to the instructions in these Operating Instructions.

1.4 Return

If the device requires repair, please send it *cleaned* to the sales centre responsible. Please use the original packaging, if possible.

Please enclose the completed "Declaration of contamination" (copy the second last page of these Operating Instructions) with the packaging and the transportation documents.
No repair without completed "Declaration of contamination"!

1.5 Notes on safety icons and symbols

Safety icons



Warning!
This symbol alerts you to hazards. They can cause serious damage to the instrument or to persons if ignored.



Caution!
This symbol alerts you to possible faults which could arise from incorrect operation. They could cause damage to the instrument if ignored.



Note!
This symbol indicates important items of information.

Electrical symbols



Direct Current (DC)
A terminal at which DC is applied or through which DC flows.



Alternating Current (AC)
A terminal at which (sine-form) AC is applied or through which AC flows.



Ground connecting
A terminal, which, from the user's point of view, is already grounded using a grounding system.



Protective ground terminal
A terminal which must be grounded before other connections may be set up.



Alarm relay



Input



Output



DC voltage source



Temperature sensor

2 Identification

2.1 Device designation

2.1.1 Nameplate

Compare the order number on the nameplate with your order.
The device version can be identified from this order number.

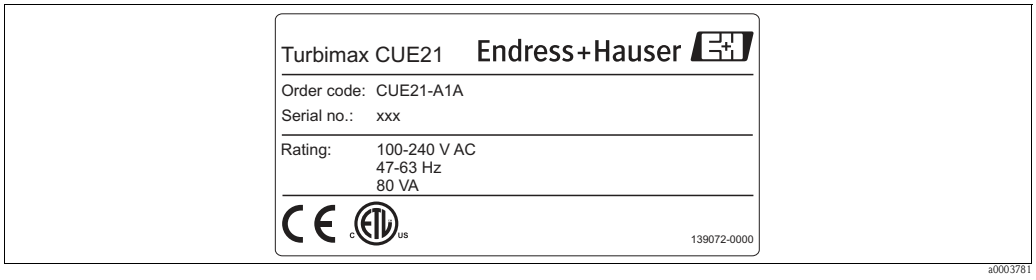


Fig. 1: CUE21 nameplate (example)

2.1.2 Ordering information

Turbimax CUE21, compact device, infrared

	Power supply			
	A	100 to 240 VAC		
		Output		
		1	4 to 20 mA or RS-485	
			Version	
			A	Standard
CUE21-				complete order code

Turbimax CUE22, compact device, white light

	Power supply			
	A	100 to 240 VAC		
		Output		
		1	4 to 20 mA or RS-485	
			Version	
			A	Standard
CUE22-				complete order code

2.2 Scope of delivery

The scope of delivery comprises:
- 1 Turbimax CUE21 / CUE22 turbidimeter
- 1 Field terminal box
- 1 Flow through assembly
- 1 Desiccant pack
- 1 Cuvette (single pack)
- 1 Tubing kit including
  - 1 shutoff clamp
  - 1 backpressure valve
  - 2 connecting tubes with fittings for flow through assembly
  - 1 drain vent screw (used in pressurized systems)
- 1 Operating Instructions BA395C/07/en

If you have any questions, please contact your supplier or your sales centre responsible .

2.3 Certificates and approvals

Declaration of conformity
The product meets the requirements of the harmonized European standards. It thus complies with the legal requirements of the EC directives.
The manufacturer confirms successful testing of the product by affixing the CE symbol.

3 Installation

3.1 Quick installation guide

Proceed as follows to completely install the measuring point:

- Mount the instrument (see "Installation instructions" section).
- Plumb the instrument as shown in the "Plumbing" section
- Connect the instrument as illustrated in the "Electrical connection" section.
- Commission the instrument as explained in the "Commissioning" section.

3.1.1 Measuring system

The Turbimax CUE21 / CUE22 measuring system comprises:

- Turbimax turbidimeter with installed cuvette and desiccant pouch
- Connecting tubing with
  - fittings for flow through assembly
  - shutoff clamp
  - backpressure valve
  - drain vent screw (in pressurized systems)
- Sensor interconnect cable

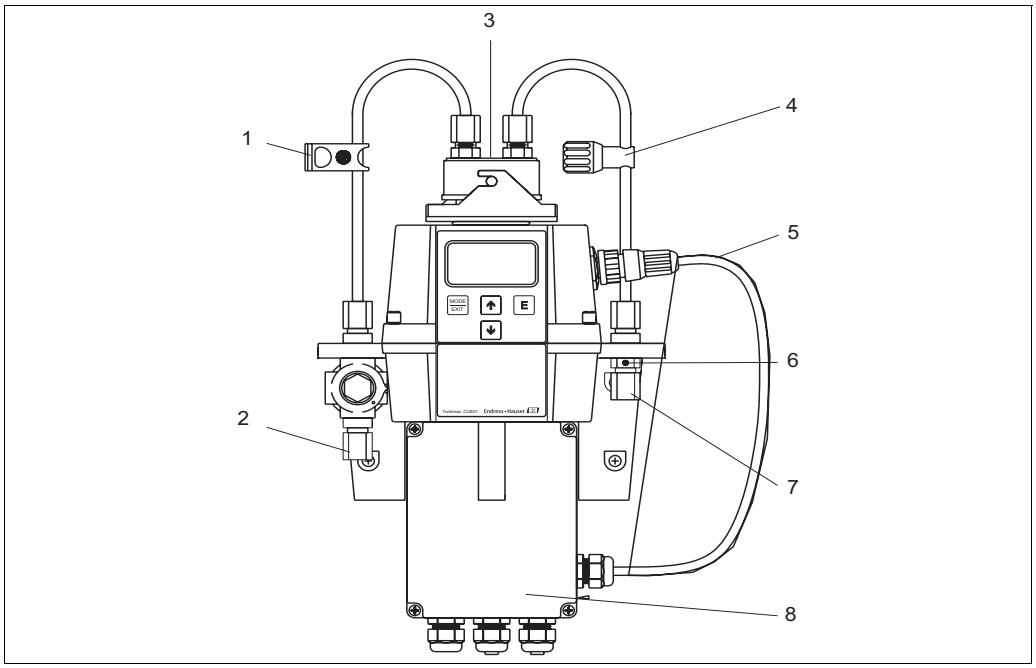


Fig. 2: Turbimax CUE21 system (example)

1 Shutoff clamp
2 Intake tubing connection (for OD 8 mm (0.31"), ID 4.75 mm (0.19") tubing)
3 Flowhead
4 Backpressure valve
5 Sensor interconnect cable
6 Drain vent
7 Drain tubing connection (for OD 8 mm (0.31"), ID 4.75 mm (0.19") tubing)
8 Field terminal box

3.2 Incoming acceptance, transport, storage

- Make sure the packaging is undamaged!
  Inform the supplier about damage to the packaging. Keep the damaged packaging until the matter has been settled.
- Make sure the contents are undamaged!
  Inform the supplier about damage to the delivery contents. Keep the damaged products until the matter has been settled.
- Check that the scope of delivery is complete and agrees with your order and the shipping documents.
- The packaging material used to store or to transport the product must provide shock protection and humidity protection. The original packaging offers the best protection. Also, keep to the approved ambient conditions (see "Technical data").
- If you have any questions, please contact your supplier or your sales center responsible.

3.3 Installation conditions

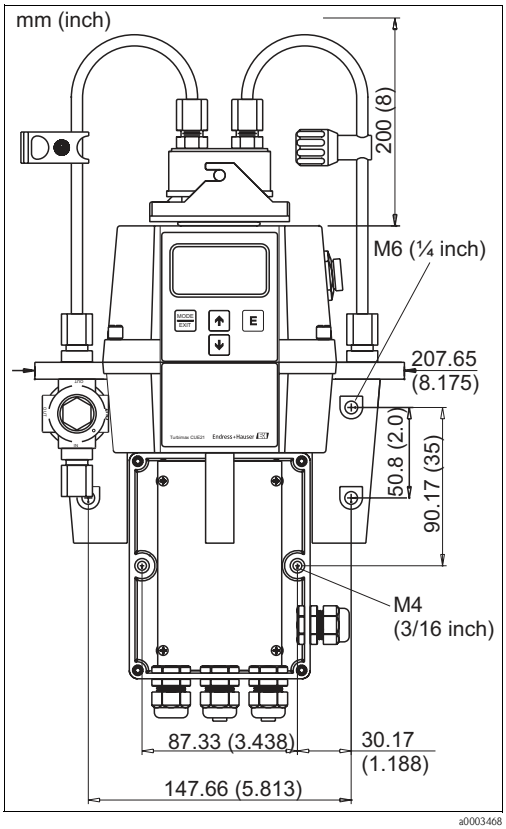


Fig. 3: Mounting dimensions front view

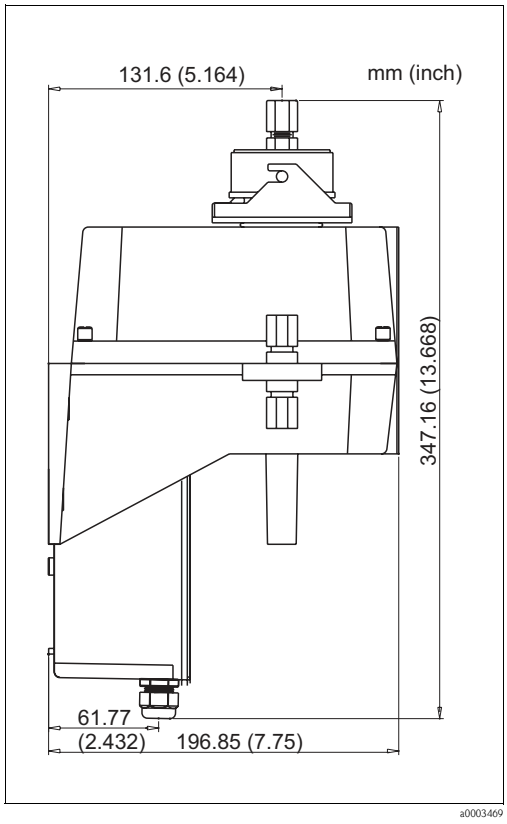


Fig. 4: Mounting dimensions lateral view

3.4 Installation instructions

3.4.1 Mounting the instrument

Turbimax CUE21 / CUE22 is designed for wall mounting. If wall mounting is not practical, the instrument can be mounted on any suitable level surface.

Note!
- Check that the temperature does not exceed the maximum permitted operating temperature range (0 to 50 °C (32 to 122 °F)).
- Leave a free area of approx. 0.20 m (8.00") above the instrument. This will ensure enough room for calibration and cuvette maintenance.
- Mount the instrument as close as possible to the sampling point to ensure a quick response time (within 2 to 3 m (6 to 10 ft)).

To mount the instrument proceed as follows:

1. Drill mounting holes for M4 (3/16") mounting screws to install the field terminal box. See the "Installation conditions" section to establish mounting hole locations.
2. Drill mounting holes for M6 (¼") mounting screws to install the instrument enclosure on top of the field terminal box. See the "Installation conditions" section to establish mounting hole locations.
3. Mount the field terminal box.
4. Mount the rest of the instrument on top of the field terminal box.

3.4.2 Installing the desiccant pouch

Turbimax CUE21 / CUE22 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 inside the instrument continuously circulates heated air around the optical well and the flow through cuvette.
To install the desiccant pouch, proceed as follows:

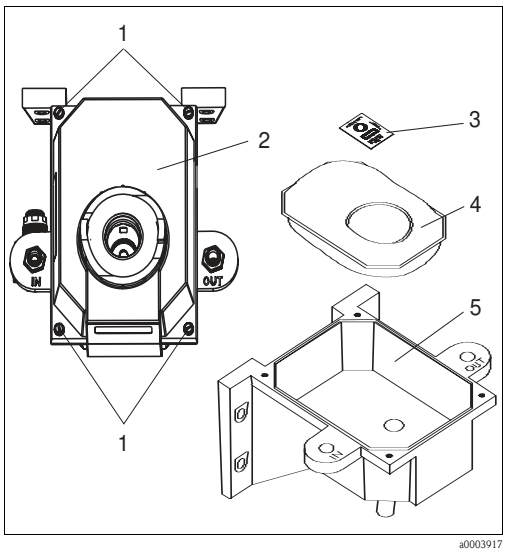


Fig. 5: Desiccant installation

1. Unscrew the four corner thumbscrews (pos.1).
2. Remove the electronics half of the instrument (pos. 2).
3. Open the bag protecting the desiccant pouch (pos. 4) and install it with the humidity indicator (pos. 3) in the instrument base (pos. 5).

   Note!
   Once the bag is opened, install the desiccant pouch immediately to prevent premature degradation of the desiccant.
4. Replace the electronics half of the instrument in its location.
5. Tighten the four corner thumbscrews again.

Note!
To prevent premature saturation of the desiccant, it is recommended to keep the measurement chamber covered at any time.

3.4.3 Installing the cuvette

Caution!
The ultrasonic cuvette must be completely dry before it is inserted into the sensor. If there is any visible moisture present on the cuvette or transducer, there is great risk of damaging the sensor electronics and the transducer.

To install the cuvette proceed as follows:

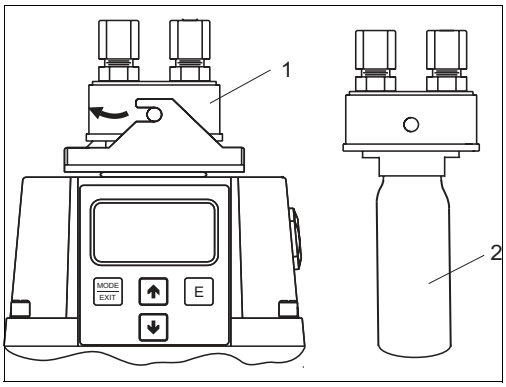


Fig. 6: Cuvette installation

1. Check that the cuvette is clean and free of scratches or marks.
2. Remove the flow head of Turbimax CUE21 / CUE22 (pos 1).
3. Carefully screw the cuvette (pos. 2) into the flow head making sure not to leave finger prints on the cuvette.
4. Insert the cuvette with the flow head in the instrument and lock the flow head.

3.4.4 Plumbing

Note!
- The instrument requires a very low head pressure to operate, approx. 0.069 bar (1 psi.)
- The pressure regulator is rated for a max. pressure 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 gal/min).
- The maximum allowable fluid temperature is 50 °C (122 °F).

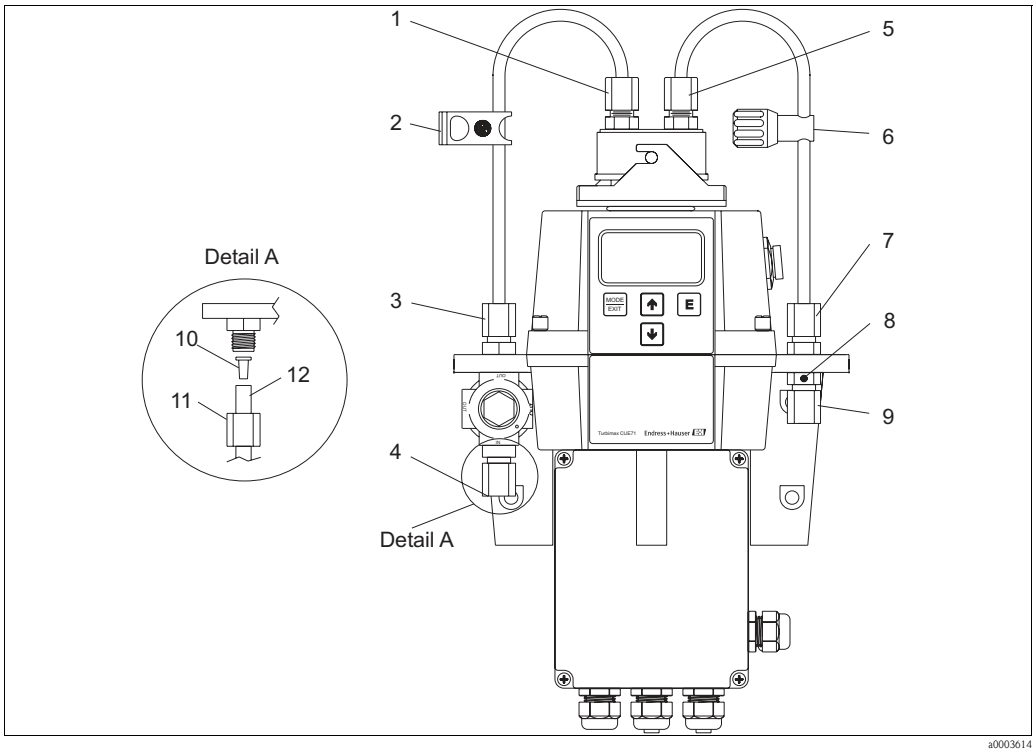


Fig. 7: Recommended plumbing

1	*Connection for intake tube*	*7*	*Connection for drain tube*
2	*Shutoff clamp*	*8*	*Drain vent*
3	*Connection for intake tube*	*9*	*Connection for drain tube*
4	*Connection for intake tube*	*10*	*Insert*
5	*Connection for drain tube*	*11*	*Nut*
6	*Backpressure valve*	*12*	*Tubing (not supplied)*

The instrument is equipped to be plumbed using 4.75 mm (3/16") ID, 8 mm (5/16") OD flexible tubing. Opaque tubing should be used if the instrument will be exposed to sunlight, to prevent algae growth.

Proceed as follows:

1. Push the shutoff clamp (pos. 2) over one of the supplied tubes.
2. Connect the tube to the upper part of the intake tubing connection (pos. 3) and to the connection on top of the instrument (pos. 1).
3. Push the backpressure valve (pos. 6) over the second supplied tube.
4. Connect the tube to the upper part of the drain tubing connection (pos. 7) and the connection on top of the instrument (pos. 5).
5. Connect a 4.75 mm (3/16") ID tube to the lower part of the intake tubing connection (pos. 4) to supply the sensor with a dependable sample flow.
6. Connect a 4.75 mm (3/16") ID tube to the lower part of the drain tubing connection (pos. 9) to route the sensor drain to a suitable site drain.
   The drain vent (pos. 8) allows for atmospheric equalization, thus helping to alleviate bubble formation in the cuvette.
   If your CUE21 / CUE22 is integrated in a high-pressure system, insert the supplied 6:32 seal screw into the vent hole and tighten it.

3.5 Post-installation check

- After installation, check the instrument for damage.
- Make sure that all connections are fitted tightly and are leakage resistant.
- Ensure that the tubing cannot be removed without effort.
- Check all tubes for damage.

4 Wiring

4.1 Electrical connection

Warning!
- The electrical connection must only be carried out by authorised technical personnel.
- Technical personnel must have read and understood the instructions in this manual and must adhere to them.
- Ensure that there is no voltage at the power cable before beginning the connection work.

4.1.1 Position of the terminals

Warning!
- The instrument is equipped with a 100 to 240 V AC, 47 to 63 Hz switching power supply. Before connection, ensure that the line voltage falls within these specifications.
- Place a circuit breaker prior to the power connection to allow for service.

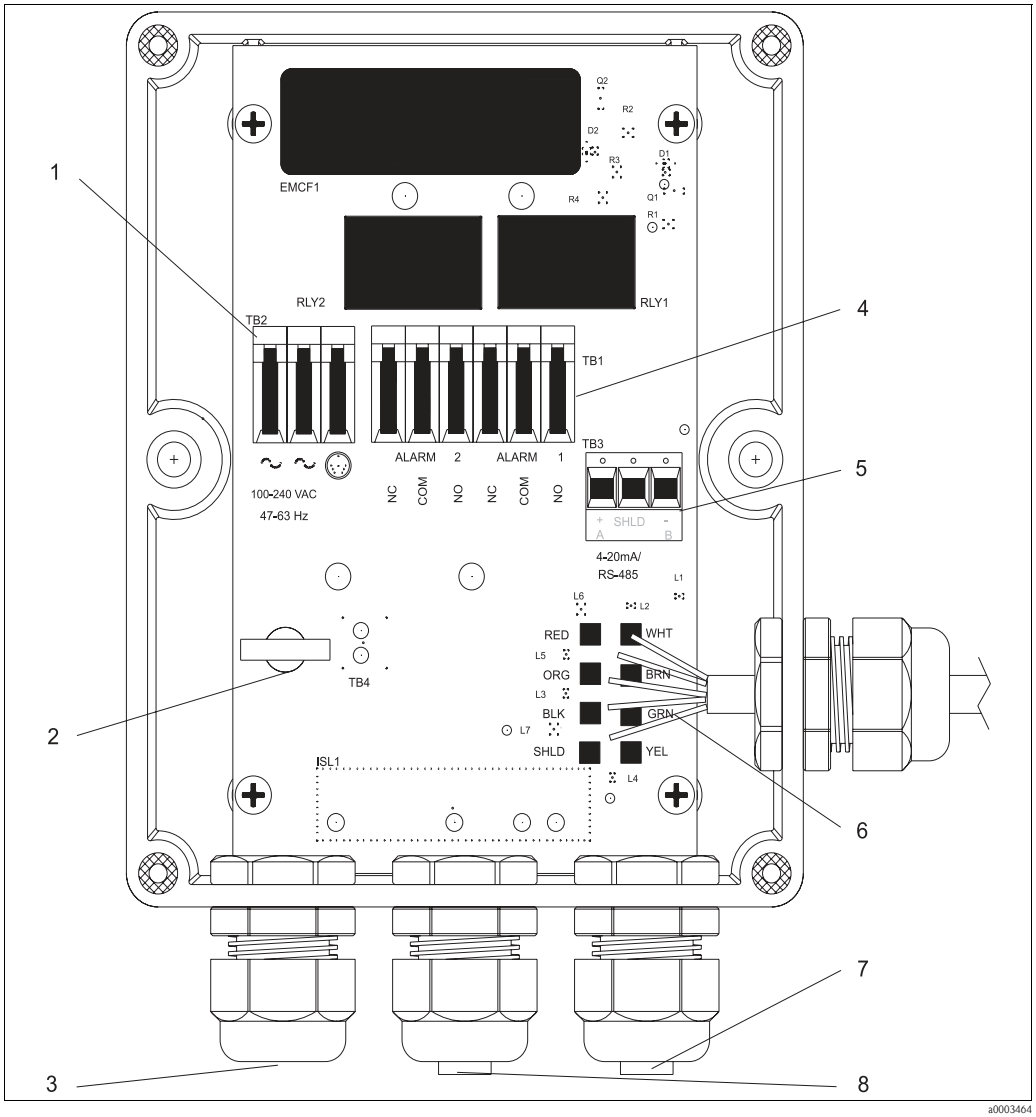


Fig. 8: Field terminal box

1	*Power supply terminal block*	*5*	*4 to 20 mA / RS485 terminal block*
2	*Power cable strain relief*	*6*	*Sensor wiring*
3	*Power cable gland*	*7*	*4 to 20 mA / RS485 cable gland*
4	*Alarms terminal block, 240 VA, 2A*	*8*	*Alarm cable gland*

4.1.2 Connecting the RS-485 cable

The RS-485 half-duplex (2-wire) digital interface operates with differential levels that are not susceptible to electrical interferences. This is why cable lengths up to 914 m / 3000 ft can be implemented. The last device on each bus may require terminating with a 120-ohm resistor to eliminate signal reflection on the line. Do not run RS-485 cables in the same conduit as power.

4.1.3 Connecting the relays

The Alarm 1 and Alarm 2 relays are mechanical relays rated at 240 V AC 2A. Please note that the relays are labeled NO (Normally Open), NC (Normally Closed), and C (Common). As these alarms are configured fail-safe, the normal condition is with power applied to the Turbimax and in a non-alarm condition. Operation of these alarms is covered in section "Configuring the alarms".

4.1.4 Connecting the 4 ... 20 mA output

The 4 ... 20 mA output is driven by a 15 V DC power source and can drive recorder loads up to 600 ohms. This output is isolated from line power and earth ground. Do not run 4 ... 20 mA cables in the same conduit as power. Operation of this output is covered in section "Selecting the output".

4.2 Post-connection check

After the electrical connection, carry out the following checks:

Device condition and specifications	Notes
Are the transmitter and cables damaged on the outside?	Visual inspection

Electrical connection	Notes
Are the mounted cables strain relieved?	
Cable run without loops and cross-overs?	
Are the signal lines correctly connected in accordance with the wiring diagram?	
Are all screw terminals tightened?	
Are all cable entries installed, tightened and sealed?	

5 Operation

5.1 Display and operating elements

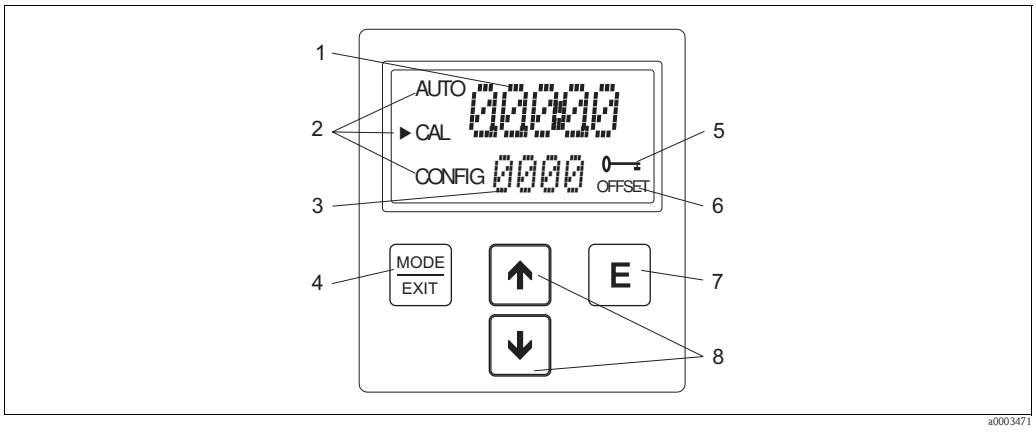


Fig. 9: Display and operating elements

1 Display of turbidity levels and user guidance in configuration
2 Mode arrow to indicate instrument operating mode; AUTO (measurement), CAL (calibration), CONFIG (configuration)
3 Display of error messages and user guidance
4 MODE/EXIT key used to cycle between the three instrument operating modes
5 Icon indicating the use of access code
6 Icon indicating OFFSET mode
7 [E] key to confirm an option or mode that is highlighted or chosen
8 [↑] [↓] keys used to change settings

5.2 Key assignment

MODE / EXIT	Cycle between the operating modes of the instrument: CAL, CONFIG and AUTO (measurement).
E	Confirm the option or mode that is highlighted or chosen.
↑	Scroll up the menu. Increase numerical values.
↓	Scroll down the menu. Reduce numerical values.

5.3 Access code

The instrument is equipped with a security access code feature to protect it from unintended or undesired changes in the configuration and calibration data. The access code can be enabled in the configuration mode. If the access security features is enabled, the code **333** must be entered to access CAL or CONFIG menus. This code may not be changed.
The screen shown in the figure below will appear when the MODE/EXIT key is pressed.

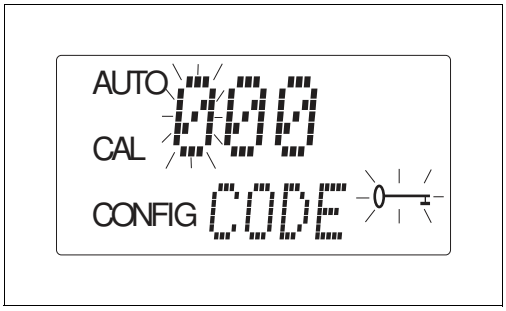


Fig. 10: Enabling security access code

5.4 Menu structure

The instrument has three operating modes that can be selected by the MODE/EXIT key:

- AUTO: standard mode of operation displaying current measured values
- CAL: mode to perform calibration procedures
- CONFIG: setup mode to configure customer-specific settings

Configuration menu

The configuration menu is split into sub-menus to facilitate configuration. The following sub-menus are available:

- Output selection
- RS-485 port configuration
- Alarm configuration
- Security access configuration
- Offset configuration
- Extended settings
  The extended settings are grouped together to prevent them from being modified by accident:
  – Speed of response
  – Displayed resolution
  – LCD backlight brightness
  – Displayed units
  – Ultrasonic cleaning
  – RS-485 parameters
  – Desiccant alarm

For a detailed explanation of the sub-menus, see the chapter "Instrument configuration".

6 Commissioning

6.1 Function check

⚠ Warning!
- Check all connections for correctness.
  Especially check that all tube connections are firmly attached and no leakages occur.
- Make sure that the supply voltage falls within the range of 100 ... 240 V AC!

6.2 Switching on

1. Familiarize yourself with the operation of the transmitter prior to switching on the device. For this purpose, read sections 1 "Safety instructions" and 5 "Operation" in particular.
2. Apply power to the instrument and allow the unit to warm up (typically 45 ... 60 minutes on intial commissioning).
3. When a continuous process stream is flowing through the instrument, it will display the measured turbidity level of the sample on the LCD screen. In addition, the equivalent signal is provided on the analog (4 ... 20 mA) output, or the digital output, depending on the options selected.
4. Configure the instrument according to your needs.

6.3 Instrument configuration

6.3.1 Selecting the output

Function	Selection	Info
Output (O/P) 	Selection ■ 4-20 ■ 485 ■ OFF	
4-20		
4 mA value	0 to 1000 NTU	Set the lower (LOLM) turbidity limit corresponding to the 4 mA output level.
20 mA value	0 to 1000 NTU	Set the upper (UPLM) turbidity limit corresponding to the 20 mA output level.
485		
Baud	1200, 2400, 4800, 9600, 19200	Set the correct baud rate for operation of the I/O port.
Addr	1 to 255	Select the desired instrument address.
MBUS	ASCII RTU	Select ASCII or RTU.

6.3.2 Configuring the alarms

The system provides two relays that are designed to operate as two independent programmable alarms. Three types of information must be input to fully program each alarm:

- Alarm function (HI, LO or OFF)
- Alarm set point (level at which alarm activates)
- Alarm delay time (the time that the set point must be exceeded prior to alarm activation and the time before resetting the alarm)

Alarm function
The alarms can either be turned OFF or programmed to operate in one of the following manners:

- HI alarm
  The relay changes state when the turbidity level is higher than the programmed alarm level for a given period of time.
- LO alarm
  The relay changes state when the turbidity level is lower than the programmed alarm level for a given period of time.



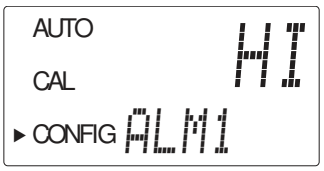
Note!
The relays automatically change state when an internal system failure is detected.

Alarm set point
The turbidity level at which an alarm activates is called the alarm set point. The set point is adjustable to any valid turbidity level over the range of the instrument in steps of 0.01 NTU.

Alarm delay time
The alarm delay times are used to prevent ringing of the alarm when the turbidity level is close to the set point. The function of the delay times is as follows:

- Delay on
  The turbidity level must exceed the alarm set point continuously for at least this number of seconds before the alarm activates.
  If the delay on time is set to 5 seconds and the process turbidity exceeds the set point for only 4 seconds, the alarm will not be activated. If, however, process turbidity exceeds the set point for 5 seconds or more, the instrument will activate the alarm.
- Delay off
  The turbidity level must not exceed the alarm set point continuously for at least this number of seconds before the alarm deactivates.
  If the delay off time is set to 5 seconds and the process has exited out of the alarm condition, the alarm will be reset only if the process is out of the alarm condition for a continuous 5 seconds. Otherwise the system will still signal an alarm condition.

Alarm menu

Function	Selection	Info
Alarm 1 (ALM1) 	Selection ■ HI ■ LO ■ OFF	
Set point (S/P)	0 to 1000 NTU	Set the desired alarm level.
Delay on (DLY▲)	1 to 30 s	Set the desired number of seconds for the delay on time.
Delay off (DLY▼)	1 to 30 s	Set the desired number of seconds for the delay off time.
Alarm 2 (ALM2)	Selection ■ HI ■ LO ■ OFF	
Set point (S/P)	0 to 1000 NTU	Set the desired alarm level.
Delay on (DLY▲)	1 to 30 s	Select the desired number of seconds for the delay on time.
Delay off (DLY▼)	1 to 30 s	Select the desired number of seconds for the delay off time.

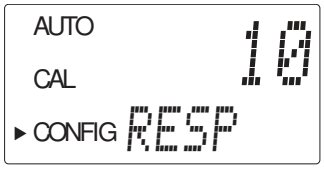
6.3.3 Enabling security access

Function	Selection	Info
Access code (CODE) 	Selection ■ On ■ Off	If the security access is turned on, you are required to input the access code to get to any other mode than AUTO. The only valid code is **333**. This code may not be changed.

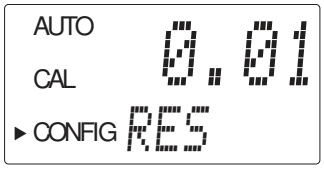
6.3.4 Extended settings

Function	Selection	Info
Extended settings (EXTD) 	Selection ■ On ■ Off	Turn extended settings on to gain access to configuration of the following options: ■ Response speed ■ Displayed resolution ■ LCD backlight brightness ■ Units ■ Ultrasonic cleaning ■ RS-485 parameters ■ Desiccant alarm

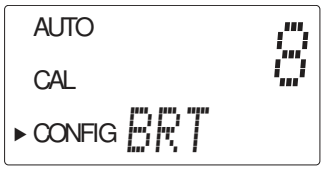
Speed of response

Function	Selection	Info
Speed of response (RESP) 	1 to 100 % Default: 10	Select the desired speed of response for displayed and output values of NTU. To avoid reading air and other anomalies, select the slowest speed (highest number). Select the fastest response where monitoring of rapid changes is needed. The displayed number is a relative speed but the approximate response time, in seconds, is the displayed number multiplied by 5.

Displayed resolution

Function	Selection	Info
Resolution (RES) 	1 to 0.0001 Default: 0.01	The instrument can display resolutions up to four digits to the right of the decimal place for readings below 10 NTU.

LCD backlight brightness

Function	Selection	Info
LCD backlight brightness (BRT) 	1 to 10 Default: 8	Adjust the backlight brightness of the display to your needs.

Units

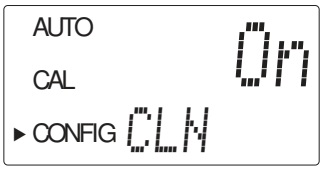
Function	Selection	Info
Units (UNIT) 	Selection ■ NTU ■ FNU Default: NTU	Select the desired turbidity unit: NTU (Nephelometric Turbidity Units) or FNU (Formazin Nephelometric Units).

Ultrasonic cleaning

The ultrasonic cleaning option is used to continuously clean the flow through cuvette. It is not intended to clean cuvettes that are already dirty, or to replace manual cleaning entirely. However, the system will increase cleaning intervals dramatically.
The system requires the use of a cuvette with ultrasonic transducer to operate correctly.
It works by sending an ultrasonic frequency through spring connections into a piezo transducer bonded to the bottom of the flow through cuvette. Cuvette detection only works in AUTO mode.

The system can detect the following error conditions:
- Incorrect cuvette installed
- Error has occurred in the transducer
- Transducer is not making contact with the spring connections

The errors are indicated by CLN being posted to the lower screen. The alarms are set and 2 mA will be sent to the current output.
By default, ultrasonic cleaning is turned on.
After inserting a new cuvette, the error CLN is removed and DRY is indicated on the lower screen for 30 minutes. During this period, the desiccant absorbes residual humidity from the ultrasonic transducer. The error CLN returns after the 30 minutes have elapsed.

Function	Selection	Info
Ultrasonic cleaning (CLN) 	Selection ■ On ■ Off Default: On	Turn off the ultrasonic cleaning function if desired.

RS-485 parameters

Turbimax can provide basic communications over simple programs such as the Hilgraeve HyperTerminal that is included with most Microsoft Windows packages. You could also use Visual Basic or other programs. The default communication parameters are 8 bits, no parity and 1 stop bit. Use the following menus to modify these parameters. They will only appear if RS-485 is selected as output (see section "Selecting the output").

Function	Selection	Info
Bits (BITS) 	Selection ■ 7 ■ 8 Default: 8	Select the required number of data bits for your communication software.
Parity (PRTY)	Selection ■ nOnE ■ ODD ■ E Default: nOnE	Select the required parity bit for your communication software.
Stop	Selection ■ 1 ■ 2 Default: 1	Select the required stop bit for your communication software.

Sample communication:
Master computer requests a report from a Turbimax.

Master will send out:
- Byte #1 the attention 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

Turbimax will respond with:
- The same attention character ":" in ASCII or "3A" hex
- Its address
- The turbidity reading
- The unit

The communication would look like this:
Master computer requesting a report from address #1: **: 1 CRLF**
Turbimax set to address #1 response: **:001 0.0249 NTU**

Desiccant alarm

When the humidity detector in the Turbimax indicates that the internal environment is close to the point where humidity could cause condensation, the instrument displays DESC as a warning. If desired, a desiccant warning can activate the alarms and send 2 mA to the current output.

Function	Selection	Info
Desiccant alarm (DESC) 	Selection ■ OFF ■ On Default: OFF	Select On to activate the alarms when the desiccant fails.

6.4 Instrument calibration

The instrument 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[1)].

Calibration can be performed in two ways:
- Complete three-point calibration
  This calibration is used if accuracy is required over the entire instrument range of 0.02 to 1000 NTU (CUE21) respectively 0.02 to 100 NTU (CUE22). See section "Three-point calibration".
  If accuracy is only required in the range below 10.0 NTU, e.g. for drinking water, a calibration may be performed using only a 10.0 NTU and a 0.02 NTU standard.
- Offset
  This type of calibration can be used if accuracy is only required in the immediate vicinity of the grab sample (see section "Instrument offset").



Note!
- Relay contacts are held at the last valid condition and will not change state while the instrument is in calibration mode.
- The instrument has a time-out feature that automatically returns to the AUTO mode after 15 minutes of inactivity.
- During calibration, the fan inside the instrument is turned off to extend the life of the desiccant. The fan will be turned on during calibration countdowns and after returning to the AUTO mode or after five minutes, whichever comes first. It is recommended that the measurement chamber be kept covered during the calibration and that the flow through cuvette be replaced immediately after the calibration to prevent premature saturation of the desiccant.

6.4.1 Calibration standards

We recommend that the following standards be used during calibration to achieve the full-scale accuracy stated in this manual:

- 0.02 NTU calibration standard
- 10.0 NTU calibration standard
- CUE21: 1000 NTU calibration standard
  CUE22: 100 NTU calibration standard

These primary calibration standards are more stable than Formazin and have a minimum shelf life of 12 months. Prior to recalibration, review the expiration dates to ensure that the standards have not expired.
If you use Formazin to calibrate the instrument, make sure that a fresh stock suspension of Formazin is used to achieve the accuracy quoted for the instrument.

1) The EPA recommends that on-line turbiditmeters be calibrated with a primary standard at least once every three months if they are to be used for EPA reporting.

6.4.2 Indexing calibration cuvettes

To achieve greatest accuracy and account for normal scratches and aberrations in cuvette glass when calibrating, we recommend indexing the cuvettes.
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 provided shutoff clamp.
2. Remove the flow head with the flow-through cuvette.
3. With the instrument in AUTO mode insert the standard.
4. Slowly rotate the standard inside the optical well, one complete revolution (360°).
   While rotating the standard slowly, observe the measured turbidity and locate the postion of the cuvette having the lowest reading.
5. With the calibration standard positioned at the location having the lowest turbidity reading, install the indexing ring over the cap on the standard so that the pointer of the indexing ring faces directly forward.

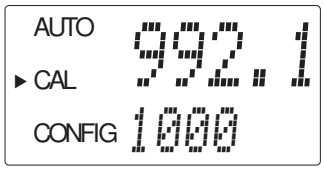
When using the standards in future, always insert the standard so that the pointer of the indexing ring faces forward. Slowly rotate the standard back and forth about 5° to find the lowest point. The standard is then indexed and ready for use.

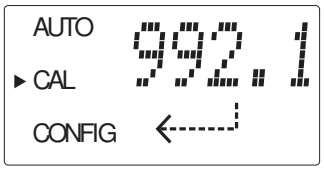
6.4.3 Three-point calibration

Step one:

1. Press the MODE/EXIT key to select the calibration function.
   The arrow beside CAL will be illuminated. The lower display shows alternating 1000 or 100 (the value of the standard that is requested) and ↵. The upper display shows the real-time reading.

   ✎ Note!
   If you want to perform a two-point calibration for potable water, press the [↓] key to bypass the 1000 NTU or 100 NTU and proceed to "Step two".



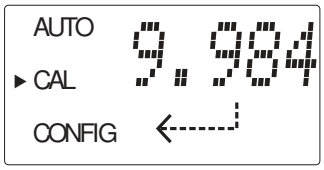


2. If the flow head with the flow through cuvette is not yet removed, remove it.
3. Insert the requested 1000 NTU or 100 NTU standard so that the pointer of the indexing ring faces directly forward.
4. Index the standard to the lowest value on the upper display by slowly rotating it back and forth about 5°.
5. Press the [E] key to accept the calibration.
6. The lower display will count down the progress of the calibration step

Step two:

1. The lower display will change to show alternating 10 and ↵, requesting the 10.0 NTU standard. If the alternating 10 and is not displayed, push the [↑] or [↓] key until this display is shown.

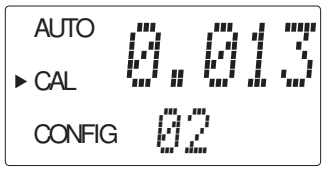


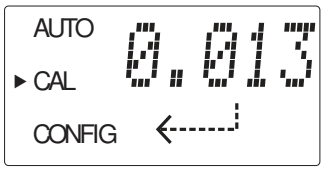


2. Insert the requested 10 NTU standard so that the pointer of the indexing ring faces directly forward.
3. Index the standard to the lowest value on the upper display by slowly rotating it back and forth about 5°.
4. Press the [E] key to accept the calibration.
5. The lower display will count down the progress of the calibration step.

Step three:

1. The lower display will change to show alternating 0.02 and ↵, requesting the 0.02 NTU standard.





2. Insert the 0.02 NTU standard so that the pointer of the indexing ring faces directly forward.
3. Index the standard to the lowest value on the upper display by slowly rotating it back and forth about 5°.
4. Press the [E] key to accept the calibration.
5. The lower display will count down the progress of the calibration step.
6. The instrument will return to AUTO mode at the end of the calibration.

Calibration error

If the calibration failed, the instrument will display an error and not return to AUTO mode.

Calibration failure can have the following reasons:
- Bad calibration standards
- Wrong order of calibration standards
- Low lamp

To continue measurement, try to remedy the problem and recalibrate.
If you cannot remedy the problem, you can restore factory settings by performing the following operation: Push and hold the [↑] key. Push and relase the [E] key and then release the [↑] key. Restoring factory settings allows the use of Turbimax with reduced accuracy. The original problem still exists and must be determined and corrected before accurate operation of the instrument is resumed.

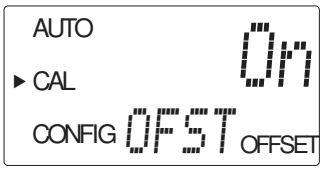
6.4.4 Instrument offset

In certain instances, it may be desirable to use an offset factor to calibrate the instrument rather than performing a physical calibration (as described in section "Three-point calibration"). This procedure is not recommended in lieu of the regular instrument calibration but can be used in situations where the number of intruments used makes regular calibration prohibitive. This calibration technique will make the instrument accurate only at turbidity levels in the immediate vicinity of the grab sample and not in the full range of the instrument.

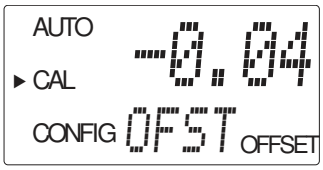
Note!
The OFFSET icon will be illuminated whenever an offset is used. The maximum offset is 1.00 NTU. If instrument variation is greater than 1 NTU, a full calibration is recommended.

To set an offset, proceed as follows.

1. Collect a grab sample of the process water that is being monitored by the instrument and record the turbidity reported by the instrument.
2. Take the grab sample and measure its turbidity using a laboratory turbidimeter, for example Turbimax CUE23 / CUE24.
3. Compare the turbidity reported by the instrument to that obtained in the laboratory. If the readings are very close, no offset adjustment or calibration is required and the procedure may be stopped at this step.
   However, if the readings differ substantially (but less than 1 NTU), continue in this procedure to improve the turbidity reading of the instrument so that it will agree with the laboratory reading between calibrations.
4. Select the offset function by pressing the MODE/EXIT key until the arrow beside CONFIG is illuminated on the display.
5. Push the [E] key until OFST is displayed on the lower row.
6. At this point, the upper row of the display wil indicate the operating status of the offset function. If the function is turned off, turn it ON by pressing the [↑] or [↓] key.



7. Select the desired offset level using the [↑] or [↓] keys. Press the [E] key to accept it.



   The offset is the deviation of the NTU value measured by Turbimax CUE21 / CUE22 from the value measured by the laboratory instrument.
   If, for example, the CUE21 / CUE22 measures the process water at 0.016 NTU but the laboratory instrument reads the sample at 0.12 NTU, entering an offset of -0.04 would result in the CUE21 / CUE22 displaying 0.12 NTU.
8. This completes the offset configuration.
   At this point, the instrument will continue through the configuration (CONFIG) mode. Press the MODE/EXIT key to return to the AUTO mode.

7 Maintenance

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

Maintenance work at the instrument comprises:
- Cleaning the flow-through cuvette
- Replacing the desiccant pouch
- Replacing the lamp

7.1 Cleaning the flow through cuvette

Measurement cuvettes should be clean and free or marks or scratches. To clean and replace a cuvette, proceed as follows:

1. Clean the interior and exterior with a detergent solution.
2. Rinse the cuvette several times with distilled or deionized water.
3. Shut off the flow at Turbimax using the provided shutoff clamp.
4. Remove the flow head from the instrument and unscrew the old cuvette.
5. Screw in the fresh clean cuvette and replace the flow head on the instrument.

Note!
After installing the clean cuvette, the desiccant absords residual heat from it. The message DRY is displayed during this period.

7.2 Replacing the desiccant pouch

Proper use of the supplied desiccant is essential in maintaining the performance of the instrument. In addition, the enclosure seal must be maintained to ensure adequate desiccant life. Inspect this seal each time the desiccant pouch is replaced.
Replace the desiccant when the instrument displays the desiccant alarm (DESC):

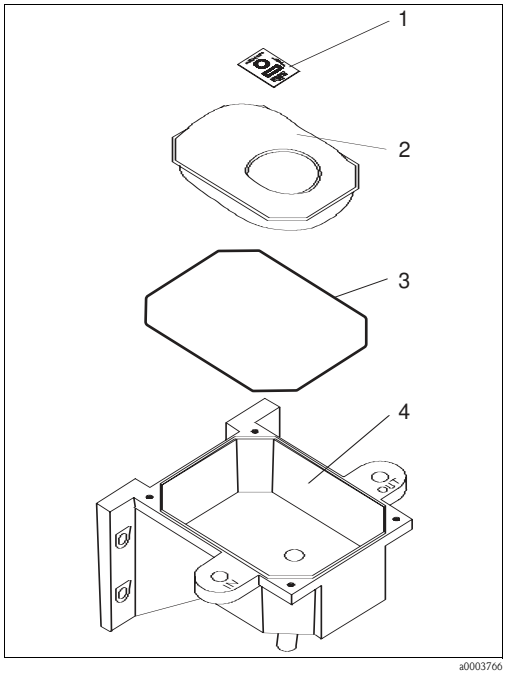


Fig. 11: Replacing the desiccant pouch

1. Unscrew the four corner thumbscrews.
2. Remove the electronics half of the instrument.
3. Remove the used desiccant pouch.
4. Check the enclosure seal (pos. 3) on the instrument base. Reseat or replace it if necessary.
5. Open the bag protecting the new desiccant pouch (pos. 2) and install it with the humidity indicator (pos. 1) in the instrument base (pos. 4).

   Note!
   Once the bag is opened, install the desiccant pouch immediately to prevent premature degradation of the desiccant.
6. Replace the electronics half of the instrument in its location.
7. Tighten the four corner thumbscrews again.
8. To speed up the recognition of the new desiccant, it will be necessary to reset the instrument by disconnecting the sensor interconnect cable for 2 seconds and then reconnecting it.

7.3 Replacing the lamp

The lamps in the instrument have a ten-year life expectancy.
If the lamp should need replacement, we recommend contacting the responsible service for assistance.

8 Accessories

8.1 Calibration solutions

Calibration kit CUE21 / CUE23 / CUE24, full range
- 0.02 NTU
- 10.0 NTU
- 1000 NTU

Order no.: 51518580

Calibration kit CUE22, full range
- 0.02 NTU
- 10.0 NTU
- 100 NTU

Order no.: 71030102

8.2 Flow chamber CUE21 / CUE22

- Flow chamber CUE21 / CUE22 for air bubble suppression
  Order no.: 51518575

Functioning of the flow chamber for air bubble suppression
The flow chamber is a cylinder with approximately 50 mm / 2" diameter and 660 mm / 26" length. The liquid enters the flow chamber via the inlet fitting near the top of the chamber (see Fig. 12). As the liquid passes through the chamber, its velocity becomes very low due to the large diameter of the flow chamber. This permits the fine air bubbles in the liquid to rise to the top of the flow chamber.
The automatic air vent in the top of the flow chamber removes the air as it collects at the top of the flow chamber.
The flow chamber should be located in the line before the liquid reaches the sensor. The outlet from the flow chamber should be run vertically at least 750 mm / 30” above the top of the automatic air release before being led to the sensor.
The BRAUKMANN Automatic Air Vent has a maximum working pressure of 6.2 bar / 90 psi and maximum temperature range to 106 °C / 225 °F. It is designed for use on all types of hot water radiators, convectors, base board convectors, heating units, venting pipes and fittings.

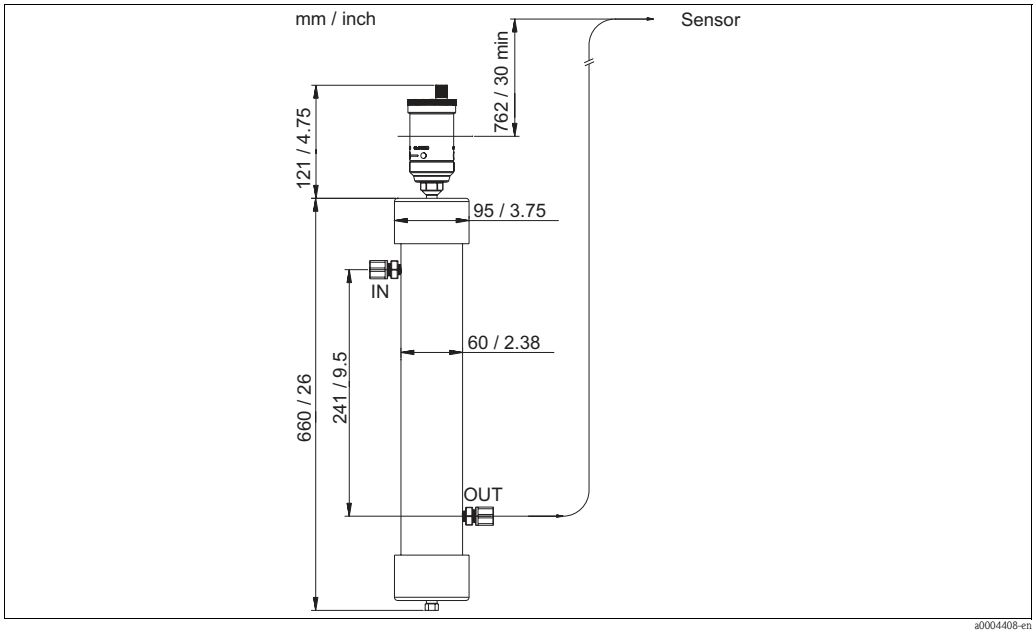


Fig. 12: Dimensions and installation distance

Operating instructions

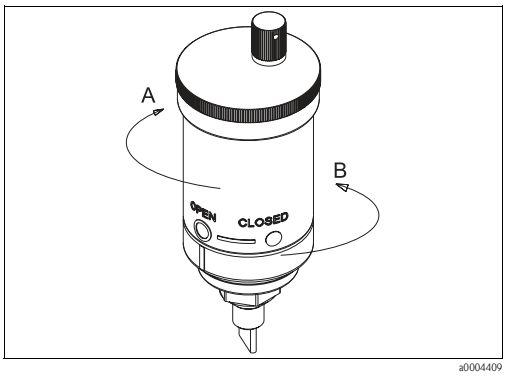


Fig. 13: Air vent in open position

A closed
B open

1. Before filling the system, make sure the red vent cap is securely tight and that the valve is in the closed position (see Fig. 13) by turning vent body clockwise. Use hands only to avoid damaging the vent.
2. With the valve in the closed position, flush the system as required to remove dirt, debris and contaminates.
3. Fill the system with the appropriate solution.
4. Start operation by turning the air vent body counter-clockwise to the open position (see Fig. 13).
5. Make sure the red vent cap is tightened all the way to the stop position for proper operation. Use hands only to tighten.

Cleaning instructions

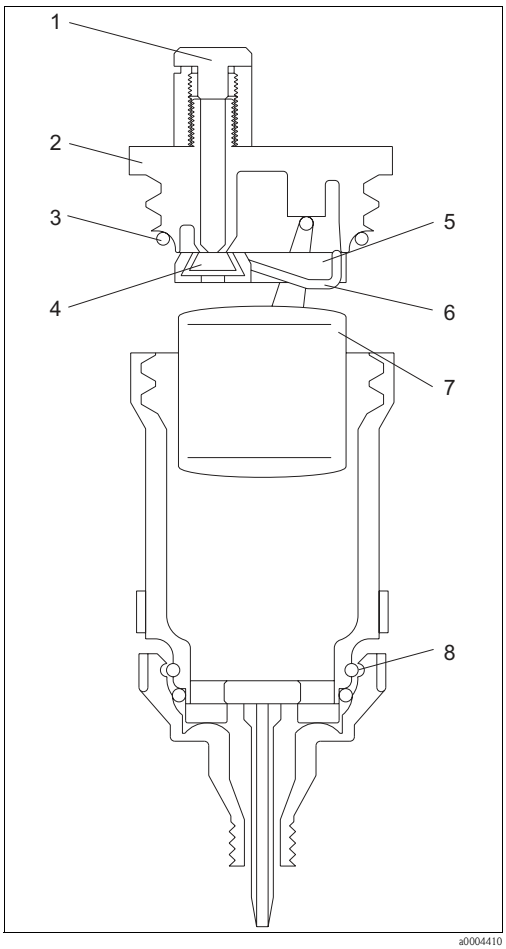


Fig. 14: Air vent detailed view

1 Red vent cap with leakage guard
2 Black cover assembly
3 O-ring
4 Seat area
5 Vent lever
6 Spring
7 Float
8 Built-in shutoff

1. Turn the vent body clockwise to the closed position, isolating the vent from the system (see Fig. 13).
2. Remove the float assembly by unscrewing the top of the body and lifting the black cover assembly up (Fig. 14., pos. 2).
3. Carefully clean the seat area (pos. 4) of any dirt or debris.
4. Carefully clean any dirt or debris from inside the vent chamber.
5. Replace the float assembly, making sure that the O-ring (pos. 3) is seated properly.
6. Replace the black cover assembly on the air vent body. Using hands only turn until handtight.
7. Operate by turning the air vent body counter clockwise to the open position. Use hands only.
8. Make sure the red vent cap (pos. 1) is tightened all the way to the stop position for proper operation. Use hands only to tighten.

9 Troubleshooting

9.1 Troubleshooting instructions

The instrument performs continuous diagnostic monitoring. Any faults are displayed in a queue form in the bottom row of the LCD.

The Turbimax provides three levels of fault detection:

- Warning
  A warning is simply a screen indication of a problem. No alarms are activated. If, for example, the desiccant alarm is turned off and the desiccant becomes saturated, a screen warning of DESC will appear.
- Error
  An error indicates a failure or a problem that usually can be corrected by the operator, e.g. lamp out (LAMP) or bad calibration (CAL). If an error occurs, both alarm relays will be activated and the current output will be held at 2 mA. The instrument will still display readings, however the accuracy is not known and instruments readings should not be trusted.
- Failure
  A failure is a system fault. This is **not** a problem that the operator can correct. 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 instrument will not function properly and will display the word FAIL on the lower row. Both alarm relays will be activated and the current output will be held at 2 mA.

Refer to the sections "System error messages" and "Process errors" to localize and rectify an error.

9.2 System error messages

Error message	Possible cause	Tests and / or corrective measures
MA	4 ... 20 mA loop open	Check the wiring. See sections "Electrical connection", "Selecting the output".
DESC	Desiccant pouch saturated	Change desiccant pouch. See section "Replacing the desiccant pouch".
LAMP	Lamp failed	Replace lamp. Contact your responsible service.
FLOW	Sample flow has stopped	Restore flow.
CLN	Ultrasonic transducer of flow through cuvette not making contact	Rotate the flow through cuvette slightly to improve connection. If this fails to work, replace the cuvette.
	Flow through cuvette removed	Insert flow through cuvette
FAIL	Major system fault	Contact your responsible service.
DRY	Drying period	Expires automatically after a period of 30 minutes.

9.3 Process errors

Error	Possible cause	Tests and / or corrective measures
Readings are higher than expected	Bubbles in solution	■ Ensure that the drain vent is open and is not obstructed. See section "Plumbing". ■ Apply backpressure. See section "Plumbing". ■ For severe cases of bubbles, a stilling chamber is available, see "Accessories".
	Condensate or leaky cuvette	Check flow through cuvette for condensate or leaks.
	Flow through cuvette dirty	Clean cuvette. See section "Cleaning the flow through cuvette".
	Instrument out of calibration	Recalibrate. See section "Instrument calibration".
Readings are erratic	Bubbles in solution	See above.
	Debris in flow through cuvette	Clean debris from cuvette.
Readings are lower than expected	Instrument out of calibration	Recalibrate. See section "Instrument calibration".
Upper display flashes	Sample over-range	Check sample. Sample turbidity may be too high to read.

9.4 Spare parts

Designation and content	Order number spare part kit
Electronic service module for CUE21, infrared	71030103
Electronic service module for CUE22, white light	71030104
Field terminal box CUE21 / CUE22	71030105
Desiccant with indicator card, refill pack	51518578
Tubing kit containing: 1 shutoff clamp, 1 backpressure valve, 2 connecting tubes with fittings for flow through assembly, drain vent	51518579
Replacement cuvette with ultrasonic transducer allowing to use the ultrasonic cleaning feature	51518576

9.4.1 Replacing the electronics module

To replace the electronics module, proceed as follows:

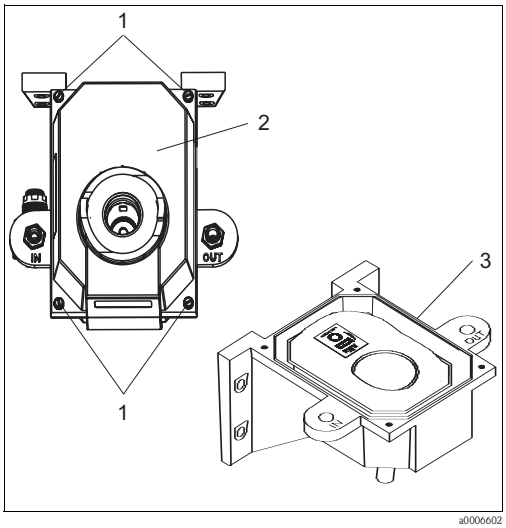


Fig. 15: Replacing the electronics module

1. Unscrew the four corner thumbscrews (pos.1).
2. Remove the electronics module (pos. 2) from the instrument base (pos. 3).
3. Place the new electronics service module on the instrument base.
4. Secure the module using the four corner thumbscrews.

9.5 Return

If the system has to be repaired, please return it *cleaned* to the sales center responsible.
Please use the original packaging, if possible.

Please enclose the completed "Declaration of Hazardous Material and De-Ccontamination" (copy the second last page of these Operating Instructions) with the packaging and also the shipping documents.

9.6 Disposal

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

10 Technical data

10.1 Input

Measured variable	Turbidity	
Measuring range	CUE21: CUE22:	0 to 1000 NTU /FNU 0 to 100 NTU /FNU

10.2 Output

Output signal	4 to 20 mA, galvanically isolated	
Signal on alarm	2 mA in case of an error	
Load	max. 600 Ω	
Communications port	Bi-directional RS-485, Modbus optional	
Relays	Switching voltage: Switching current:	max. 240 VAC max. 2 A
Limit value and alarm functions	Setpoint adjustment: CUE21: CUE22: Alarm delay:	 0 to 1000 NTU 0 to 100 NTU 0 to 30 s

10.3 Power supply

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

10.4 Performance characteristics

Response time	adjustable 1 to 100 % (approx. 5 to 500 seconds) CUE21: 0 to 1000 NTU CUE22: 0 to 100 NTU	
Reference temperature	25 °C (77 °F)	
Resolution	0.0001 NTU (below 10 NTU)	
Maximum measured error	below 40 NTU: above 40 NTU:	±2 % of reading or ±0.02 NTU whichever is greater ±5 % of reading
Repeatability	±1 % of reading	

10.5 Environment

Storage temperature	-20 to +60 °C (-4 to +140 °F)
Ingress protection	IP 66 / NEMA 4x
Insulation rating	Double insulated, pollution degree 2
Overvoltage protection	Category II
Relative humidity	max. 95%, non-condensing
Altitude	up to 2000 m

10.6 Process

Ambient temperature	1 to 50 °C (34 to 122 °F)
Medium temperature range	1 to 50 °C (34 to 122 °F)
Process pressure	max. 13.78 bar (200 psi) controlled by integral pressure regulator
Flow rate	0.1 to 1 liter/min. (0.026 to 0.26 US.gal/min.)

10.7 Mechanical construction

Dimensions	H x W x D:	347.16 x 207.65 x 196.85 mm (13.668" x 8.175" x 7.750")
Weight	2 kg (4.4 lbs.)	
Materials	Housing:	ABS
	Flow-through head:	Nylon
	Sample cuvette:	Borosilicate glass
	Sample cuvette seal:	Silicon
	Flow-through fittings:	Polypropylene
	Flow-through lock down pins:	Stainless steel (AISI 304 or AISI 303)
Light source	Turbimax CUE21:	Infrared LED, 860 nm
	Turbimax CUE22:	White light Tungsten lamp, ~600 nm, 2250 °K

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Endress+Hauser

People for Process Automation

Declaration of Hazardous Material and De-Contamination

Erklärung zur Kontamination und Reinigung

RA No. ☐☐☐☐☐☐☐☐

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.
Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.
Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

☐ **Used as SIL device in a Safety Instrumented System /** *Einsatz als SIL Gerät in Schutzeinrichtungen*

Process data/ *Prozessdaten*
Temperature / *Temperatur*_____ [°F] _____ [°C]
Pressure / *Druck* _____ [psi] _____ [Pa]
Conductivity / *Leitfähigkeit* _____ [µS/cm]
Viscosity / *Viskosität* _____ [cp] _____ [mm²/s]

Medium and warnings
Warnhinweise zum Medium

	Medium /concentration *Medium /Konzentration*	Identification CAS No.	 flammable *entzündlich*	 toxic *giftig*	 corrosive *ätzend*	 harmful/ irritant *gesundheits-schädlich/ reizend*	 other * *sonstiges**	 harmless *unbedenklich*
Process medium *Medium im Prozess*								
Medium for process cleaning *Medium zur Prozessreinigung*								
Returned part cleaned with *Medium zur Endreinigung*								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / *Fehlerbeschreibung* _____

_____

_____

Company data / *Angaben zum Absender*

Company / *Firma* _____

_____

Address / *Adresse*

_____

_____

Phone number of contact person / *Telefon-Nr. Ansprechpartner:*

_____

Fax / E-Mail _____

Your order No. / *Ihre Auftragsnr.* _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."
"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."

_____ (place, date / *Ort, Datum)*

_____ Name, dept./*Abt.* (please print / *bitte Druckschrift*)

_____ Signature / *Unterschrift*

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