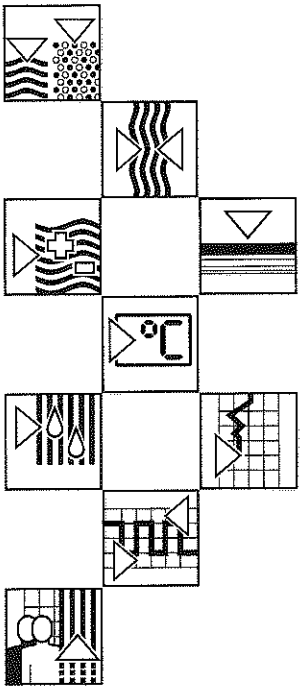
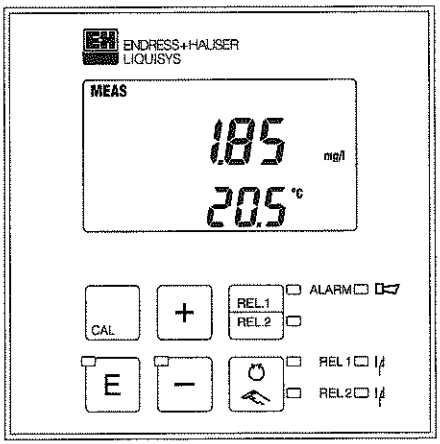
BA 164C/07/en/07.97
No. 50085469
Software version 1.00 or later

liquisys COM 221 Transmitter for Dissolved Oxygen with Limit Contacter

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?

Troubleshooting

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 measuring transmitter Liquisys COM 221 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 COM 221 is a field-tested and reliable measuring instrument for determining the dissolved oxygen content. It is equipped with a current output 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 can lead to unsafe and improper functioning of the measuring system.
- The instrument must only be used as a panel-mounted device or in conjunction with the optional field housing.

Installation, start-up, operation

The Liquisys COM 221 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 or temperature sensor failure 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. 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 only valid, however, for an instrument connected according to the notes in these installation and operating instructions.

3 Description

3.1 Areas of application

The measuring transmitter Liquisys COM 221 is suitable for measuring tasks in the following areas of application:

- Sewage treatment plants
- Waste water treatment
- Water treatment and water monitoring
- Drinking water
- Surface water (rivers, lakes, sea)
- Fish farming

3.2 Measuring system

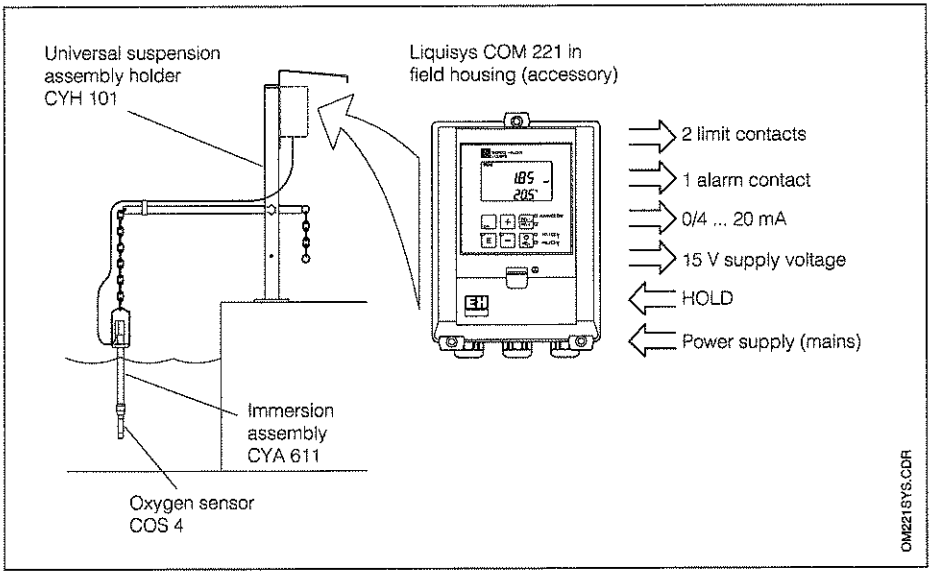


Fig. 3.1 Example of a complete measuring system

A typical measuring system comprises:

- an oxygen sensor COS 4 with an integrated NTC temperature sensor
- an immersion, flow or retractable assembly
- a measuring cable extension (type CMK) with junction box VBM where necessary
- the Liquisys COM 221 measuring transmitter as a panel-mounted instrument or with the field housing (accessory)

3.3 Important features

- Measuring range 0 ... 20.00 mg O_2/l or 0 ... 200.0 % saturation (switchable)
- Temperature measuring range –9.9 ... + 60.0 °C
- Easy to read, two-line display
- Simple configuration with only three keys
- Configuration protected by access code
- Fast calibration using the "CAL" key
- Sensor Check System (SCS) for sensor and process monitoring
- Two switched outputs which can be configured as limit contacters
- One switched output for alarm signalling in cases of limit violation or SCS alarm
- One current output with selectable measurement range, switchable between 0 ... 20 or 4 ... 20 mA proportional
- Automatic "hold" function to "freeze" the current output and contacts during calibration and configuration
- "Hold" function can be controlled externally via a galvanically separated contact input using an auxiliary voltage

3.4 Instrument variants

Order code

Type

221 Panel-mounted instrument, 96 x 96 x 145 mm, ingress protection IP 54 (front)

Power supply

0 230 V, 50 / 60 Hz
1 115 V, 50 / 60 Hz
2 200 V, 50 / 60 Hz
3 24 V, 50 / 60 Hz
5 100 V, 50 / 60 Hz
9 Special version

Additional features

10 Base version
20 Moisture protection lacquering
99 Special version

COM 221 - ☐☐ ⇐ complete order code

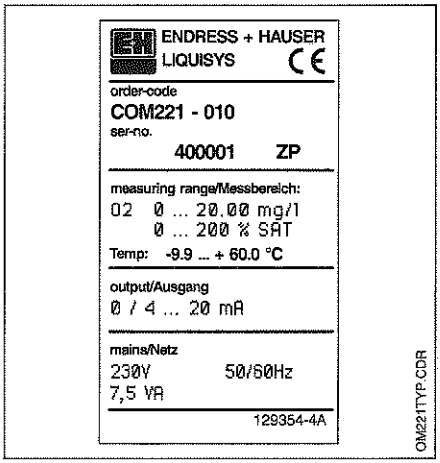


Fig. 3.2 Nameplate of Liquisys COM 221

By the order code on the nameplate of the instrument, you can identify the device variant and the mains supply type.

3.5 Accessories

Field housing

Type	Features	Order number
Field housing	For installation of a CPM/CLM/COM 221 Dimensions (HxWxD): 204 x 155 x 215 mm Ingress prot. IP 65, for wall / post mounting	50054413

Oxygen sensor

Type	Features	Areas of application
COS 4	Amperometric 2-electrode sensor in all-plastic housing with permanently attached cable, optional length 7 or 15 m, ingress protection IP 68, with integrated temperature sensor	Waste water treatment, drinking water, surface water, fish farming

Assemblies

Type	Features	Areas of application
CYH 101	Universal suspension assembly holder	Installation for immersed operation, e.g. in activated sludge basins or fish ponds
CYA 611	Immersion assembly	
COA 250	Flow assembly	Installation for flow operation, e.g. in water works or analytical cabinets
COA 461	Retractable assembly	Installation for in-line operation, e.g. in pipes or on basin walls

Cleaning systems

Type	Features	Areas of application
Chemoclean CYR 20	Programme sequencer for automatic control of cleaning cycles, user-definable weekly programme	For use in extremely soiled media
Chemoclean CYR 10	Injector with valves for drive water and cleaning agent	
Chemoclean COR 3	Spray head in conjunction with hanging or immersion assemblies for 1/2" hose connection, material: PVC	

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
- Identification card(s)

Included in delivery:

- Flat gasket
- Two tensioning screws for panel installation
- 3-, 9- and 14-pole terminal strips

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

Panel mounting of Liquisys COM 221

The instrument is fastened using the tensioning screws supplied with the instrument (see figure 4.1). The required mounting depth is approx. 175 mm.

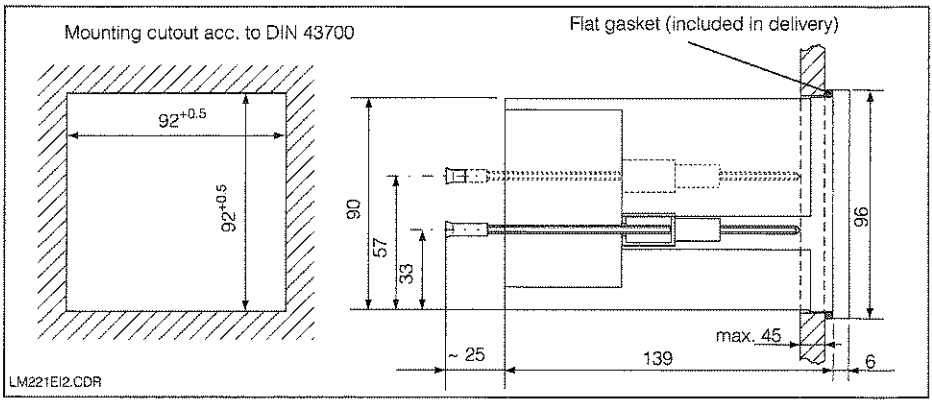


Fig. 4.1 Panel mounting of Liquisys COM 221

Wall mounting of Liquisys COM 221 with optional field housing

The brackets and screws for wall mounting are contained in the shipment. Mount the brackets onto the rear of the instrument for wall installation. The dimensions of the mounting holes are shown in figure 4.2.

Warning:

For installation in the field, weather protection cover VH3 is required (see mounting accessories). The protective cover is suitable for wall or post mounting.

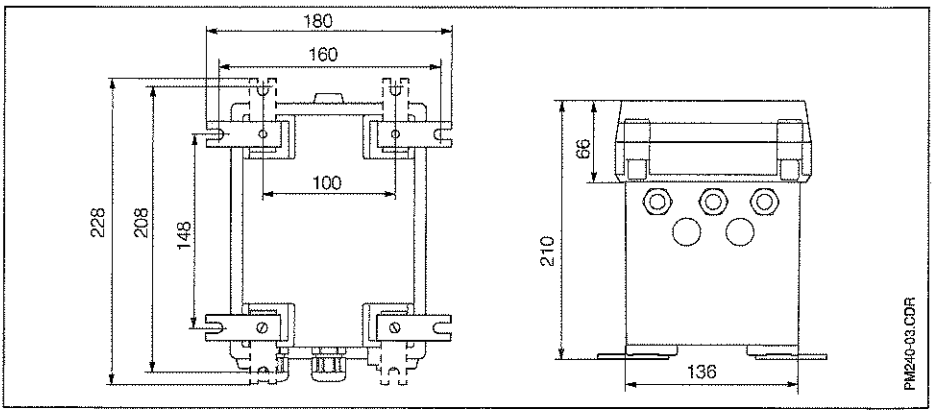


Fig. 4.2 Wall mounting of Liquisys COM 221 with optional field housing

Post mounting of Liquisys COM 221 with optional field housing

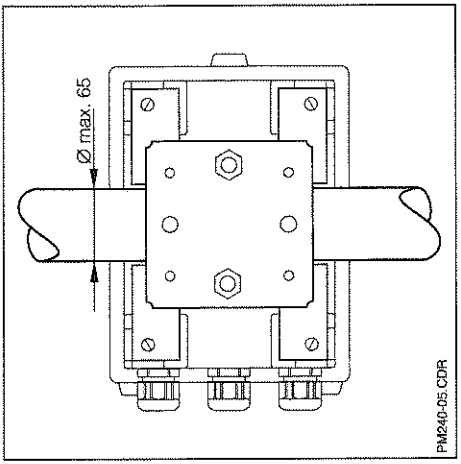


Fig. 4.3 Post mounting of Liquisys COM 221 with optional field housing

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 pipes. The maximum pipe diameter is 65 mm (see figure 4.3).

Mounting accessories

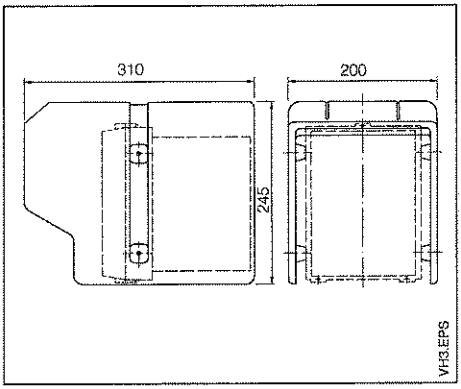


Fig. 4.4 Weather protection cover VH3

Weather protection cover VH3
Weather protection cover for installation on field housing.
Dimensions: 245 x 200 x 310 mm (H x W x D)
Material: plastic
Order no.: 50003254

Post mounting kit
Retrofit kit for mounting the field housing on horizontal of vertical pipes (max. Ø 65 mm).
Material: galvanised steel
Order no.: 50003244

4.4 Connection

Warning:

- The connection to the mains may only be performed by properly trained 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.
- Live components can be touched through the vent slots in the housing and the openings on the rear of the housing. Do not insert tools, wires, etc., in these slots.

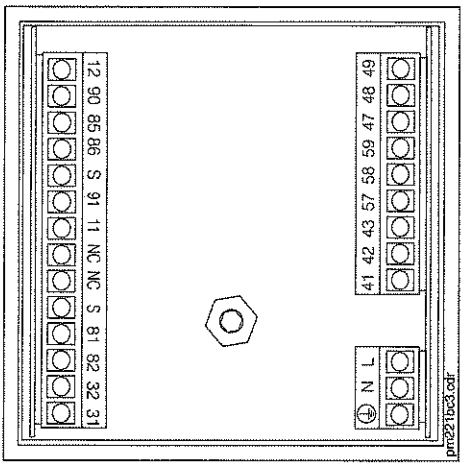


Fig. 4.5 Position and designations of the connections on the rear of the instrument

Instrument connections

Connections are carried out on the rear of the instrument

- for sensor connection, transmitter power supply, switched „hold" input and current output via the removable 14-pin terminal block,
- for limit contacts and alarm contact via the removable 9-pin terminal block,
- for the mains via the removable 3-pin terminal block.

The max. conductor cross section is 2.5 mm^2. See figure 4.6 for terminal assignments.

Connection diagram

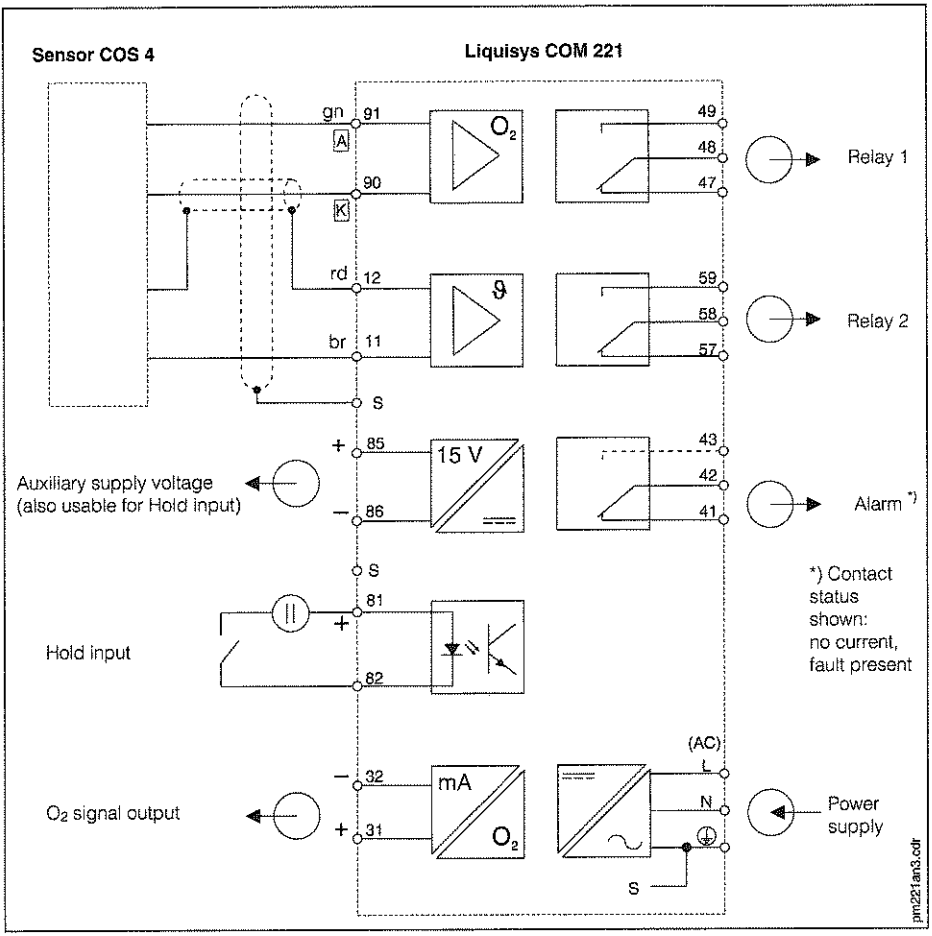


Fig. 4.6 Electrical connection of Liquisys COM 221

Liquisys COM 221
Connect the instrument according to figure 4.6.

Liquisys COM 221 in field housing
Introduce the connecting cables through the glands in the field housing. Connect the instrument according to figure 4.6. Slide the instrument into the housing, exerting a slight pulling force on the cables to pull them out. Tighten the cable glands. Install the front panel and tighten the screws with a hexagon socket wrench.

Connection of oxygen sensor COS 4

Oxygen sensors are connected via the special multicore measuring cable attached to the sensor. Should it become necessary to extend the measuring cable, use junction box VBM and measuring cable type CMK (not assembled).

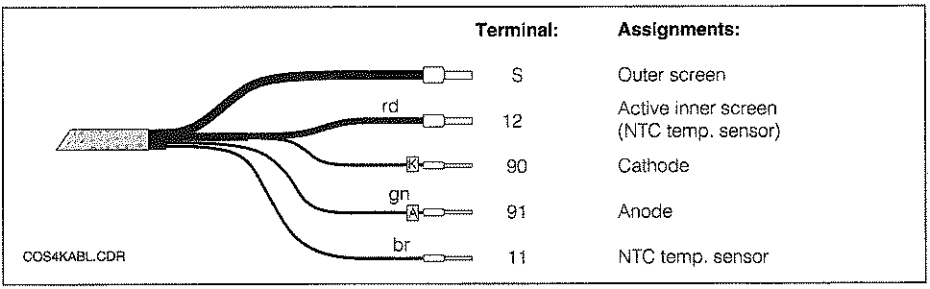


Fig. 4.7 Prepared sensor cable on COS 4

Warning:

Cable end sleeves 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: Aluminium painted; protection class: IP 65
Order no.: 50003987

Measurin cable CMK

Coaxial cable with two pilot wires and extra outer screen.
Order no.: 50005374

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

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

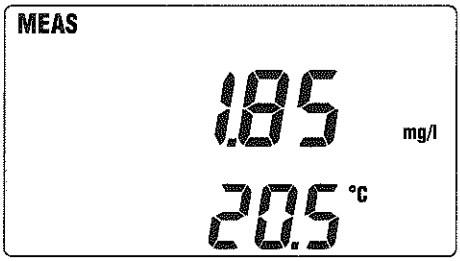


Fig. 5.1 Display after power-up and completion of self-test

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 maintained.

The controller relays can be operated manually for function checks, maintenance work, etc. See chapter 6.7, 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	Oxygen concentration in mg/l
Temperature offset	0 °C
Limit 1	2.00 mg/l
Contact function of limit contacter 1	MIN contact without delay (switches when value drops below limit 1)
Limit 2	10.00 mg/l
Contact function of limit contacter 2	MAX contact without delay (switches when limit 2 is exceeded)
Current output 0 / 4 ... 20 mA	4 ... 20 mA
Measured value for 4 mA signal current	0.00 mg/l
Measured value for 20 mA signal current	10.00 mg/l
Altitude	0 m above sea level
Salinity	0.0 % salt content

Note:

When the factory defaults are active, both limit contacters are switched on.
There are three ways to prevent a limit alarm from being issued when the instrument is switched on for the first time:

- Switch off the controller function ("Cntr" menu), or
- increase / decrease limit 1 and / or limit 2, or
- enter a limit alarm delay ("ConF" menu).

6 Operation

6.1 Operator interface

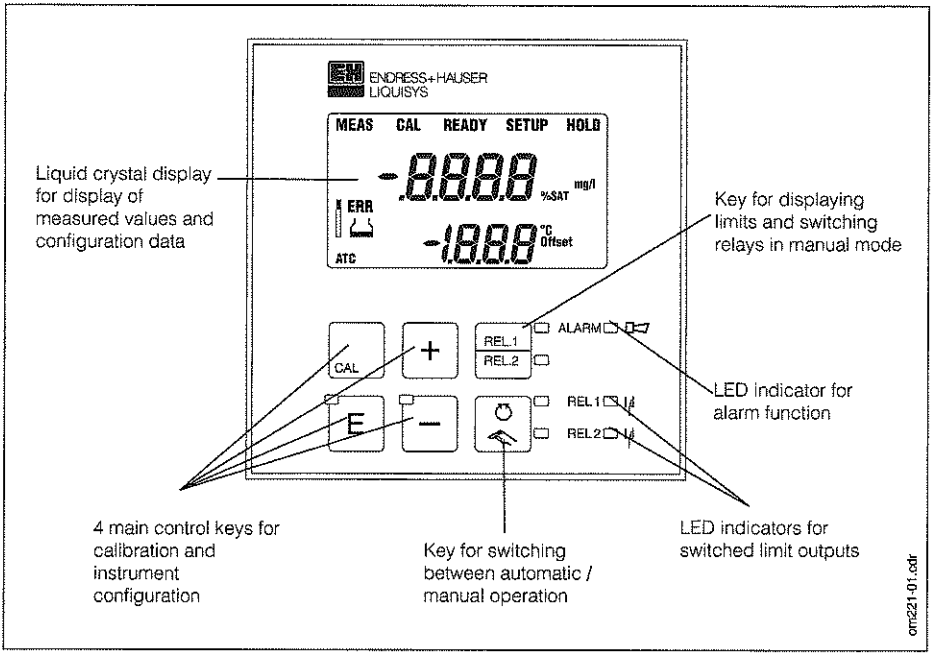


Fig. 6.1 Operating elements of Liquisys COM 221

6.2 Display elements

LED indicators

REL.1 / REL.2 — Indication for relay controlled in "manual" mode (red LED).

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

REL1 / REL2 — 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, temperature sensor failure, AD converter overflow or system errors.

Liquid crystal display

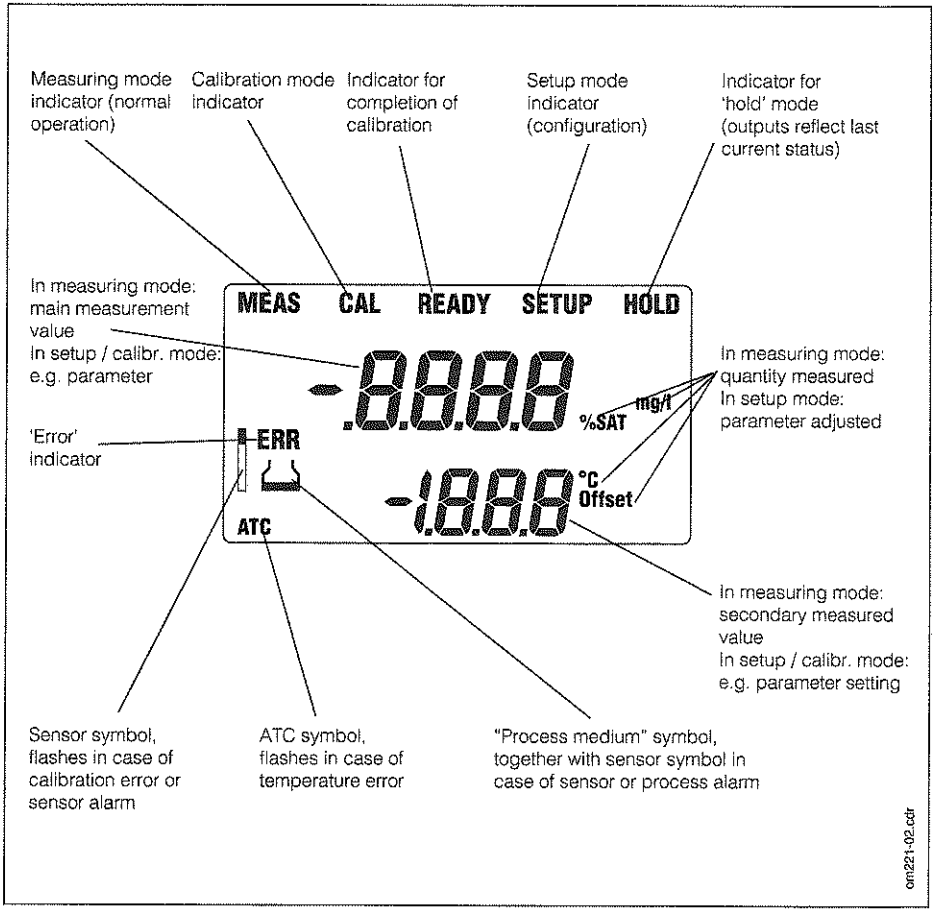


Fig. 6.2 Liquid crystal display of Liquisys COM 221

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

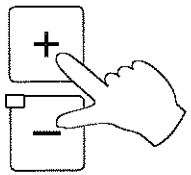
Setup
After pressing the E key and entering the setup code (22), the instrument switches to the setup mode. The E key is further used for:

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

\+

In measuring mode: Relay 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:

Push 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 and relay 2 in „manual" mode.

Toggles the relays between the „auto" and „manual" modes.

6.4 Operating concept

Operating modes

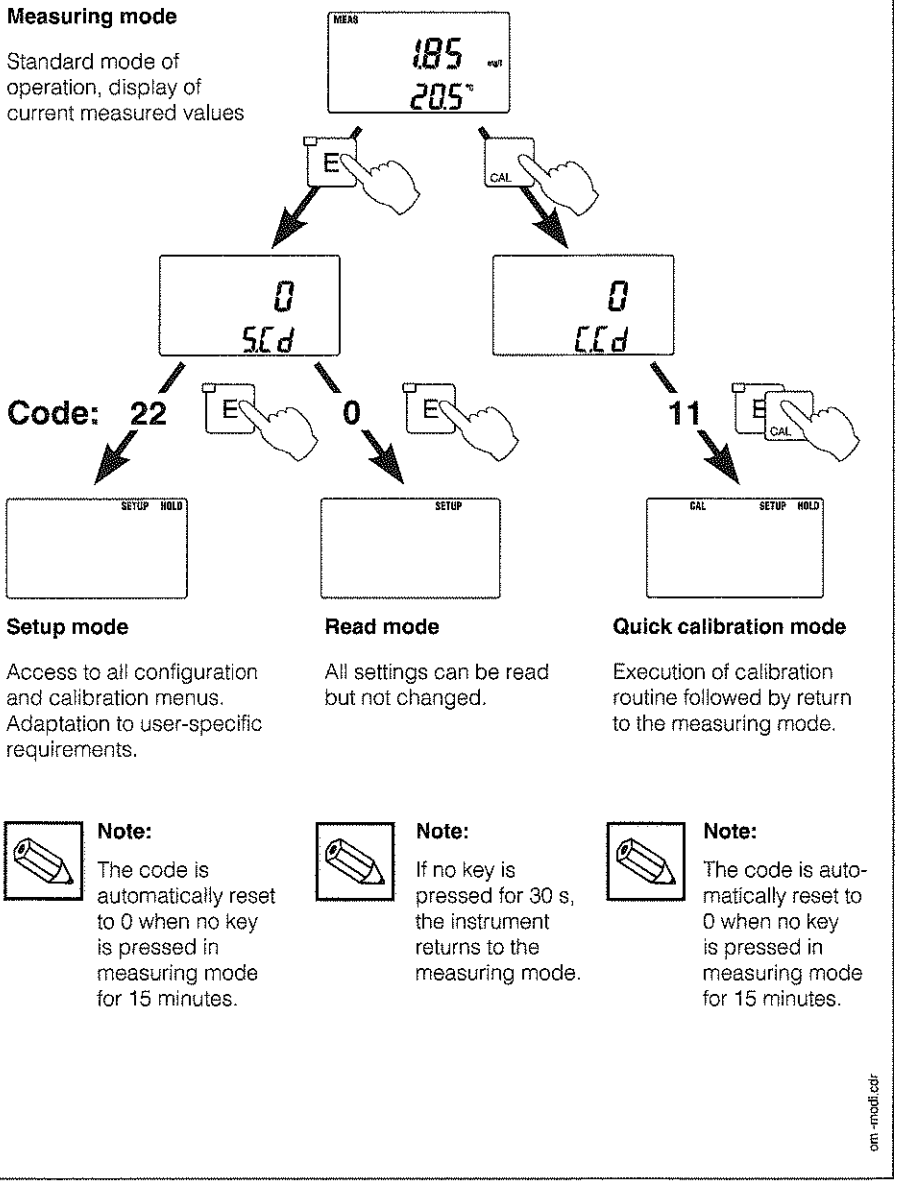


Fig. 6.3 Description of the four operating modes

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.
Settings that are outside the permissible adjusting range are rejected.

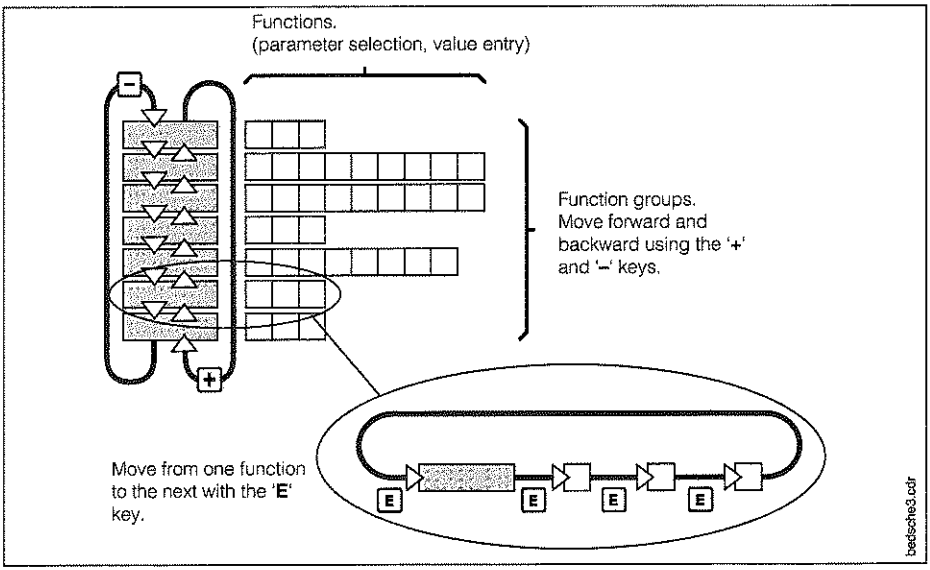


Fig. 6.4 Schematic representation of Liquisys menu structure

Hold function: "freezes" the 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.

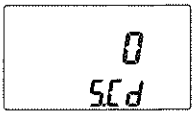
6.5 Operation example

Note:

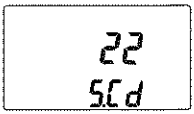
Cf. menu structure on fold-out back page.

Supposing the limit value for relay 2 were to be set to 6 mg/l as the switching point using the min. function, you would proceed as follows:

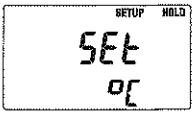
E Select the "SetupCode" field (S.Cd = Setup Code)



\+ / − Enter code 22 to access the configuration mode.



E Confirm the code.
The instrument is now in setup mode, and the first function group is selected ("Set °C" = Temperature Offset).
The hold function is active.



+ / −

Select function group "Setpoint 2" (SP 2 = Set Point 2).

E

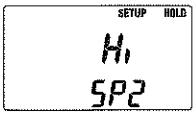
Select the „Set Limit" function.

+ / −

Change the setting, e.g. from 10 mg/l to 6 mg/l.

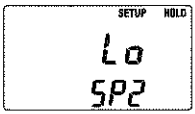
E

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



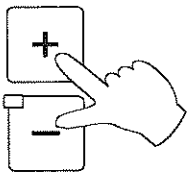
+ / −

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

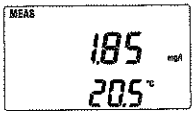


E

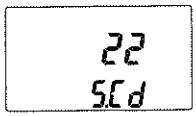
Confirm the setting.
The instrument advances to the next function
(HYS = Hysteresis Setting).

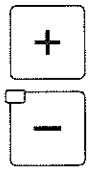


Return to the measuring mode by pressing the '+' and '–' keys at the same time.
The hold function is deactivated.

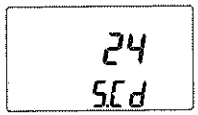


Select the „Setup Code" field.

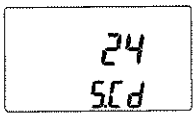


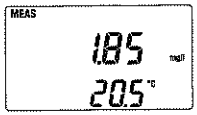


Change the code
(to any number) to block the access to the configuration function.



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





6.6 Relay operating modes auto / manual

Automatic operation

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

REL.1
REL.2

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 operation

The instrument is switched to the manual mode by pressing the Auto / Manual key. In this mode, the relays are switched on and off manually with the '+' und '–' keys. The relay status is shown on the second line of the display.
Press the „REL 1 / REL 2" key to toggle between the relays.

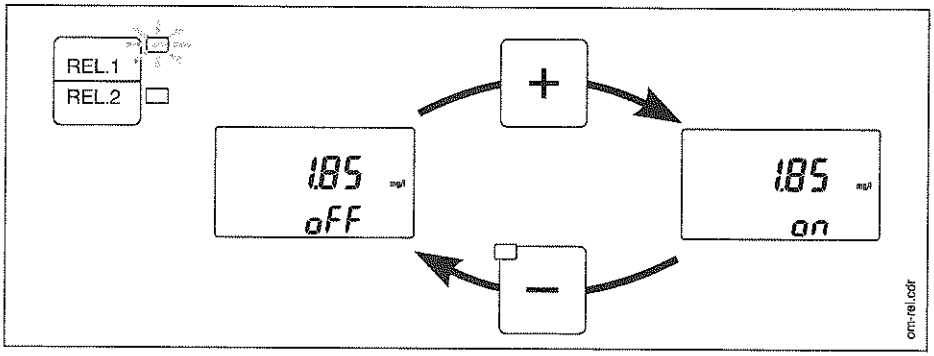


Fig. 6.5 Manual operation of relay 1

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 Temperature offset entry SEt °C

This function group is used to calibrate the NTC temperature sensor in the sensor COS 4.

Field	Selection / range	Display	Info
Adjusts the NTC signal by an offset. The actual measured value plus the offset is displayed on the second line of the display.	-5 ... +5 °C relative to absolute value **Default:** 0 °C	SETUP HOLD 3.0 28.0 °C	When an offset has been entered, the "Offset" status is displayed in measuring mode

7.2 Limit contacter configuration SP 1, SP 2

These function groups are used to configure the limit parameters.
Programming for limits 1 and 2 is identical; therefore both function groups are covered by this description.

Note:

If the controller function is disabled in the „Controller" function group, the „SP 1" and „SP 2" function groups are not displayed.
Exception: When SCS controller monitoring ("CC") is activated, the parameters for limit contacter 1 can be accessed.

Characteristic of limit contacters

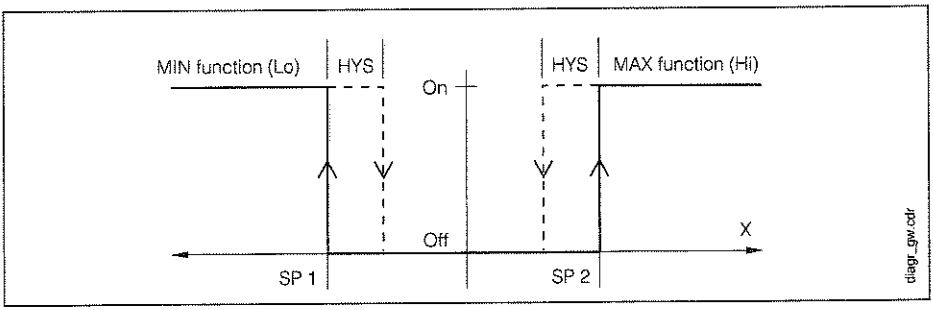
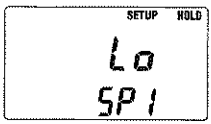
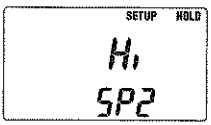
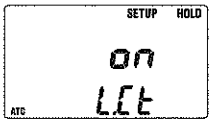


Fig. 7.1 Characteristic of limit contacters (HYS = hysteresis, SP = setpoint)

Field	Selection / range	Display	Info
Entry of limit for controller 1 / 2 in mg/l or %SAT (SP1 = setpoint 1 = limit 1) (SP2 = setpoint 2 = limit 2)	0 ... 20.00 mg/l 0 ... 200.0 %SAT **Default:** Limit 1: 2.00 mg/l 20.0 %SAT Limit 2: 10.00 mg/l 100.0 %SAT	 	
Determines the contact function (Lo = MIN contact, activated when below limit) (Hi = MAX contact, activated when above limit) (SP 1 / 2 = limit 1 / 2)	Lo Hi **Default:** Limit 1: Lo Limit 2: Hi	 	All combinations of the two contacts (Lo/Lo, Lo/Hi, Hi/Lo and Hi/Hi) can be selected
Determines the hysteresis for limit contacter 1 / 2 in mg/l or %SAT. See fig. 7.1 for effect (HYS = hysteresis)	0 ... 5.00 mg/l 0 ... 50.0 %SAT **Default:** 0.10 mg/l 1.0 %SAT		
Adjusts the pickup delay for the limit contacter relay (On.d = On delay = pickup delay)	0 ... 2000 s **Default:** 0 s		
Adjusts the dropout delay for the limit contacter relay (OF.d = Off delay = dropout delay)	0 ... 2000 s **Default:** 0 s		

7.3 Controller configuration Cntr

This function group is used to switch the limit contacter function on or off and determine the direction of action of the relays (NC / NO contact).
These settings affect both limit contacters.

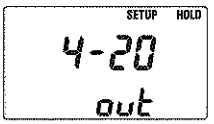
Field	Selection / range	Display	Info
Switches the limit contacter function on or off (on = limit contacter on) (oFF = limit contacter off) (L.Ct = limit monitor)	on oFF **Default:** on		If oFF is selected here, the next function is not available
Toggles the normally closed / normally open function (rEL = relay function) (dEEn = deenergized, normally closed contact) (En = energized, normally open contact)	dEEn En **Default:** dEEn		

Note:

If the controller function is disabled in the „Controller" function group, the „SP 1" and „SP 2" function groups are not displayed.
Exception: When SCS controller monitoring ("CC") is activated, the parameters for limit contacter 1 can be accessed.

7.4 Measuring range selection rng

This function group is used to select the measuring function (oxygen content in mg/l or oxygen saturation index %SAT) and determine the measuring range for the current output.

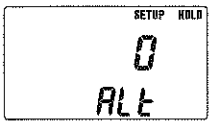
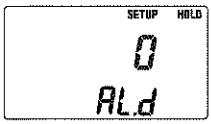
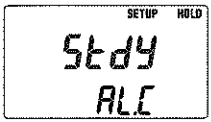
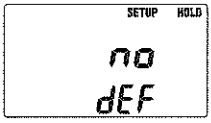
Field	Selection / range	Display	Info
Switches the meas. function: oxygen content in mg/l (ConC) or oxygen saturation index in %SAT (Sat) (Uni = unit)	ConC SAt **Default:** ConC		
Toggles the lower limit of the current output between 0 and 4 mA (out = current output)	0 – 20 mA 4 – 20 mA **Default:** 4 – 20 mA		
Entry of mg/l or %SAT value for 0 or 4 mA (depending on lower limit setting) (r. 0 = value for 0 mA with 0-20 mA) (r. 4 = value for 4 mA with 4-20 mA)	0 ... 20.00 mg/l 0 ... 200.0 %SAT **Default:** 0.00 mg/l 0.0 %SAT		The difference between the 0/4 and the 20 mA value must be at least Δ2 mg/l or Δ20 %SAT
Entry of mg/l or %SAT value for 20 mA (r.20 = value for 20 mA)	0 ... 20.00 mg/l 0 ... 200.0 %SAT **Default:** 10.00 mg/l 100.0 %SAT		

Note:

Falling assignments are possible (e.g. 4 mA → 10 mg/l, 20 mA → 5 mg/l); the difference must be at least Δ2 mg/l or Δ20 %SAT.
If the value falls outside of the display range of 0 ... 20 mg/l or 0 ... 200 %SAT, the message 'Ur' (Underrange) or 'Or' (Overrange) appears.

7.5 General instrument configuration CONF

This function group is used for general instrument configuration settings.

Field	Selection / range	Display	Info
Entry of local altitude of measuring point in metres above sea level (Alt = altitude)	0 ... 4000 m **Default:** 0 m		
Entry of salt content of medium in per cent by weight (SAL = salt content)	0 ... 4.0 % **Default:** 0.0 %		For example: sea water 3.5 ... 3.8 %
Determines the alarm delay between the violation of a limit and the activation of the alarm relay. (AL.d = Alarm delay)	0 ... 2000 min **Default:** 0 min		
Defines the alarm relay as a steady or fleeting contact. (StdY = steady contact) (FLEt = fleeting contact) AL.C = alarm contact)	StdY FLEt **Default:** StdY		Closing time for "fleeting contact" is 1 s.
Use this function to restore the factory settings for all 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!

7.6 Sensor and process monitoring SCS SEn

This function group is used to select and set the monitoring functions.

Note:

All monitoring functions are disabled when the factory settings are in effect.

The Sensor Check System is adapted to the conditions at hand by enabling and adjusting appropriate functions.

Alarm threshold monitoring

In oxygen measurement **without** oxygen transfer control (aeration), sensor errors result in incorrect measurement but this does not have any effect on the process medium (examples: measurement in surface waters or in water works for monitoring purposes).
Sensor errors usually result in implausibly high or low measured values.
Such implausible values can be detected and signalled by means of a user-defined alarm threshold.

Controller monitoring

In oxygen measurement **with** oxygen transfer control, sensor errors not only result in incorrect measurement but also directly influence the process medium.
Particularly in the case of oxygen transfer control in sewage treatment plants, there is a risk that the aeration will not be reactivated at all if the measured value is permanently too high due to the control loop. Inadequate oxygen transfer poses a considerable danger to the microbiology and its clarification performance. Conversely, measured values that are permanently too low can cause a higher operating expenses because the aeration equipment works continuously.
These cases are detected and signalled by means of user-selectable monitoring times for maximum permissible controller ON or OFF times.

Sensor activity monitoring

The process medium may also affect the sensor, and this in turn may result in incorrect measurement. Braid formation on the sensor from solids floating in the medium or coats on the sensor membrane result in a very sluggish or totally passivated measuring signal.
Passivation can be detected and signalled by means of permanent signal activity monitoring.

Overview of SCS monitoring functions

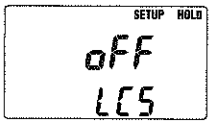
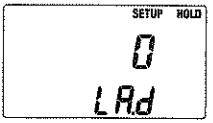
	Function	Settings	Alarm event	Application
Alarm threshold monitoring **(LCS: Limit Check System)**	User-selectable lower alarm threshold (AT) User-selectable upper alarm threshold (AT)	off	–	Applications **with** or **without** oxygen transfer control
		lower AT only	lower At: reached or felled below	
		upper AT only	upper At: reached or crossed	
		upper and lower AT	lower At reached or felled below or upper At reached or crosssed	
Controller monitoring **(PCS: Controller Check)**	ON period monitoring OFF period monitoring	off	–	Applications **with** oxygen transfer control
		on	Maximum setting for permanent ON or OFF period exceeded	
Sensor activity monitoring **(PCS: Alternati-on Check)**	Monitoring for signal change	off	–	Applications **with** or **without** oxygen transfer control
		on	Change within one hour less than ±0.1 mg/l or ±1 %SAT	

Fault signalling

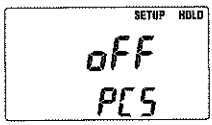
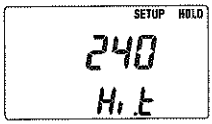
Errors detected by sensor and process monitoring are signalled by the symbol ERR and the "Sensor" and "Process medium" symbols together flashing on the display. They can be displayed by pressing the "+"- or "–" key in the measuring mode. When one of these keys is pressed once, all errors
(up to the maximum of three) are shown on the display in turn at intervals of approx. 2 s.

Troubleshooting

Refer to chapter 8.2 for further information on troubleshooting when sensor or process alarms have been detected.

Field	Selection / range	Display	Info
Selection of alarm threshold monitoring (Lo = lower alarm threshold Hi = upper alarm threshold LCS = Limit Check System)	off Lo Hi Lo.Hi *) **Default:** off		
Adjusts the lower alarm threshold (L.Lo = lower alarm threshold)	0 ... 19.00 mg/l *) 0 ... 190 %SAT **Default:** 0.00 mg/l 0.0 %SAT		Field is only available if alarm threshold monitoring has been selected
Adjusts the upper alarm threshold (L.Hi = upper alarm threshold)	1 ... 20.00 mg/l 10 ... 200 %SAT **Default:** 20.00 mg/l 200.0 %SAT		Field is only available if alarm threshold monitoring has been selected
Adjusts the alarm threshold delay time (LA.d = alarm threshold delay time)	0 ... 2000 min **Default:** 0 min		Can be used to suppress known events that are not supposed to trigger an alarm. Field is only available if alarm threshold monitoring has been selected.

*) If you controll the upper and lower alarm threshold at the same time you can only adjust a minimum distance from 1 mg/l or 10 % SAT. If these condition do not come true you can not switch to "Lo.Hi". In these case the symbol "ERR" is sparkling if you use the E-button. After restoring the minimum distance you can choose again the operating mode "Lo.Hi".

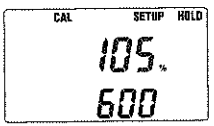
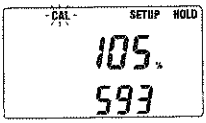
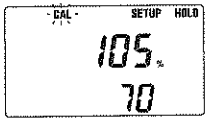
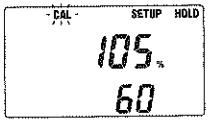
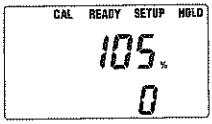
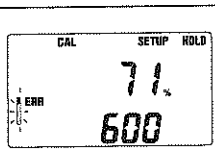
Field	Selection / range	Display	Info
Selection of process monitoring (AC = Alternation Check CC = Controller Check PCS = Process monitoring)	off AC CC AC.CC **Default:** off		**Controller monitoring always uses the limit set for limit contacter 1. When an external controller is used, the setpoint must be additionally defined in the "SP1" menu!** **An alarm delay defined in the "ConF" menu is disabled when the Controller Check "CC" is active!**
Adjusts the maximum permissible period for limit violation (below limit) (Lo.t = maximum time below limit)	0 ... 2000 min **Default:** 480 min		Field can only be accessed when Controller Check "CC" has been selected.
Adjusts the maximum permissible period for limit violation (above limit) (Hi.t = maximum time above limit)	0 ... 2000 min **Default:** 240 min		Field can only be accessed when Controller Check "CC" has been selected.

7.7 Calibration of measuring transmitter CAL 02

This function group is used to calibrate the measuring transmitter.
Please also note the relevant information in the operating instructions of the sensor connected.

Prerequisites for calibration

- Altitude adjustment in "ConF" menu has been performed.
- Sensor is completely polarised.
- Sensor is clean and dry on the outside.
- Sensor is located in the air, as close to a water surface as possible.
- Sensor is not exposed to direct solar radiation.

Description	Display	Info
Enter field by pressing the "E" or "CAL" key. Instrument is ready for calibration.		Upper field: slope of oxygen sensor in % Lower field: calibration time display 600 s
Remove sensor from medium and prepare for calibration (refer to sensor operating instructions)		
Press the "E" or "CAL" key once more to initiate the calibration. The "CAL"-symbol is sparkling.		Countdown of calibration time display
After 530 s, the sensor slope is checked for 10 s		Desired range: sensor slope 75 ... 140 %
If the sensor slope is outside the desired range, the calibration is aborted immediately and calibration error notice (see below)		
The signal stability is checked during the last 60 s of the calibration		Desired range: deviation < ± 1%
If the deviation exceeds ± 1%, the calibration is aborted immediately and calibration error notice (see below)		
Successful completion of calibration is signalled by the message "READY"		Return to the measuring mode by pressing the "+"- and "–" keys at the same time
By calibration error the "ERR" and the sensor symbol are sparkling together. The calibration time display will be put back to 600 s		After the sensor check you restart the calibration with the E-button

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

When sensor and process monitoring are not selected, an alarm is signalled when the measured value
- exceeds the upper limit or
- stays below the lower limit

for a period which exceeds the alarm delay set in the "ConF" menu.

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

8.2 Sensor or process alarm

SCS alarm "alarm threshold"

Depending on the monitoring function selected ("Lo", "Hi" or "Lo.Hi"), an alarm is triggered:
- when the measured value drops below or reach the lower alarm threshold or
- when the upper alarm threshold is exceeded or reached

upon expiration of the delay time defined.

SCS alarm "controller"

An alarm is triggered when:
- the maximum permissible ON time is exceeded or
- the maximum permissible OFF time is exceeded.

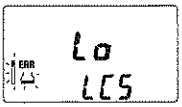
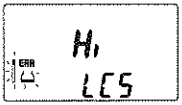
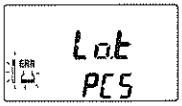
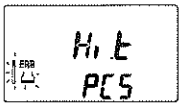
SCS alarm "sensor activity"

An alarm is triggered when the change in oxygen signal within one hour is less than ± 0.1 mg/l or ± 1 %SAT.

Effect:
- Alarm LED is on
- Alarm contact (41 / 42) is closed
- "ERR" symbol is displayed
- "Sensor" and "process medium" symbols sparkling together on display

When an SCS alarm condition exists, the "+"- or "–" key can be pressed in the measuring mode to display the error conditions that exist (up to 3) in turn for approx. 2 s.

Error messages and their meaning

	the lower alarm threshold is felled below
	upper alarm threshold is crossed
	signal change during one hour smaller than ± 0,1 mg/l or ± 1 %SAT
	adjusted maximum period for the lower limit value crossed
	adjusted maximum period for the upper limit value crossed

8.3 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:
- when the temperature sensor cable is defective, or
- when a temperature is measured that lies outside the measuring or ATC range.

Effect:
- Alarm LED is on
- Alarm contact (41 / 42) is closed
- "ERR" symbol is displayed
- "ATC" symbol flashes on display

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.

EEPROM error / Err 1
Internal communication error / Err 2

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.

Error message in the event of AD converter overflow

Effect:
- "ERR" symbol on display
- Alarm LED is on
- Alarm contact (41 / 42) is closed

To eliminate the error:
Check calibration, offset setting and measuring input wiring.

8.4 Possible faults in measuring mode and remedy

Test	Remedy
Limit alarm	
• Read actual value • Check limit settings • Check limit alarm delay setting	• Move actual value to desired range • Change limits • Increase delay time
SCS alarm "alarm threshold"	
Lo alarm	
• Read actual value • Check lower alarm threshold • Check delay setting	• See chapter 8.5 Measuring system check "Display value too low"
Hi alarm	
• Read actual value • Check upper alarm threshold • Check delay setting	• See chapter 8.5 Measuring system check "Display value too high"
SCS alarm "controller"	
• Read actual value • Read limit • Determine whether limit is violated permanently	• Permanently exceeded: See chapter 8.5 Measuring system check "Display value too high" • Permanently too low: See chapter 8.5 Measuring system check "Display value too low"
SCS alarm "sensor activity"	
• Visual inspection of sensor	• See chapter 8.5 Measuring system check "No sensor response"

8.5 Measuring system checks

Test	Remedy
No display, no sensor response	
• Transmitter supplied with power?	• Apply mains voltage
• Sensor connected to transmitter?	• Connect sensor
• Is medium flow sufficient?	• Establish required medium flow
• Membrane completely soiled?	• Clean sensor
• Measuring chamber filled with electrolyte?	• Fill electrolyte into measuring chamber
Display value too high	
• Polarisation completed?	• Wait for polarisation to complete
• Instrument previously calibrated (with a different sensor)?	• Perform calibration
• Temperature indicated on transmitter obviously too low?	• Return sensor to manufacturer
• Remove sensor from medium and dry: Correct membrane cap installed on sensor?	• Cap COY 3-WP for COS 4 (do not use COY3-S-WP)
• Membrane visibly bulged?	• Install new membrane cap
• Open membrane chamber: Electrolyte soiled?	• Clean measuring chamber and fill in fresh electrolyte
• Dry the electrodes: Does transmitter display go to zero?	• Check connecting line (also junction box if present) for shunt. If not OK, return sensor to manufacturer
• Anode coating missing, does electrode have silver coat?	• Return sensor to manufacturer for recoating
• Silver on gold cathode?	• Clean gold cathode

Test	Remedy
Display value too low	
• Has sensor been calibrated?	• Perform calibration
• Is medium flow sufficient?	• Establish required medium flow
• Temperature indicated on transmitter obviously too high?	• Return sensor to manufacturer
• Remove sensor from medium and dry: Correct membrane cap on sensor?	• Cap COY 3-WP for COS 4
• Visible coating on membrane?	• Clean membrane or replace membrane cap
• Open measuring chamber: Electrolyte soiled?	• Clean measuring chamber and fill in fresh electrolyte
Considerable fluctuation of display value	
• Membrane visibly bulged?	• Install new membrane cap
• Open measuring chamber, dry electrodes: Does transmitter display go to zero?	• Check connecting line (also junction box if present) for shunt. If not OK, return sensor to manufacturer

8.6 Measuring transmitter checks

Caution:

These transmitter checks require a basic knowledge of electrical engineering. You also need the following equipment:

- Multimeter
- Resistance 37.4 kΩ
- Resistance 2.61 MΩ

Carry out the check in this order	
Measure	**Desired value**
Voltage check	
• Disconnect oxygen sensor COS 4 • Measure polarisation voltage on transmitter between terminals 90 and 91	Reading on multimeter: –750 mV
Zero check	
• Switch instrument off (power off) • Connect 37.4 kΩ resistance between terminals 11 and 12 • Switch instrument on (power ON)	Display on transmitter: 0.00 mg/l (or 0.0 %SAT) and 20 °C Current output (terminals 31 and 32): 0 or 4 mA
Slope check	
• Switch instrument off (power off) • Connect 2.61 MΩ resistance between terminals 90 and 91 • Switch instrument on (power ON) • Altitude entry ("ConF" menu): 0 m • Salinity input ("ConF" menue): 0,0 %	Display before recalibration: 6.00 ... 11.20 mg/l and 20 °C (or 85 ... 157 %SAT) Display after recalibration: 9.20 ... 9.30 mg/l and 20 °C (or 102 %SAT)

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 keyboard.

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 screw on the rear of the instrument and pull the plug-in unit out of the housing halfway. The fuse is located on the right board between the transformer and the rear of the instrument. Use only the same fise.

Other 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

O_2 measurement with sensor COS 4

Display and measuring range	0 ... 20 mg/l or 0 ... 200 %SAT
Measured value resolution	0.01 mg/l, 0.1 %SAT
Measurement deviation1), display	max. 0.5 % of MR
Reproducibility1)	max. 0.2 % of MR
Temperature compensation range	0 ... 50 °C
Altitude adjustment range	0 ... 4000 m
Salinity adjustment range	0 ... 4.0 %
O2 signal input	
Signal current	0 ... 3000 nA
Slope adjustment	75 ... 140 % of nominal slope
Nominal slope (sensor in air, 20 °C, 1013 mbar)	290 nA
O2 signal output	
Current range	0 / 4 ... 20 mA
Measurement deviation	max. 0.75 % of MR
Load	max. 500 W
Transmission range	D 2 ... D 20 mg/l or D 20 ... D 200 %SAT

Temperature measurement

Temperature sensor	NTC, 30 kW at 25 °C
Display range	-9.9 ... +60 °C
Measured value resolution	0.1 °C
Measurement deviation1), display	1.0 % of MR

Limit contacter

Limit adjustment range	0 ... 20 mg/l or 0 ... 200 %SAT
Switching hysteresis	0 ... 5 mg/l or 0 ... 50 %SAT
Pickup / dropout delay	0 ... 2000 s
Contact type (switchable)	MIN / MAX

Alarm function

Alarm threshold adjustment range	
Lower limit	0 ... 19 mg/l or 0 ... 190 %SAT
Upper limit	1 ... 20 mg/l or 10 ... 200 %SAT
Alarm delay	0 ... 2000 min
MIN monitoring timeout	0 ... 2000 min
MAX monitoring timeout	0 ... 2000 min
Function (switchable)	steady contact / fleeting contact

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

Electrical data and connections

Voltage supply, AC	24 / 100 / 115 / 200 / 230 V AC, +10 / –15 %
Frequency	48 ... 62 Hz
Power consumption	max. 7.5 VA
Auxiliary voltage output	
Output voltage	15 V +/– 0.6 V
Output current	max. 10 mA
Contact outputs	potential-free changeover contacts
Switching current	
With ohmic load (cos j = 1)	max. 5 A
With inductive load (cos j = 0.4)	max. 3 A
Switching voltage	max. 250 V AC, 30 V DC
Switching power	
With ohmic load (cos j = 1)	max. 1250 VA AC, 150 W DC
With inductive load (cos j = 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. 2500 Vrms
Connection terminals	plug-in printed board terminals, 3, 9 and 14 poles
Conductor cross section	max. 2.5 mm2
Mains fuse	fine-wire fuse, medium time lag, 250 V / 1 A

General technical data

Measured value display	LCD, 2 lines, 4 and 3½digits, with status symbols
Electromagnetic compatibility (EMC)	
Emission	according to EN 50081-1, 01.92
Immunity	according to EN 50082-1, 03.93
Nominal operating conditions	
Ambient temperature	0 ... +50 °C
Relative humidity	10 ... 95 %, non-condensing
Limit operating conditions	
Ambient temperature	–10 ... +60 °C
Storage and transport temperature	–25 ... +65 °C

Physical data

Dimensions	
Built-in control panel housing (H x W x D)	96 x 96 x 145 mm
Installation depth	approx. 175 mm
Field housing (H x W x D)	204 x 155 x 215 mm
Weight	
Liquisys COM 221 (built-in control panel housing)	max. 0.7 kg
Liquisys COM 221 with field housing	max. 2.3 kg
Protection type	
Liquisys COM 221 (built-in control panel housing)	IP 54 (front) / IP 30 (housing)
Field housing	IP 65
Materials	
Housing	polycarbonate
Front membrane	polyester, UV-resistant
Field housing	polycarbonate

10.2 Index

Display	Abbreviation	Meaning
AC	alternation check	sensor activity monitoring
AC.CC	alternation check / controller check	snesor activity and controller monitoring
ALt	altitude	altitude
AL.C	alarm contact	alarm contact
AL.d	alarm delay	alarm delay
CAL	calibration	calibrate function group
CC	controller check	controller monitoring
C.Cd	calibration code	calibration code
Cntr	controller	function group controller
Conc	concentration	dissolved oxygen measuring range in mg/l
ConF	configuration	configure function group
dEEn	deenergized	normally closed contact
dEF	default	default settings
En	energized	offnormal contact
FLEt	fleeting contact	fleeting contact
H i	high	Max contact limit check system with upper alarm threshold
Hi.t	high time	maximum period for permanent setpoint exceeding
HYS	hysteresis	hysteresis

Display	Abbreviation	Meaning
.Cd	installation code	commissioning code
LAd	limit alarm delay	alarm delay
LCS	limit-check-system	limit check system
LCt	limit contacter	limit contacter
LHi	limit high	upper alarm threshold crossed
LLo	limit low	lower alarm threshold crossed
Lo	low	Min contact limit check system with lower alarm threshold
LoHi	low / high	imit check system with lower and upper alarm threshold
Lot	low time	maximum period for permanent setpoint remaining under
no	no	no setting of default values
OFd	off delay	relay opening delay time
oFF	off (controller / ATC)	controller / ATC off
on	on	controller / ATC on
Ond	on delay	relay contacting delay time
Or	over range	scale maximum exceeded
out	output	current output
O2		dissolved oxygen
PCS	process ckeck system	process ckecking system
r.0	range 0 mA	display at 0 mA (0...20 mA)
r.4	range 4 mA	display at 4 mA (4...20 mA)

Display	Abbreviation	Meaning
r.20	range 20 mA	display at 20 mA (0/4...20 mA)
rEL	relay	relay function
rng	range	function group measuring range
SAL	salinity	salinity
SAt	saturation	dissolved oxygen measuring range in % SAT
SCd	setup code	setup-Code
SCS	sensor check system	sensor check system
SEn	sensor	sensor
SEt °C	set temperature °C	function group temperature calibration
SP 1	setpoint 1	limit 1
SP2	setpoint 2	limit 2
StdY	steady	latching contact
Uni	unit	unit of measuring range
Ur	under range	scale minimum exceeded
YES	yes	default value take over
0-20		choose output range 0-20 mA
4-20		choose output range 4-20 mA

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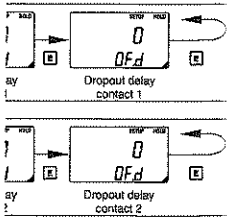
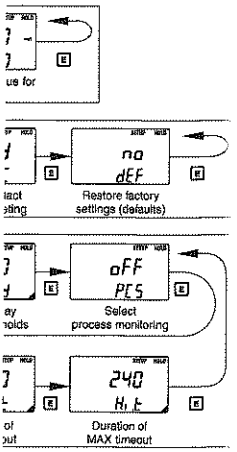
ens shown in this overview are exam
rent during operation.

Return to measuring mode
from all menu fields

Fields marked with a triangle in
the lower right corner may
not be shown depending on the
instrument configuration.





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