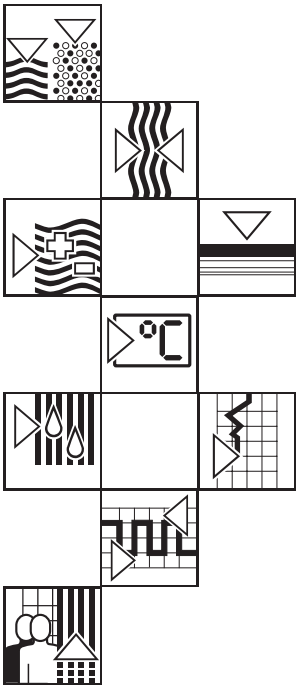
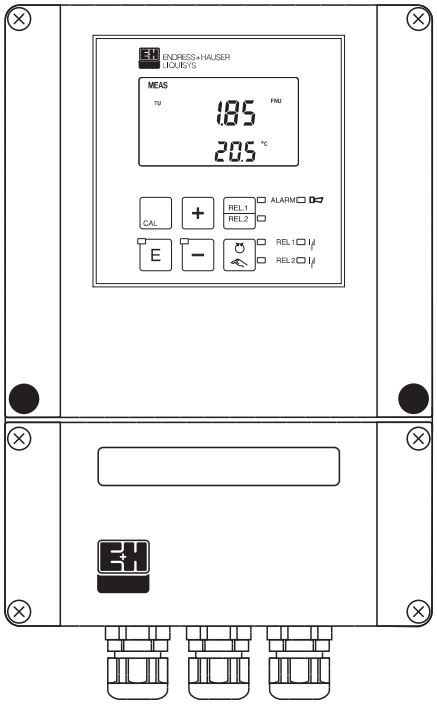
BA 174C/07/en/01.98
No. 50088699
Software version 1.0 or later

liquisys CUM 252 Transmitter for Turbidity and Solids Content

Operating Instructions





Quality made by Endress+Hauser

ISO 9001

Endress+Hauser

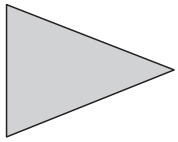
Nothing beats know-how

Please familiarise yourself with the instrument before you take any other steps:

General information

Safety

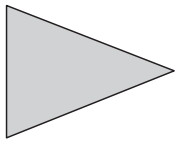
Description



You wish to install and start up the instrument. The required steps are described in these chapters:

Installation

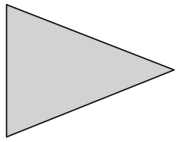
First start-up



You wish to operate or reconfigure the instrument. The operating concept is explained in these chapters:

Operation

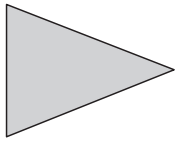
Instrument configuration



Need help with problems or maintenance?

Diagnostics

Maintenance and service



See the back cover for a fold-out overview of the menu structure.

Table of contents

1 General information

1.1 Symbols used

Warning:

This symbol alerts to hazards which may cause serious injuries as well as damage to the instrument, measuring system or other equipment if ignored.

Caution:

This symbol alerts to possible malfunction due to operator error.

Note:

This symbol indicates important items of information.

1.2 Conformity statement

The Liquisys CUM 252 measuring transmitter has been developed and manufactured in accordance with the applicable European standards and directives.

Note:

The corresponding certificate of conformity may be requested from Endress+Hauser.

2 Safety

2.1 Intended use

The measuring transmitter Liquisys CUM 252 is a field-tested and reliable measurement device for determining turbidity or solids concentration. It is equipped with two current outputs and two switched outputs for connection to automated process controllers.

2.2 General safety notes

Warning:

Operation of the device in a manner other than as described in these operating instructions may lead to unsafe and improper functioning of the measuring system.

Installation, start-up, operation

The Liquisys CUM 252 instrument has been designed for safe operation according to the state of the art in engineering and in keeping with the applicable regulations and EC directives; see "Technical data". However, if used improperly or other than for the intended purpose, it may pose a hazard, e.g. due to improper connection.

Installation, electrical connection, start-up, operation and maintenance of the measuring system must therefore be performed exclusively by trained specialists authorised by the system operator. This personnel must have read and understood these operating instructions and must adhere to them.

2.3 Safety devices

- **Access code:**
  Unauthorised access to the calibration and configuration data of the measuring transmitter is effectively prevented by access codes. The instrument settings can be read at any time without entry of an access code.
- **Alarm function:**
  Continuous violation of the limit settings, sensor failure or process-related problems will activate an alarm. This condition is indicated by an LED on the control panel and via a switched output. The alarm contact has been designed as a fail-safe switch, i.e. the alarm condition will be immediately signalled in case of a power failure (requires two separate current supply circuits). The alarm contact is also activated by internal system errors (see 8.2).
- **Data protection:**
  The instrument configuration is retained even after a power failure.
- **Immunity to interference:**
  This instrument is protected against interference, such as pulse-shaped transients, high frequency and electrostatic discharges, according to the applicable European standards. This is, however, only the case for instruments connected as outlined in these operating instructions.

3 Instrument description

3.1 Areas of application

The measuring transmitter Liquisys CUM 252 is an excellent choice for measuring and control tasks in the following areas of application:

- Sewage treatment plants, solids concentration measurement
- Effluent treatment
- Water treatment and water monitoring
- Drinking water
- Surface water (rivers, lakes, dams, ocean)
- Service water
- Indirect discharge
- Water recycling

3.2 Measuring system

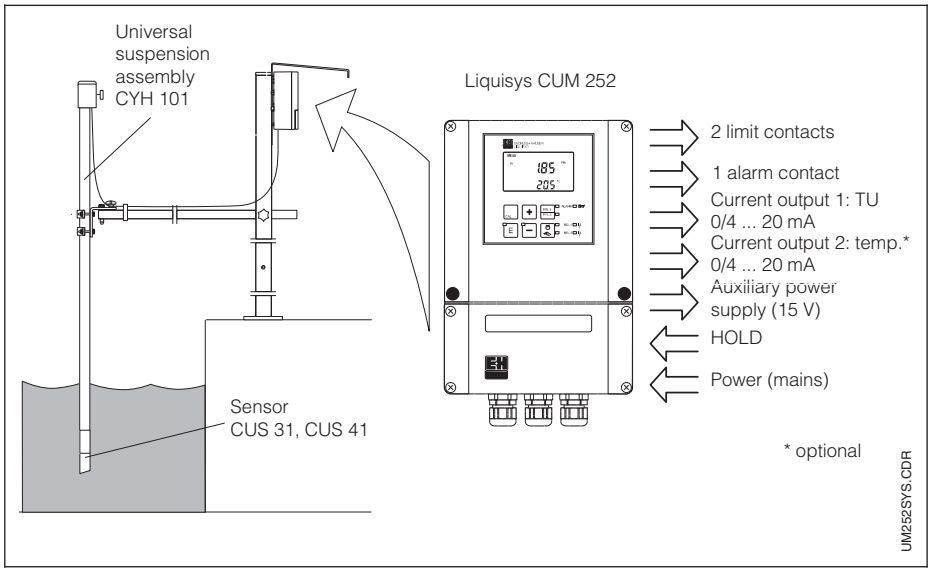


Fig. 3.1 Example of a complete measuring system

A typical measuring system comprises:

- a CUS 31 or CUS 41 sensor with an integrated temperature sensor
- an appropriate immersion, flow or retractable assembly
- an extension cable (shielded standard cable / 2 × 2 wires, twisted pair) with junction box VBM if necessary
- the Liquisys CUM 252 measuring transmitter

3.3 Essential features

- Field housing with protection type IP 65
- Measuring ranges 0 ... 9999 FNU, 0 ... 3000/9999 ppm, 0 ... 3/300 g/l, 0 ... 200% (depending on sensor and sample)
- Temperature measuring range –5.0 ... + 70.0 °C
- Easy to read, two-line display
- Simple configuration with only three keys
- Configuration protected by access code
- Quick calibration using the “CAL” key
- Two switched outputs which can be configured as limit contacts
- One contact which can be configured as a spray cleaning contact
- One switched output for alarm signalling in cases of limit violation
- Two current outputs with selectable measurement range, switchable between 0 ... 20 or 4 ... 20 mA proportional (switching affects both outputs)
- Automatic “hold” function to “freeze” the current outputs and switched outputs during calibration, configuration and cleaning
- “Hold” function can be controlled via a galvanically separated input using an external or internal auxiliary voltage
- Interference-free communication with the sensor via digital interface
- Wiper control via digital interface

3.4 Instrument variants

Order code

Version / measuring range

TU Turbidity / solids content measuring transmitter
in PC/ABS protection housing, 247 × 170 × 115 mm (H × W × D),
2-line display, protection type IP 65
Application units FNU, ppm, g/l and % or % DM

Power supply

0 Power supply: 230 V AC
1 Power supply: 115 V AC
2 Power supply: 200 V AC
3 Power supply: 24 V AC
5 Power supply: 100 V AC
8 Power supply: 24 V DC
9 Special version to customer specifications

Measurement output

0 Meas. output: turbidity / solids content (DM)
1 Meas. output: turbidity / solids content and temperature
9 Special version to customer specifications

Additional features

10 Base version
20 Moisture protection lacquering
99 Special version to customer specifications

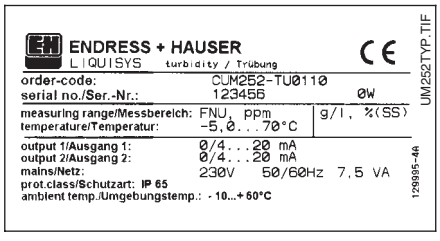


Fig. 3.2 Nameplate of Liquisys CUM 252

You can identify the device variant and the mains supply type by the order code on the nameplate of the instrument.

3.5 Accessories

Sensor

Type	Features	Areas of application
CUS 31	Scattered light sensor in all-plastic housing with sapphire windows and perm. attached cable, cable length optionally 7 or 15 m, prot. type IP 68, with integrated temp. sensor	Drinking water, surface water, service water, waste treatment effluent
CUS 41	Scattered light sensor in all-plastic housing with sapphire windows and perm. attached cable, cable length optionally 7 or 15 m, prot. type IP 68, with integrated temp. sensor	Solids concentr. meas. in – sewage treatment plants – sedimentation – water conditioning

Assemblies

Type	Features	Areas of application
CYH 101	Universal suspension assembly holder	Installation for immersed operation, e.g. in activated sludge basins
CYA 611	Immersion assembly	
CUA 250	Flow assembly	Installation for flow operation
CUA 461	Retractable assembly	Installation for in-line operation, e.g. in pipelines or on tank walls

Cleaning system

Type	Features	Areas of application
Chemoclean CYR 20	Program sequencer for automatic control of cleaning cycles, user-definable weekly program, hold output	For use with heavily soiled media
Chemoclean CYR 10	Injector with drive water and cleaning agent valves	
Chemoclean CUR 4	Spray head for CUS 31, CUS 41 also in conjunction with suspension or immersion assembly CYH 101 for ½" hose connection, material: PVC	
Spray clean. system for CYA 611	Spray cleaning set for immersion assembly CYA 611, D16 pressure hose bush connection	

4 Installation

4.1 Storage and transport

The packaging material used to store or transport the instrument must provide shock and moisture protection. Optimal protection is provided by the original packaging materials. Conformance with the ambient conditions (see “Technical data”) must be assured.

4.2 Unpacking

Verify that the contents are undamaged. Inform the post office or freight carrier as well as the supplier of any damage.

Check that the delivery is complete and agrees with the shipping documents and your order:

- Quantity delivered
- Instrument type and version according to the nameplate (see chapter 3.4)
- Accessories
- Operating instructions

Included in delivery:

- 1 set of plug-in screw terminals
- 1 × cable gland Pg 7
- 1 × cable gland Pg 16 reduced
- 2 × cable gland Pg 13.5

The cable gland openings in the housing have not been punctured. **Puncture only the openings needed** and leave the cover in place when making the openings to keep the housing as stable as possible.

The post mounting kit is **not** included in the delivery.

Save the original packaging in case the device must be stored or shipped at a later time.

If you have any questions, please consult your supplier or the Endress+Hauser sales office in your area (see back cover of these operating instructions for addresses).

4.3 Mounting

Wall mounting of Liquisys CUM 252 in field housing

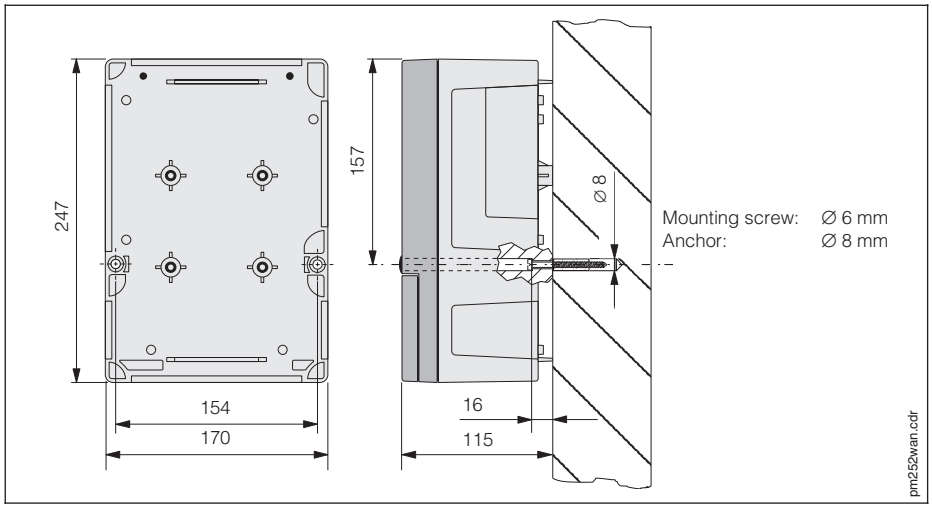


Fig. 4.1 Wall mounting of Liquisys CUM 252

Post mounting of Liquisys CUM 252 in field housing (optional)

Additional requirements: post mounting kit (see Mounting accessories). Install the post mounting kit on the rear of the instrument. Installation is possible on horizontal or vertical piping. The maximum pipe diameter is 60 mm (see figure 4.2).

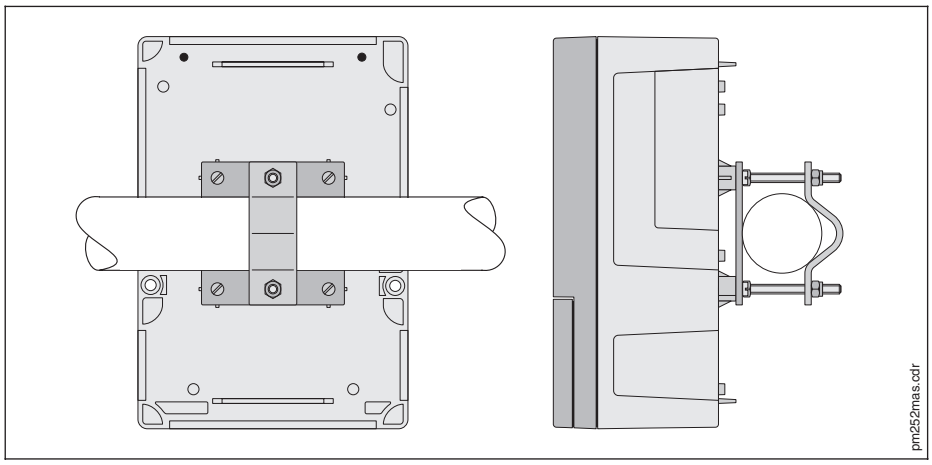


Fig. 4.2 Post mounting of Liquisys CUM 252

Mounting accessories

Post mounting kit
Kit for installation of field housing on horizontal or vertical pipes (max. Ø 60 mm);
Material: stainless steel VA; order no. 50086842

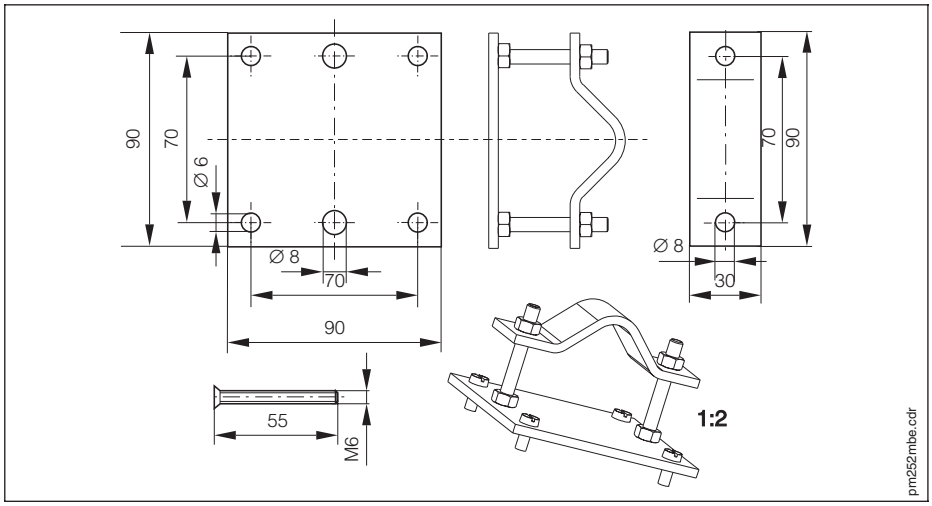


Fig. 4.3 Post mounting kit

Caution:

Weather protection cover CYY 101 (see Mounting accessories) is to be used for outdoor installation. The protection cover is suitable for wall or post mounting.

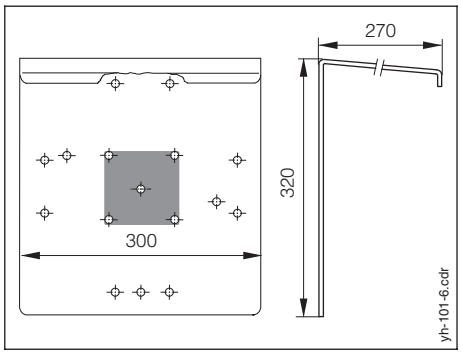


Fig. 4.4 Weather protection cover CYY 101

Weather protection cover CYY 101

Weather protection cover for outdoor use of instrument, to be installed on field housing.
Dimensions: 320 × 300 × 270 mm (H × W × D);
Material: stainless steel
Order no.: CYY101-A

A post mounting kit is not needed when another mounting assembly, e.g. the CYH 101 (cf. page 4), is used.

4.4 Connection

Warning:

- The connection to the mains may only be established by properly trained specialist personnel.
- Do not perform service work on the instrument while the instrument is energised.
- The instrument must be grounded before start-up!
- A clearly identified mains disconnecting device must be installed close to the instrument.
- Before connecting the instrument to the mains, make sure the mains voltage matches the voltage rating on the nameplate.

Instrument connections

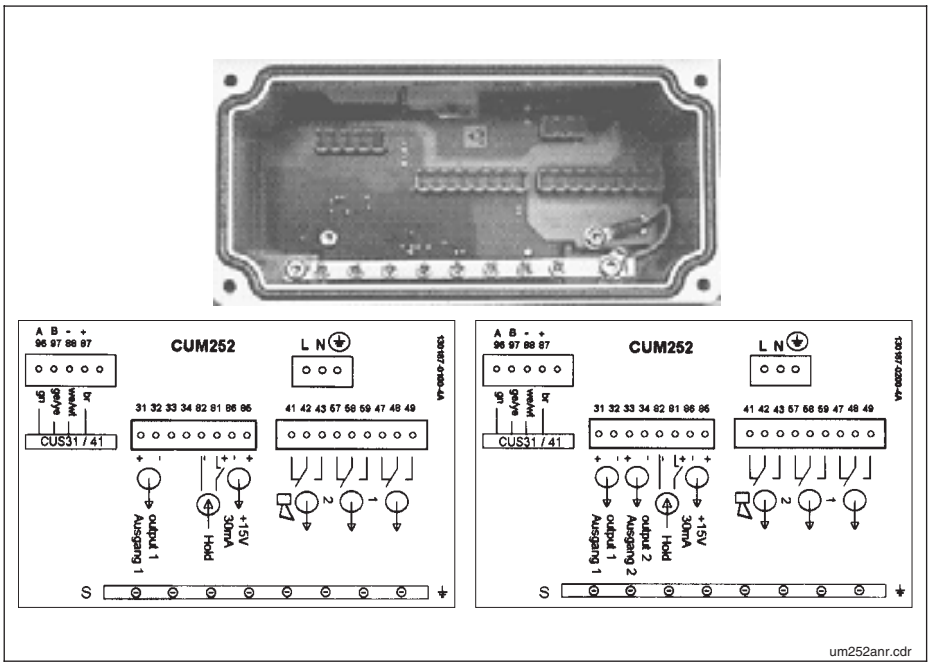


Fig. 4.5 Position and designation of connections in wiring compartment; top: wiring comp.; left: instrument with one current output; right: instrument with two current outputs; connection for 220 V AC

Connection diagram

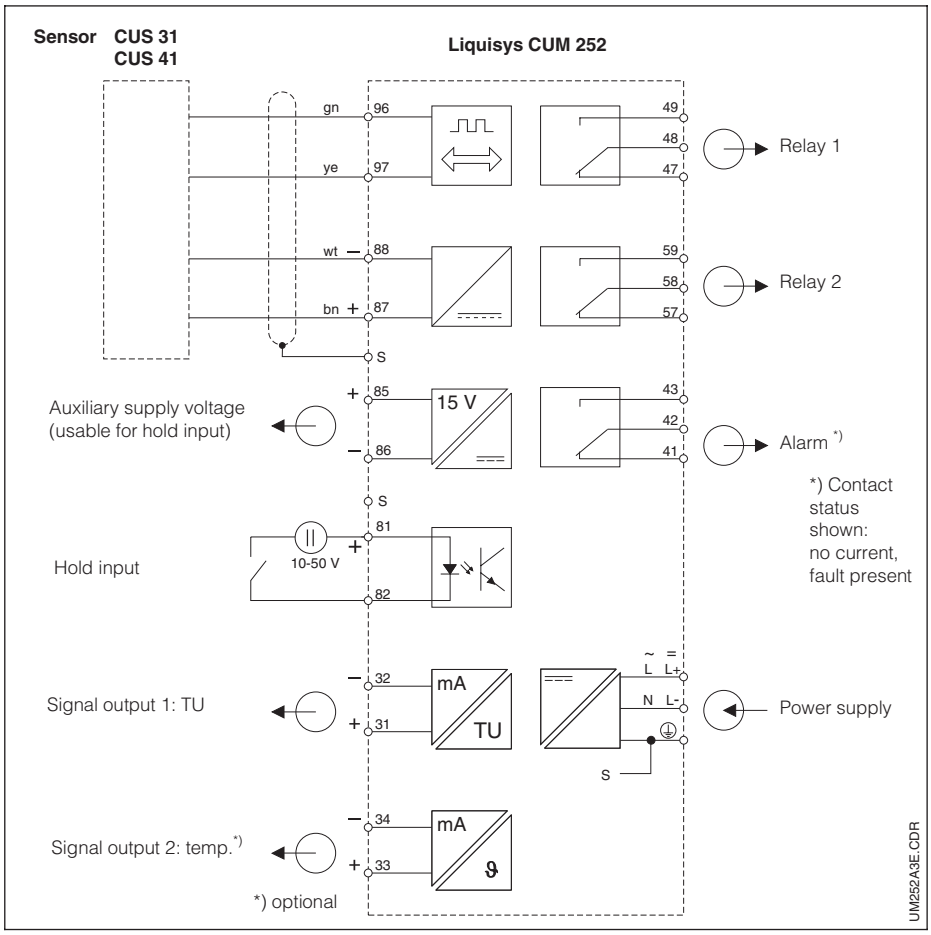


Fig. 4.6 Electrical connection of Liquisys CUM 252

Caution:

Do not connect the two signal outputs with each other! If you want to connect them both to a PLC with common ground of all inputs, then you must anew isolate one output galvanically.

Connection of sensor CUS 31 or CUS 41

The sensor is connected via the multi-core measuring cable attached to the sensor. Should it become necessary to extend the measuring cable, use junction box VBM and a shielded twisted pair cable with 2 × 2 wires.

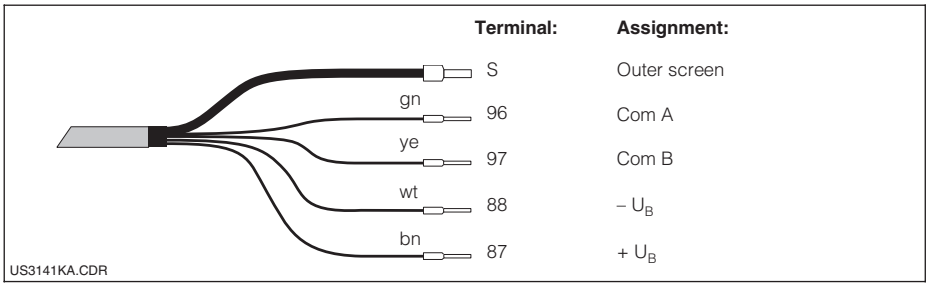


Fig. 4.7 Permanently attached sensor cable on CUS 31, CUS 41

Warning:

Connectors and terminals must be protected against humidity, otherwise faulty measurements will result!

Connection accessories

Junction box VBM

Junction box for measuring cable extension with 10 high-impedance terminals and Pg 13.5 cable glands for cable entry. Material: painted aluminium; protection type: IP 65
Order no.: 50003987

Extension cable

2 × 2-wire shielded twisted pair cable

4.5 Packaging and disposal

Packaging
Packaging must provide shock and moisture protection. Optimal protection is provided by the original packaging materials.

Disposal

Note:

Electronic components to be disposed of are considered special waste!
Please observe local regulations for disposal!

5 First start-up

Connect a type CUS 31 or CUS 41 sensor to the CUM 252 transmitter. After power-up, the measuring chain is ready to measure turbidity (in FNU units) without requiring calibration. If you intend to measure the solids concentration in ppm, g/l or %, you should select the measured quantity/unit and the calibration data set after power-up (see chapters 7.1 and 7.4), and then calibrate the sensor if necessary (see chapter 7.6).

Note:

Familiarise yourself with the operation of the measuring instrument before switching it on for the first time!

Caution:

Before power-up, check that all connections have been properly made!

Warning:

Before power-up make sure that there is no risk of damage to the system the instrument is a part of; for example, due to valves or pumps that might operate in an uncontrolled manner, etc.

Power-up, test

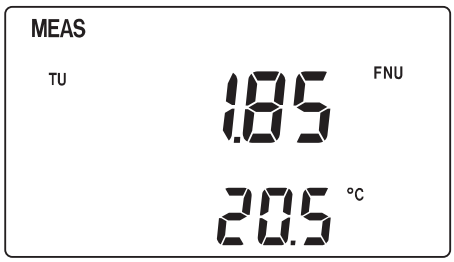


Fig. 5.1 Display after power-up and completion of self-test

After power-up, the instrument performs a self-test and then starts up in the measuring mode.

If the display is similar to figure 5.1, the instrument is functioning properly.

The measured values shown on the display may be different.

In order to check the alarm function as well as any connected alarm signalling device, the current supply can be interrupted for a moment. All configuration data will be retained.

The relays can be operated manually for function checks, maintenance work, etc.
See chapter 6.6, Auto / manual mode of operation.

Factory settings

The following factory settings are active when the instrument is powered up for the first time:

Type of measurement	Turbidity measurement in FNU
Temperature offset / turbidity offset	0 °C 0 FNU
Limit 1	0 FNU
Contact function, limit contactor 1	MIN contact without delay (switches when value drops below limit 1)
Limit 2	9999 FNU (upper range value, depending on sensor and unit selected)
Contact function, limit contactor 2	MAX contact without delay (switches when limit 2 is exceeded)
Current outputs 1 and 2	4 ... 20 mA
Current output 1: TU value for 4 mA signal current	0 FNU
Current output 1: TU value for 20 mA signal current	9999 FNU (upper range value, depending on sensor and unit selected)
Current output 2: temp. value for 4 mA signal current*	0 °C
Current output 2: temp. value for 20 mA signal current*	40 °C
Filter time constant / filter strength	10 s
Calibration data set	No. 3
Wiper control	Off (“oFF”)

* On instruments with two current outputs

6 Operation

6.1 Operator interface

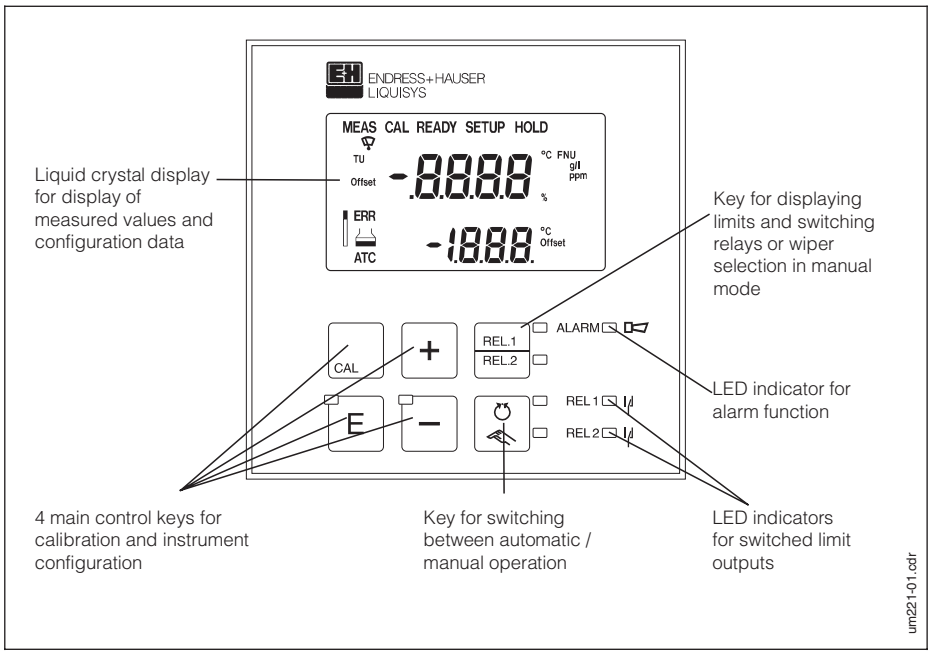


Fig. 6.1 Operating elements of Liquisys CUM 252

6.2 Display elements

LED indicators

Indication for relay controlled in “manual” mode (red LED).

Indication for “auto” (green LED) or “manual” (yellow LED) mode.

Indicates the status of relays 1 and 2.
LED green: measured value is within permissible limits, relay is inactive.
LED red: measured value is outside of permissible limits, relay is active.

Alarm indication for continuous limit violation, sensor / process alarm, sensor error, AD converter overflow or system error.

Liquid crystal display

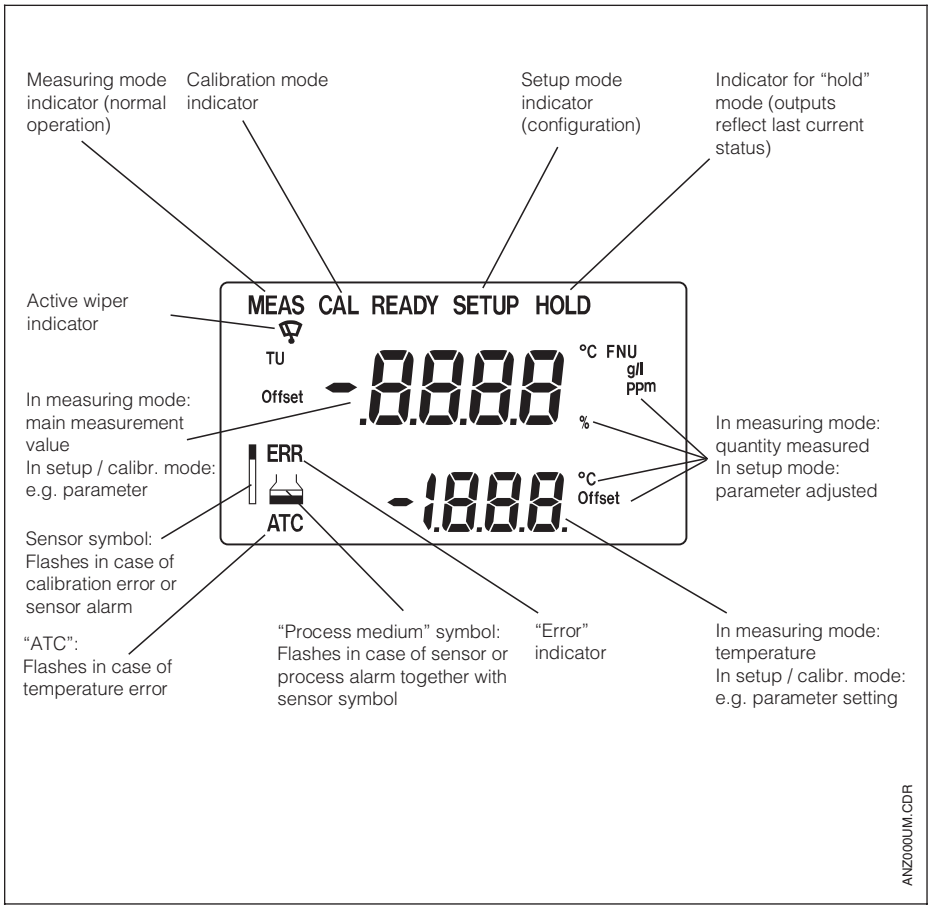


Fig. 6.2 Liquid crystal display of Liquisys CUM 252

6.3 Key functions

CAL

Quick calibration
Press the CAL key and enter the access code for quick calibration (11) to directly access the calibration mode.

E

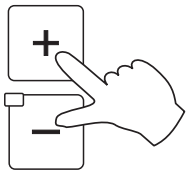
Setup
After pressing the E key and entering the setup code (22), the instrument switches to the setup mode. The E key is further used for:

- selecting the individual functions in setup mode
- saving the data entered in setup mode
- starting calibration

\+

In measuring mode: Relay / wiper operation in “manual” mode.
In setup mode: Function group selection, setting of parameters and numerical values (the setting speed increases when the key is held down).

\−



Note:

Press both keys simultaneously to jump back to the measuring mode.

REL.1
REL.2

Displays the limits set for the relays in “auto” mode,
switches between relay 1, relay 2 and wiper in “manual” mode.

Toggles the relays and the wiper between the “auto” and “manual” modes.

6.4 Operating concept

Operating modes

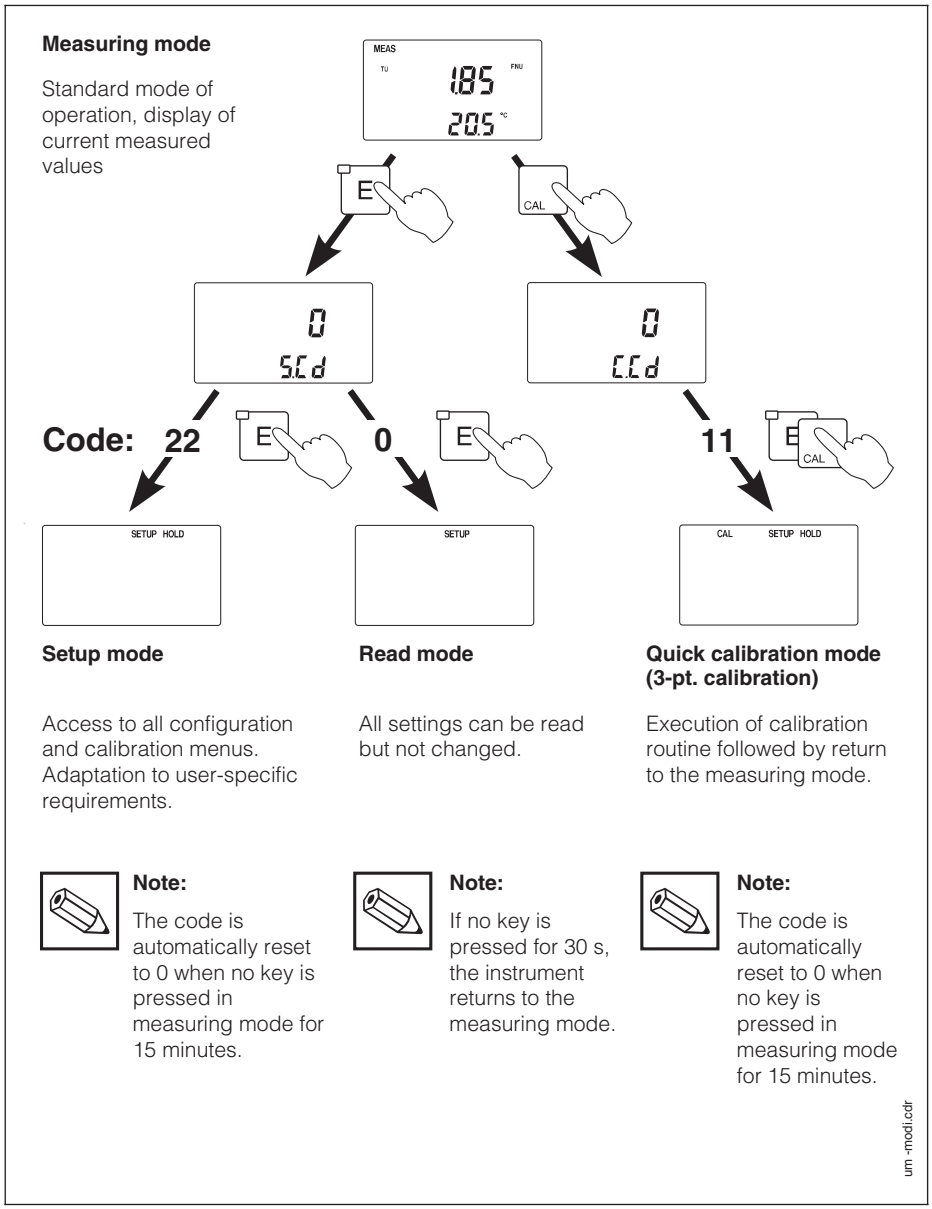


Fig. 6.3 Description of the four operating modes

Menu structure

The configuration and calibration functions are arranged in a menu structure by function groups.

Note:

See the fold-out back page of these operating instructions for an overview of the Liquisys menu structure.

- The function groups are selected in the setup mode with the "**+**" and "**–**" keys.
- The "**E**" key is used to move from one function to the next within a function group.
- The "**+**" and "**–**" keys are used for option selection and editing. Selections must be confirmed by pressing the "**E**" key.
- Pressing the "**+**" and "**–**" keys at the same time terminates programming and accepts the changes made.

Note:

If a change is made but not confirmed by pressing the "**E**" key, the previous setting is retained.

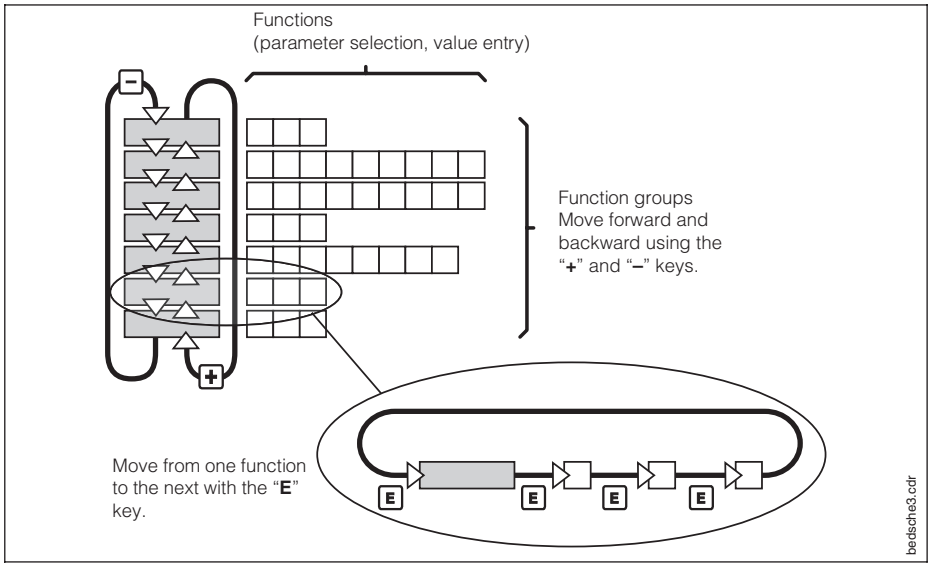


Fig. 6.4 Schematic representation of Liquisys menu structure

Hold function: “freezing” of outputs

The current output is “frozen” in the setup mode and during quick calibration, i.e. the last current value is constantly output. The display shows the “HOLD” message. During automatic operation, all contacts will go to their normal positions. Any alarm delay accumulated will be reset to “0”. This function can also be activated externally via a contact input (see chapter 4.4, “Connection”).

Note:

If the hold function is to remain active even after a power failure, the hold contact input is to be used.

6.5 Operation example

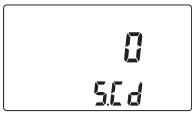
Note:

Cf. menu structure on fold-out back page.

Supposing the limit value for relay 2 were to be set to 120 FNU as the switching point using the min. function, you would proceed as follows:

E

Select the “Setup Code” field (S.Cd = Setup Code).



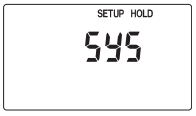
\+

−

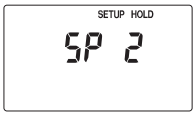
Enter code 22 to access the configuration mode.

E

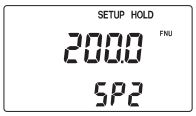
Confirm the code.
The instrument is now in setup mode, and the first function group, “SYS” (system configuration), is selected.
The hold function is active.



Select function group “setpoint 2” (SP 2).

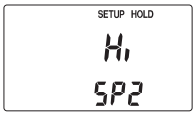


Select the “Set Limit” function.

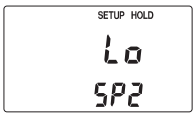


Change the setting, e.g. from 200.0 FNU to 120.0 FNU.

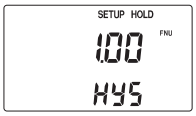
Confirm the entry.
The instrument advances to the next function.

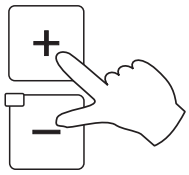


Change the factory setting of
“Hi” (upper limit = Max Function) to
“Lo” (lower limit = Min Function).



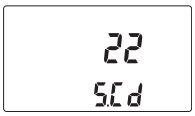
Confirm the setting.
The instrument advances to the next function
(HYS = Hysteresis Setting).

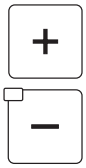




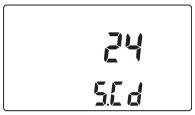
Return to the measuring mode by pressing the "**+**" and "**–**" keys at the same time.
The hold function is deactivated.

Select the "Setup Code" field.

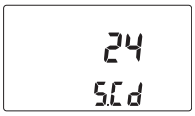




Change the code (to any number) to block the access to the configuration function.



Confirm the (blocking) code entry.
The instrument returns to the measuring mode.



6.6 Auto / manual operating mode

Auto mode

In this mode of operation, the relays are controlled by the measuring transmitter.

The limit settings can also be displayed in the measuring mode with the relay toggle key. When this key is pressed, limit 1 is displayed for 2 seconds, then limit 2 for another 2 seconds. Then the display reverts to the current measured value.

Switching to manual mode

The instrument is switched to the manual mode by pressing the Auto / Manual key.
In this mode, the relays and a wiper (if present on the sensor) can be switched on and off manually with the "**+**" and "**–**" keys.
The relay status is shown on the second line of the display.
Press the "REL 1 / REL 2" key to switch among relay 1, relay 2 and the wiper control function.

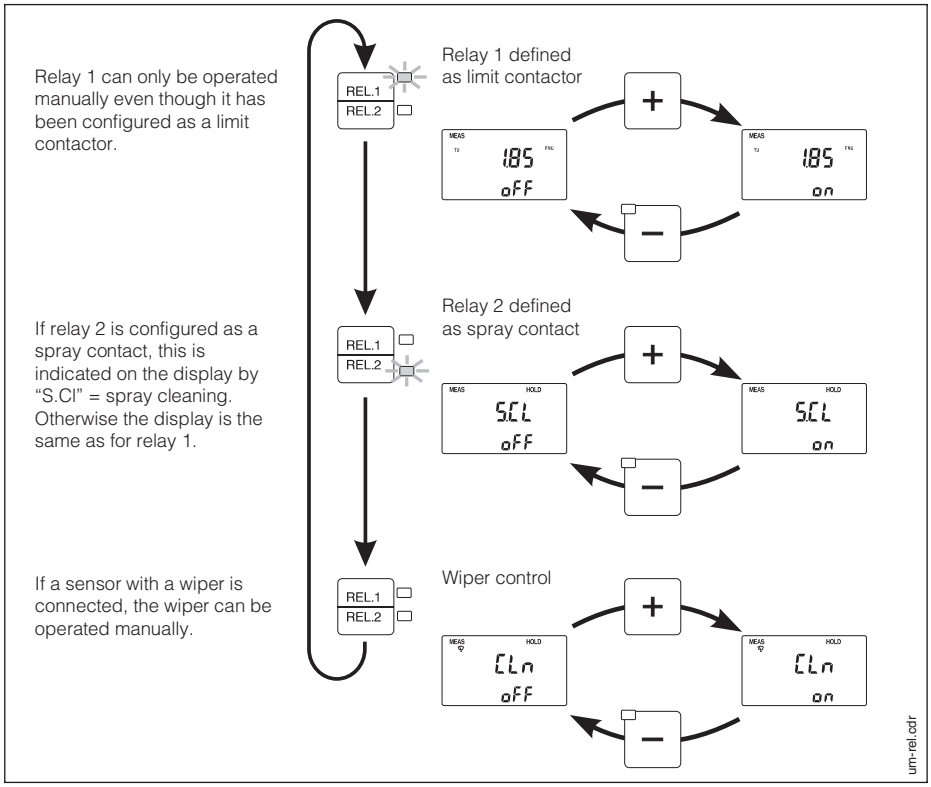


Fig. 6.5 Manual relay and wiper operation

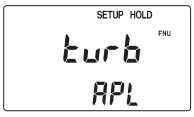
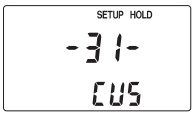
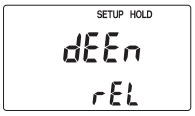
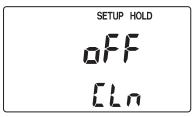
Note:

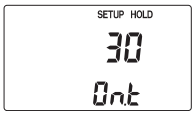
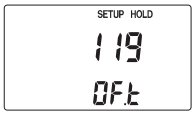
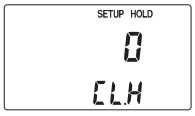
- The manual mode must be enabled by entering setup code "22".
- The current operating mode setting is retained even in the event of a power failure.
- The manual mode has precedence over an external hold request.

7 Instrument configuration

7.1 Measuring point configuration SYS

This function group is used to select the measured quantity (application range) and to configure the relay and cleaning functions.

Field	Selection / range	Display	Info
Selects the quantity measured and unit (turb = turbidity) (Conc = concentration = solids concentration) (APL = application = application range)	Turbidity: 0 ... 9999 FNU Concentration: 0 ... 3000/9999 ppm, 0 ... 3/300 g/l 0 ... 200% **Default:** 0 ... 9999 FNU		The measuring range depends on the sensor selected. The display shows the corresponding unit symbol.
Display of sensor type connected to measuring transmitter	CUS 31 or CUS 41 or no sensor connected		This setting is merely displayed and cannot be changed.
Selection of configuration for relay 1 and relay 2 (oFF = no function of relays) (LC = limit contact = limit contactor) (SC = spray cleaning = spray cleaning contact)	Relay 1 / relay 2 oFF LC LC LC SC — SC **Default:** LC.LC		If the relay configuration is “oFF”, “—.SC” or “LC.SC”, the function groups for limit 1 and/or 2 cannot be accessed.
Selects the normally closed / normally open relay function (rEL = relay function) (dEEn = deenergized = normally closed contact) (En = energized = normally open contact)	dEEn En **Default:** dEEn		This setting affects both relays.
Activation / deactivation of wiper control (on = wiper control on) (oFF = wiper control off) (CLn = cleaner = wiper)	on oFF **Default:** oFF		If the spray cleaning contact and wiper are deactivated, the following functions are not accessible.

Field	Selection / range	Display	Info
Entry of cleaning time for wiper and spray cleaning system (On.t = cleaning time = period during which wiper and/or spray cleaning system is/are activated)	3 ... 600 s **Default:** 30 s		These fields are not shown when the wiper and spray cleaning system are not activated. The measured value is not updated during cleaning. The wiper symbol is displayed during wiper cleaning.
Entry of pause between two cleaning intervals (OF.t = pause between the end and beginning of a cleaning interval)	1 ... 1440 min **Default:** 119 min		
Entry of HOLD time after cleaning (CL.H = clean HOLD = time after cleaning during which the HOLD state is to remain active)	0 ... 300 s **Default:** 0 s		

The figure below shows the relationships among cleaning time, pause (off time) and clean HOLD time.

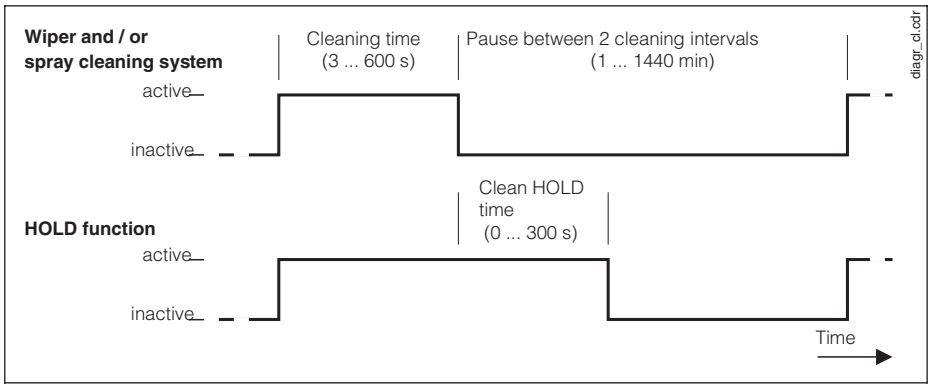


Fig. 7.1 Relationships among cleaning time, pause and clean HOLD time

7.2 Limit contactor configuration SP 1, SP 2

These function groups are used to configure the limit parameters.
Programming for limits 1 and 2 is the same and is therefore only described once.

Characteristic of limit contactors

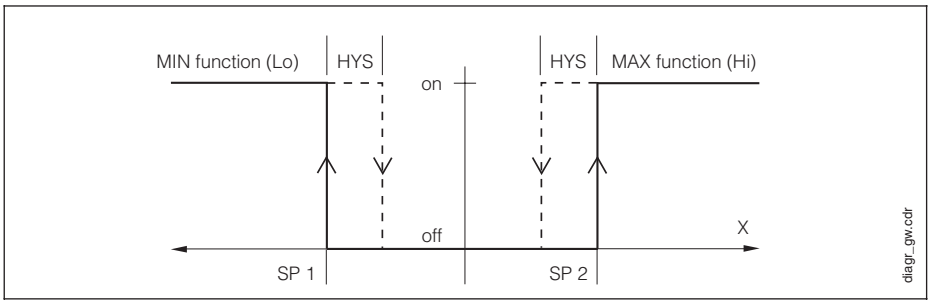
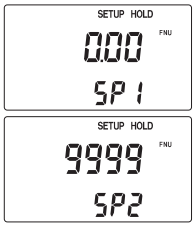
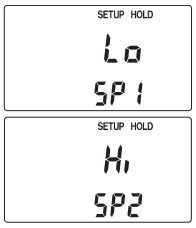
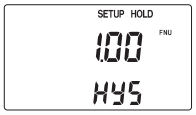
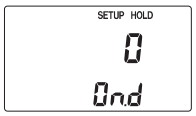
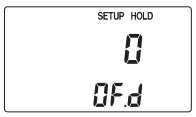
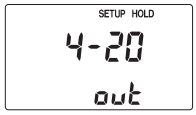
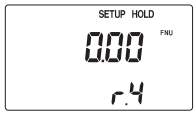
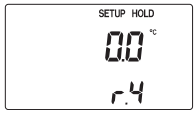
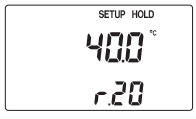


Fig. 7.2 Characteristic of limit contactors (HYS = hysteresis, SP = setpoint, x = measured value)

Field	Selection / range	Display	Info
Entry of limit for limit contactor 1 / 2, depending on measuring range selected, in FNU, ppm, g/l, % (SP1 = setpoint 1 = limit 1) (SP2 = setpoint 2 = limit 2)	0 ... upper range value **Default:** Limit 1: 0.00 FNU, ppm, g/l or % Limit 2: upper range value in FNU, ppm, g/l or %		
Defines the contact function (Lo = MIN contact, activated when value drops below limit) (Hi = MAX contact, activated when limit is exceeded) (SP 1 / 2 = limit 1 / 2)	Lo Hi **Default:** Limit 1: Lo Limit 2: Hi		All possible combinations of the two contacts (Lo/Lo, Lo/Hi, Hi/Lo and Hi/Hi) can be selected.
Defines the hysteresis for limit contactor 1 / 2 in FNU, ppm, g/l or % depending on measured quantity selected See figure 7.1 for effect (HYS = hysteresis)	0.00 ... 99.99 FNU 0.00 ... 99.99 ppm 0.0 ... 99.9 g/l 0.0 ... 99.9% **Default:** 1.0 FNU, 10.00 ppm, 1.0 g/l or 1.0% dep. on meas. quantity		
Sets the pickup delay for limit contactor relays (On.d = On delay = pickup delay)	0 ... 2000 s **Default:** 0 s		
Sets the dropout delay for limit contactor relays (OF.d = Off delay = dropout delay)	0 ... 2000 s **Default:** 0 s		

7.3 Current output range selection rng

This function group is used to determine the range for the current output(s).

Field	Selection / range	Display	Info
Toggles the lower current output limit between 0 and 4 mA (out = current output)	0 – 20 mA 4 – 20 mA **Default:** 4 – 20 mA		
Current output 1: Entry of turbidity or solids concentration value for 0 or 4 mA (depending on lower range setting) (r. 0 = value for 0 mA with 0–20 mA) (r. 4 = value for 4 mA with 4–20 mA)	0 ... 9999 FNU 0 ... 9999 ppm 0 ... 300 g/l 0 ... 200% depending on meas. range selected **Default:** 0.00 FNU; 0.00 ppm 0.0 g/l; 0.0%		Difference between 0/4 and 20 mA values must be at least Δ0.1 FNU, Δ10 ppm, Δ1 g/l or Δ0.1%.
Current output 1: Entry of turbidity or solids concentration value for 20 mA (r.20 = value for 20 mA)	0 ... 9999 FNU 0 ... 9999 ppm 0 ... 300 g/l 0 ... 200% depending on meas. range selected **Default:** 9999 FNU; 9999 ppm; 300.0 g/l; 200.0%		
Current output 2 (option): Entry of temperature value for 0 or 4 mA (depending on lower range setting)	Temp. measurement: –5.0 ... +70 °C **Default:** 0 °C		°C symbol appears on display. Difference between 0/4 and 20 mA values must be at least 10% of MR, i.e. 7.5 °C.
Current output 2 (option): Entry of temperature value for 20 mA.	Temp. measurement: –5.0 ... +70 °C **Default:** 40 °C		

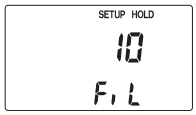
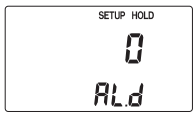
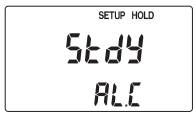
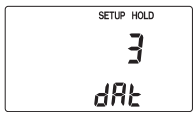
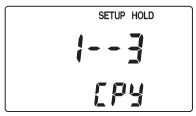
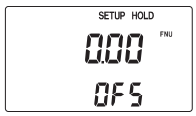
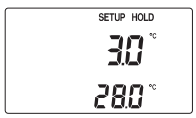
Note:

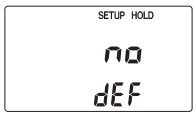
Falling assignments are possible (e.g. 4 mA → 100 FNU, 20 mA → 50 FNU).
The difference must not be less than the values specified in the table.

If outside the display range, the message “Ur” (underrange) or “Or” (overrange) appears on the display.

7.4 General instrument configuration CONF

This function group is used for general instrument configuration settings.

Field	Selection / range	Display	Info
Entry of filter time T of the floating measured value filter with PT1 behaviour, step response: $k\cdot(1 - e^{-t/T})$ (fiL = filter time)	0 ... 120 s **Default:** 10 s		
Determines the alarm delay between the violation of a limit and the activation of the alarm relay. (AL.d = alarm delay)	0 ... 2000 s **Default:** 0 s		
Defines the alarm relay as a steady or fleeting contact. (StdY = steady contact) (fLEt = fleeting contact) (AL.C = alarm contact)	StdY FLEt **Default:** StdY		If set to "fleeting contact", closing time is approx. 1 s.
Selection of calibration data set for measured quantity selected. (dAt = data set)	1 ... 3 **Default:** 3		See explanations below table.
Copy function used to copy a data set to another storage location. (CPY = copy)	1 — 2 1 — 3 2 — 3 3 — 2 **Default:** no		See explanations below table.
Entry of a turbidity offset value to be added to the measured turbidity value. (OFS = offset)	–99.99 ... 99.99 FNU –99.99 ... 99.99 ppm –99.9 ... 99.9 g/l –99.9 ... 99.9% **Default:** 0.00		If an offset is defined, the "Offset" message is displayed in measuring mode. The value shown is the meas. value plus the offset.
Entry of a temperature offset value to be added to the temperature value. The sum of the offset and measured value appears on the 2nd display line.	–5.0 ... +5.0 °C **Default:** 0.0 °C		

Field	Selection / range	Display	Info
Use this function to restore the factory settings for all transmitter functions. (no = do not restore) (YES = restore) (dEF = defaults = factory settings)	no YES **Default:** no		

Warning:
All user settings are lost if the instrument is reset to the factory default settings!
This includes the settings in the other function groups!

Note:

The fields for entry of the two offset values are only accessible when a sensor is connected.

Administration of calibration data sets of CUM 252 transmitter

Three calibration data sets can be selected for each application range (fNU, ppm, g/l, %). Of these three data sets (sample characteristics), 1 or 2 are programmed at the factory depending on the application range; these cannot be modified (read only). The others are assigned standard characteristics at the factory which can be adapted by the user (3-pt. calibration / 1-pt. adaptation / reflection adaptation).

	FNU	ppm	g / l	%
Data set no. 1	formazine **(read only)**	SiO_2 **(read only)**	activated sludge **(read only)**	thoroughly digested sludge **(read only)**
Data set no. 2	formazine (editable)	kaolin **(read only)**	activated sludge (editable)	thoroughly digested sludge (editable)
Data set no. 3	formazine (editable)	SiO_2 (editable)	activated sludge (editable)	thoroughly digested sludge (editable)

Note:

The data sets are stored in the sensor, i.e. these data are not lost when the transmitter is replaced. The data are automatically read into the transmitter (according to selection).

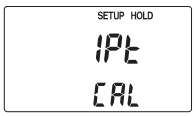
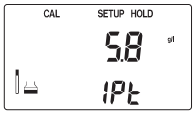
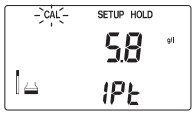
7.5 Calibration adaptation FIt

This function group is used to adapt the current calibration characteristic following completion of the 3-point calibration.

1-point adaptation for samples with elevated concentrations

Adaptation of characteristic in g/l or % measuring range to any concentration with sensor immersed in sample (1-point adaptation), e.g. in case of a change in sludge condition.

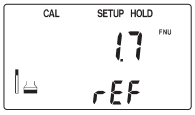
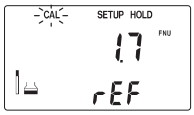
In this case, the sensor is immersed in a new sample of a known turbidity or known solids concentration, and the correct turbidity/solids concentration value is entered.

Field	Selection / range	Display	Info
Selection of 1-point adaptation method (1Pt = 1-point adaptation) (rEFL = reflection adaptation)	1Pt rEFL **Default:** 1Pt		
1-point adaptation: Place sensor in sample and adjust to correct value with “+” and “–”.	0 ... 3/300.0 g/l, 0 ... 200.0%		If rEFL has been selected in the 1st field, these fields are not shown. “CAL” flashes on the display during calculation.
Press “E” to enter the calibration value and start the computation of the correction.			

Reflection adaptation for low-turbidity samples

Adaptation to an installation condition where reflection on pipeline or assembly walls at *low turbidities* is possible, causing incorrect measurement results (minimum pipe diameter with reflecting inside pipe wall should be DN 100 or sensor should be installed at appropriate distance from wall).

In the case of reflection adaptation, either a reflection-free 3-point calibration must be performed beforehand, i.e. the sensor is calibrated in a sufficiently large or blackened vessel without the assembly such that reflection of the calibration vessel can be excluded, or the factory calibration is used. Subsequently the sensor is installed in the assembly/pipeline and exposed to the medium flow. The actual turbidity value determined in the laboratory is entered in the transmitter, thereby adjusting the characteristic.

Field	Selection / range	Display	Info
Selection of reflection adaptation method (1Pt = 1-point adaptation) (rEFL = reflection adaptation)	1Pt rEFL **Default:** 1Pt		
Reflection adaptation: sensor is installed in assembly and medium (clean water) flows through assembly. The actual turbidity value determined in the lab is adjusted with “+” and “–”.	0 ... 2.00 FNU, 0 ... 2.00 ppm, only zero calibration (no editing) is possible for g/l and %		If 1Pt has been selected in the 1st field, these fields are not shown. “CAL” flashes on the display during calculation.
Press “E” to enter the calibration value and start the computation of the correction.			

Note:

Both the 1-point adaptation and the reflection adaptation are based on a 3-point calibration. Any change in this calibration resets the reflection adaptation to an initial value of “zero”. The reflection adaptation can be performed repeatedly. It is only reset by another 3-point calibration.

7.6 3-point calibration of transmitter CAL 3PT

This function group is used to calibrate the transmitter.

Calibration overview

The calibration of the measuring chain is a 3-point calibration in all cases, i.e. the entire calibration characteristic of the measuring chain for the process medium is computed by the CUM 252 transmitter based on three medium samples of known turbidity or known solids concentration.
The calibration should be performed in the turbidity or solids concentration range in which you intend to measure. To simplify the 3-point calibration, we recommend preparing the three samples required for calibration by dilution of a process medium sample. Usually, very good calibration results are obtained with concentrations of 10%, 33% and 100% of the original concentration. The transmitter will propose these concentrations for the 3-point calibration.
An added advantage of this procedure is that only the turbidity or solids concentration value of the original sample needs to be determined in the laboratory.

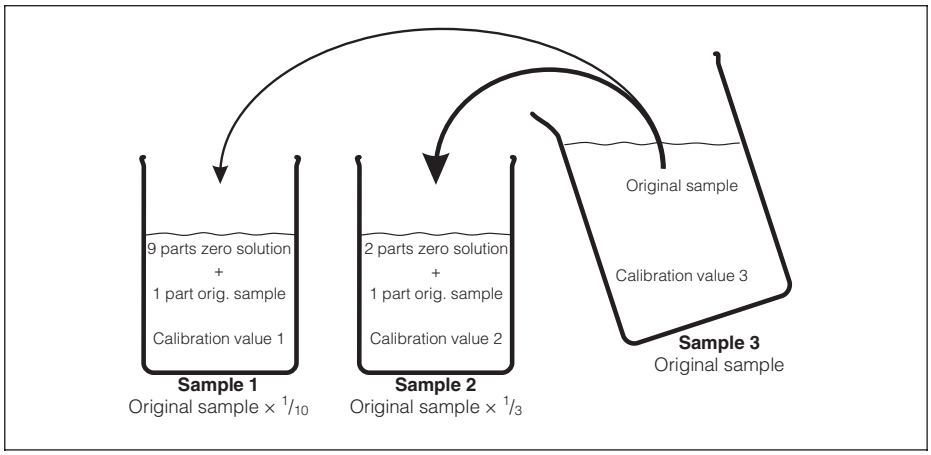


Fig. 7.3 Preparation of samples for 3-point calibration

However, this procedure is not a mandatory prerequisite for calibration. You can also take three different samples of the process medium and determine their turbidity or solids concentration values. The following conditions must be met:

- The calibration must be performed in ascending order of concentration.
- The measured values of the three samples must differ by at least 10%.
- Clean water can be used as the zero solution in the case of elevated solids concentrations.

Caution:

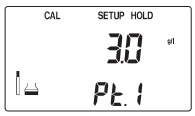
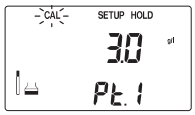
Sludge samples tend to sediment. It is therefore important to stir the sample well, possibly even during calibration.

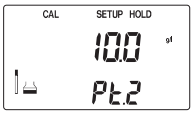
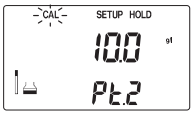
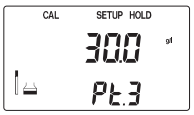
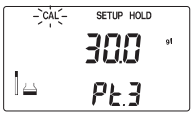
Calibration options

The CUM 252 transmitter offers several options for 3-point calibration in this function group. In the first field of the function group, you can select among three calibration functions:

- **Selection "SEnS":** (function 1)
  3-point wet calibration with three samples of known or estimated concentration.
- **Selection "Edit":** (function 2)
  Entry of accurate concentration values of the three samples used for wet calibration when the correct concentration values of the samples are not known at calibration time.
- **Selection "Corr":** (function 3)
  If the wet calibration with the recommended procedure (dilution of an original sample to precisely $^1/_3$ and $^1/_{10}$ of the original sample concentration) has been performed and the exact concentration of the original sample is unknown, only the exact concentration value of the original sample needs to be entered for this calibration function. The concentration values of the diluted samples are then computed automatically.

3-point wet calibration (function 1)

Description	Display	Info
Select function "SEnS" in first field of function group, confirm with "E".		
Immerse the sensor in the sample with the lowest concentration, preferable $^1/_{10}$ of original sample concentration, and use "+" and "–" to enter the known or estimated concentration value. (Example: concentration of original sample: 30 g/l Entry: $^1/_{10} \cdot 30$ g/l = 3.0 g/l)		Adequate distance from calibration vessel wall is required! Assure even solids distribution, particularly for high solids concentrations. Stir the sample before calibration if necessary! The max. concentration value permissible is 80% of the upper measuring range value.
Start the calibration with the "E" or "CAL" key. The "CAL" symbol flashes. The display advances to the 2nd calibration point when the measured value has been registered.		When an invalid calibration value is entered, the symbols "Err" and "Sensor" flash on the display. Repeat entire calibration sequence!

Description	Display	Info
Immerse the sensor in the sample with the medium concentration, preferably $^1/_3$ of original sample concentration. A value of 3.3·calibration value1 is suggested on the display. If the sample has been prepared accordingly, the calibration procedure can be started with “E”. If another concentration or dilution of the original sample has been chosen, enter the correct value with “+” and “–”.		Concentration values between 1.1·calibration value1 and 90% of the upper measuring range value are permissible.
Start the calibration with the “E” or “CAL” key. The “CAL” symbol flashes. The display advances to the 3rd calibration point when the measured value has been registered.		When an invalid calibration value is entered, the symbols “Err” and “Sensor” flash on the display. Repeat entire calibration sequence!
Immerse the sensor in the sample with the highest concentration, i.e. preferably the original sample. A value of 10·calibration value1 is suggested on the display. If the sample has been prepared accordingly, the calibration procedure can be started with “E”. If another concentration or dilution of the original sample has been chosen, enter the correct value with “+” and “–”.		Concentration values between 1.1·calibration value2 and the upper measuring range value are permissible.
Start the calibration with the “E” or “CAL” key. The “CAL” symbol flashes. The display returns to the operating function in question when the measured value has been registered.		When an invalid calibration value is entered, the symbols “Err” and “Sensor” flash on the display. Repeat entire calibration sequence!

Caution:

- The characteristic computed during the 3-point calibration is stored in the currently selected calibration data set (see function group “ConF”, General instrument settings). If a read-only calibration data set is selected, calibration is not possible.
- If the computed relative calibration results (function group data-Cal) differ by more than 50% from the reference value of 100%, a warning is issued (“sensor” symbol flashes). However, the calibration results can be entered anyway by confirming them with “E”.
- If the computed results are outside the permissible limits, a calibration error is indicated (“Err” and “sensor” symbol flashes). The calibration is rejected.

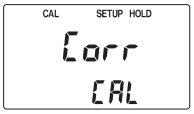
Entry of exact concentration values (function 2)

Description	Display	Info
Select function “Edit” in first field of function group, confirm with “E”.	CAL SETUP HOLD Edit CAL	
Enter concentration value of sample with lowest concentration with “+” and “–”. Accept the value with “E”. The display advances to let you enter the 2nd calibration value.	CAL SETUP HOLD 3.0 g/l Pt.1	A maximum concentration value of up to 80% of the upper measuring range value is permissible.
Enter concentration value of sample with medium concentration with “+” and “–”. Accept the value with “E”. The display advances to let you enter the 3rd calibration value.	CAL SETUP HOLD 10.0 g/l Pt.2	A concentration value between 1.1·calibration value1 and 90% of the upper measuring range value is permissible.
Enter concentration value of sample with highest concentration with “+” and “–”. Accept the value with “E”. The display returns to the operating function in question.	CAL SETUP HOLD 30.0 g/l Pt.3	A concentration value between 1.1·calibration value2 and the upper measuring range value is permissible.

Caution:

The characteristic computed during 3-point calibration is stored in the currently selected calibration data set (see function group “ConF”, General instrument settings). If a read-only calibration data set is selected, calibration is not possible.

Entry of exact concentration value for original sample (function 3)

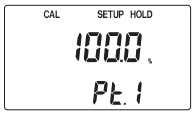
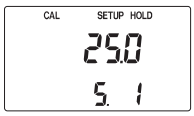
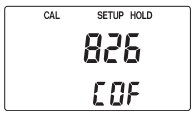
Description	Display	Info
Select function “Corr” in first field of function group, confirm with “E”.		
Entry of concentration value of undiluted original sample with “+” and “–”. Accept the value with “E”.		A concentration value between 0 and the upper range value is permissible.

7.7 Calibration result data dAtA CAL

After calibration, the characteristics of the current calibration data set are displayed in this function group and can be read out.

Relative calibration results

The relative calibration results displayed in this function group provide information on the quality of the previously performed calibration. If the 3-point calibration is good, the difference between the three relative calibration results for calibration points 1, 2 and 3 should not exceed 50%.

Field	Selection/range	Display	Info
Display of relative calibration result for calibration point1 (Pt.1 = calibration point1)	10.0 ... 500.0%		
Display of relative calibration result for calibration point2 (Pt.2 = calibration point2)	10.0 ... 500.0%		
Display of relative calibration result for calibration point3 (Pt.3 = calibration point3)	10.0 ... 500.0%		
Display of calibration characteristic parameter “slope1” (s1 = slope1)	2.0 ... 999.9 1000 ... 3000		Only exists for g/l and %.
Display of calibration characteristic parameter “slope2” (s2 = slope2)	2.0 ... 999.9 1000 ... 3000		
Display of factor to be used for conversion to user unit (COF = conversion factor)	1 ... 9999		

8 Diagnostics

Warning:

Alarm signalling devices must have an independent power supply to permit alarm signalling in the event of a power failure!

8.1 Limit alarm

An alarm condition exists when the measured value
– exceeds the upper limit or
– stays below the lower limit
for a period which exceeds the alarm delay setting specified in the “ConF” menu.

Effect:
- Alarm LED is on
- Alarm contact (41 / 42) is closed

8.2 Errors

Editing error

If values outside of the permissible value range are entered when editing a configuration setting, the “ERR” symbol on the display flashes briefly.

Temperature error

A temperature error is signalled as a sensor error.

Effect:
- Alarm LED is on
- Alarm contact (41 / 42) is closed
- “ERR” symbol is displayed

System errors

Internal communication errors lead to the display of a system error. The message “Err.” and a one-digit error code flash on the main parameter display field.

1: EEPROM error
2: Internal communication error

Effect:
- Alarm LED is on
- Alarm contact (41 / 42) is closed
- Hold function is activated

If the system error cannot be eliminated by switching the power supply to the instrument off and back on, the instrument must be sent to the competent Endress+Hauser sales agency for servicing.

8.3 Possible faults in measuring mode and elimination

Test	Remedy
No display, no sensor response	
Transmitter supplied with power?	Apply mains voltage
Sensor connected to transmitter?	Connect sensor
Considerable fluctuation of display value	
No homogeneous sample/medium flow	Position sensor to optimise medium flow
Air bubbles in system	Increase measured value filter
	Pressurise medium to dissolve air bubbles
	Use an assembly with an integrated gas bubble elimination feature
Installation in pipeline: pipe filled only partially	Install in a vertical pipe with upward flow
Electrical screen	Connect screen
Display value too high	
Sensor soiled	Clean
Incorrect calibration	Recalibrate
	Reflection (installation) adaptation required
Measured value remains unchanged	
Sensor soiled	Clean
Measuring range exceeded	Select another measured quantity
	Dilute sample
Calibration not possible	
No sensor connected	Connect sensor
Incorrect code entry	Use correct code
“Read only” calibration data set selected	Select another calibration data set
Calibration solution not suitable	Use correct dilution or enter appropriate concentration values

9 Maintenance and service

9.1 Cleaning

Use a soft cloth and soap solution to clean the front of the field housing and the membrane keypad.

Caution:

Even if the instrument becomes very dirty (e.g. from paint or varnish) do not use agressive cleaning agents such as thinner or acetone!

9.2 Repair

Replacing a blown fuse

Disconnect the instrument from the power source. Loosen the four screws on the connection space cover and remove the cover. The fuse is located in the upper right corner of the connection space in the black, upright fuse holder. To change the fuse, loosen the fuse holder cap (bayonet lock), replace the fuse and reinstall the cap.

Further repairs

Further repairs may only be carried out directly by the manufacturer or through the Endress+Hauser service organisation. An overview of the Endress+Hauser service network can be found on the back cover of these operating instructions.

10 Appendix

10.1 Technical data

Turbidity and solids concentration measurement with sensor CUS 31, CUS 41

Display and measuring range
- Sensor CUS 31 . . . . . 0 ... 9999 FNU, 0 ... 3000 ppm, 0 ... 3 g/l, 0 ... 200%
- Sensor CUS 41 . . . . . 0 ... 9999 FNU, 0 ... 9999 ppm, 0 ... 300 g/l, 0 ... 200%

Measured value resolution
- Sensor CUS 31 . . . . . auto range
- Sensor CUS 41 . . . . . auto range

Measurement deviation[1], display . . . . . max. 0.5% of MR
Reproducibility[1] . . . . . max. 0.2% of MR
TU signal input . . . . . digital
TU signal output
- Current range . . . . . 0 / 4 ... 20 mA
- Measurement deviation . . . . . max. 0.75% of MR
- Load . . . . . max. 500 Ω
- Output range . . . . . adjustable, Δ 0.1 FNU, Δ 1g/l, Δ 0.1%, Δ 10 ppm

Temperature measurement

Temperature sensor . . . . . NTC, 30 kΩ at 25 °C
Display range . . . . . –5.0 ... +70 °C
Measured value resolution . . . . . 0.1 °C
Measurement deviation[1], display . . . . . 1.0% of MR
Temperature signal output (optional)
- Current range . . . . . 0 / 4 ... 20 mA, galvanically separated
- Measurement deviation[1] . . . . . max. 1.25% of URV
- Load . . . . . max. 500 Ω
- Output range . . . . . adjustable, Δ 10 ... Δ 100% of URV

Limit contactor

Limit adjustment range . . . . . 0 ... 9999 FNU, 0 ... 9999 ppm, 0 ... 300 g/l, 0 ... 200%
Switching hysteresis . . . 0.00 ... 99.99 FNU, 0.00 ... 99.99 ppm, 0.0 ... 99.9 g/l, 0.0 ...99.9%
Pickup / dropout delay . . . . . 0 ... 2000 s
Contact type (switchable) . . . . . MIN / MAX

[1] acc. to DIN IEC 746 part 1, for nominal operating conditions

Alarm function

Alarm delay	0 ... 2000 s
Contact function (switchable)	steady contact / fleeting contact

Electrical data and connections

Voltage supply, AC	24 / 100 / 115 / 200 / 230 V AC +10 / –15%
Voltage supply, DC	24 V DC +20 / –15%
Frequency	48 ... 62 Hz
Power consumption	max. 7.5 VA
Auxiliary voltage output	
Output voltage	15 V ± 0.6 V
Output current	max. 30 mA
Contact outputs	potential-free changeover contacts
Switching current	
With ohmic load (cos φ = 1)	max. 5 A
With inductive load (cos φ = 0.4)	max. 3 A
Switching voltage	max. 250 V AC, 30 V DC
Switching power	
With ohmic load (cos φ = 1)	max. 1250 VA AC, 150 W DC
With inductive load (cos φ = 0.4)	max. 500 VA AC, 90 W DC
Hold input	
Voltage	10 ... 50 V
Current consumption	max. 10 mA
Isolation voltage, signal output	max. 350 V_{rms}
Connection terminals	plug-in printed board terminals, 3, 5, 8 and 9 poles
Conductor cross section	max. 2.5 mm^2
Mains fuse	fine-wire fuse, medium time lag, 250 V / 1 A
Max. cable length	200 m

General technical data

Measured value display	LC display, two lines, 4 and 3½ digits, with status indicators
Electromagnetic compatibility (EMC)	
Emission	acc. to EN 50081-1:1992
Immunity	acc. to EN 50082-2:1995
Overvoltage (lightning) protection	acc. to ENV 50142:1994
Nominal operating conditions	
Ambient temperature	–10 ... +55 °C
Relative humidity	10 ... 95%, non-condensing
Limit operating conditions	
Ambient temperature	–20 ... +60 °C
Storage and transport temperature	–25 ... +65 °C

Physical data

Dimensions of field housing (H × W × D)	247 × 170 × 115 mm
Weight	max. 1.8 kg
Protection type of field housing	IP 65
Materials	
Front membrane	polyester, UV-resistant
Field housing	ABS PC Fr

10.2 Index

Display	Abbreviation for	Meaning	Page
ALC	alarm contact	Alarm contact	30
ALd	alarm delay	Alarm delay	30
APL	application	Application range	25
CAL	calibration	Function group Calibration	32-37
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Corr	correction	Correction selection, point 3	34, 37
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CUS		Sensor variant	25
dAt	data set	Data set	30
dAtA	data	Function group Calibration result data	37
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Display	Abbreviation for	Meaning	Page
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1Pt	1 point	1-point adaptation	32
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LC.SC	limit contact.spray cleaner	Relay selection, limit contactor and spray cleaning contact	25
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OF.d	off delay	Dropout delay	28
oFF	off	Limit contactor off, wiper off	24, 25
OFS	offset	Turbidity offset	30
OF.t	off time	Time between two cleaning steps	26
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rEF	reflection	Reflection adaptation	33
rEL	relay	Relay function	25
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r.20	range 20 mA	Display value at 20 mA (0/4...20 mA)	29
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SCL	spray cleaner	Spray cleaning	24
SEnS	sensor	Wet calibration	34
SP 1	setpoint 1	Limit (setpoint) 1	27, 28
SP 2	setpoint 2	Limit (setpoint) 2	22, 27, 28
Stdy	steady	Steady contact	30
SYS	system	Function group Measuring system configuration	21, 25
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turb	turbidity	Turbidity in FNU	25

Display	Abbreviation for	Meaning	Page
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Ur	under range	Below display range	29
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-31-		Sensor CUS 31	25
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--.SC		Relay 1 off and spray cleaning contact on	25
----		Sensor unknown Sensor fault	25

Appendix

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Menu

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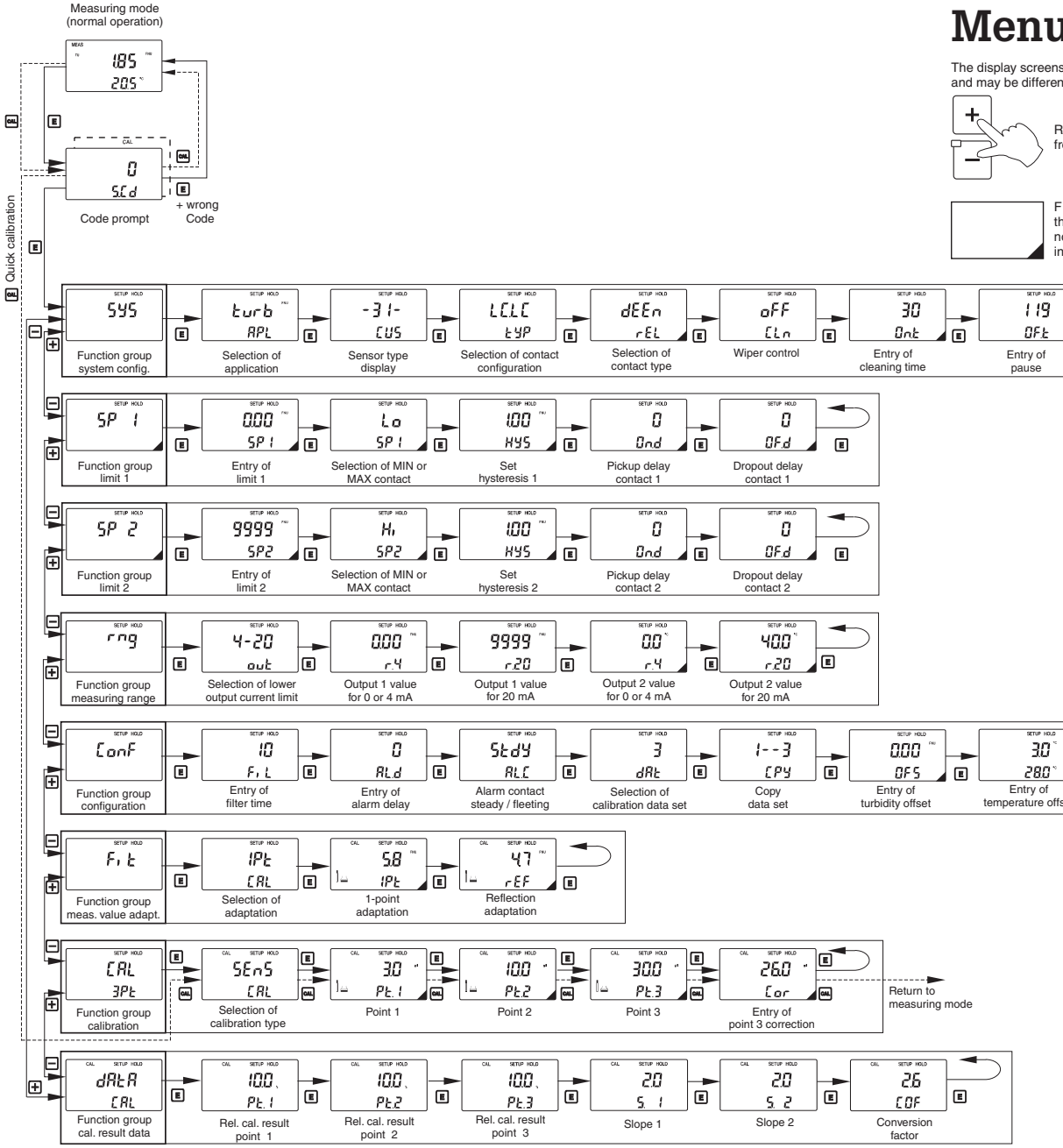

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