O_2 Transmitter 4220X

Your Representative:

04/03
52 120 755

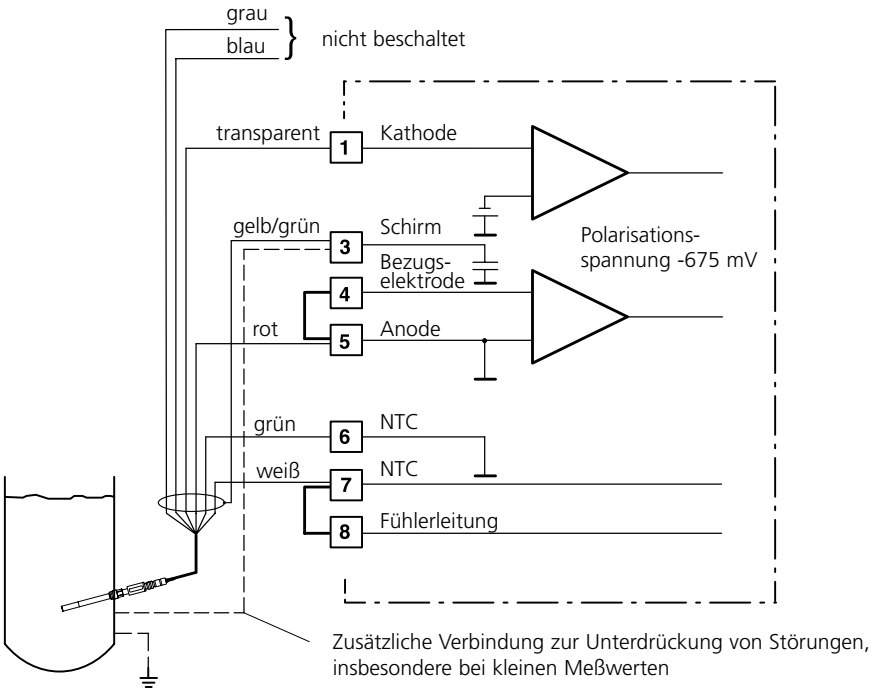
Mettler-Toledo GmbH, Process Analytics, Postfach, 8902 Urdorf, Switzerland
Tel. +41 (01) 736 22 11, Fax +41 (01) 736 26 36

CE

Warranty
Defects occurring within 3 years from delivery date shall be remedied free of charge at our plant (carriage and insurance paid by sender).
Accessories: 1 year

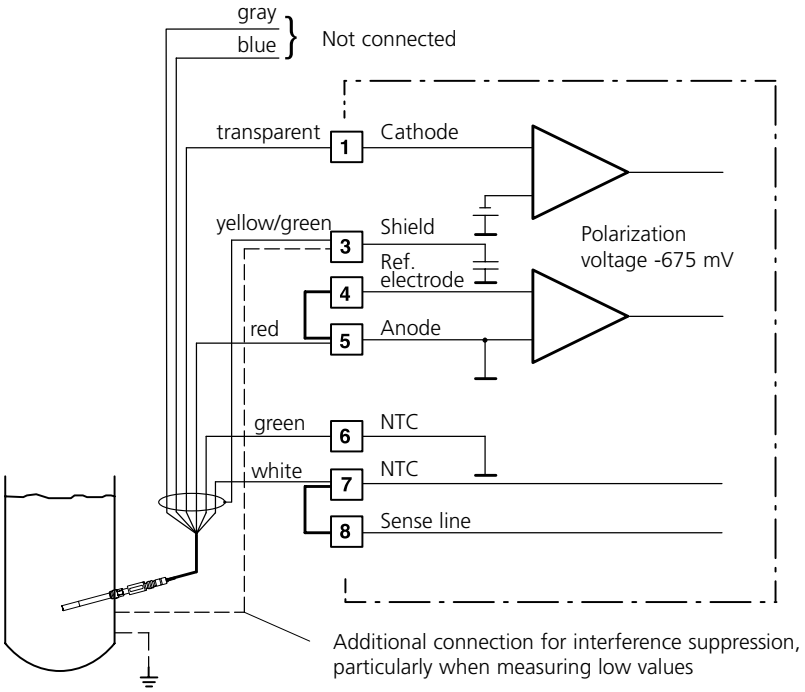
Subject to change without notice

Neu ab Softwareversion 5.0 (April 2003):
Geräte mit Option 467 (HART®-Kommunikation) unterstützen nun auch die Produktkalibrierung über die HART®-Schnittstelle.
Der O_2 Transmitter 4220X unterstützt zusätzlich die neuen Mettler-Toledo Sensoren InPro6800 und InPro6900.



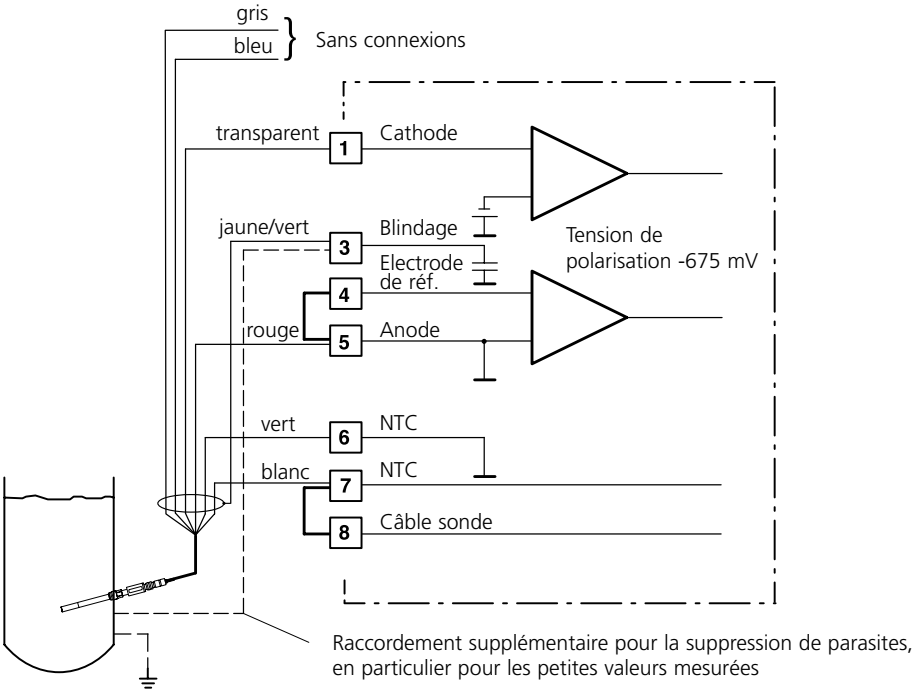
Beschaltungsbeispiel mit Sensoren InPro6800 bzw. InPro6900

New features for software version 5.0 (April 2003):
Units with Option 467 (HART® communication) now also support product calibration via HART® interface.
The O_2 Transmitter 4220X supports the new Mettler Toledo InPro6800 and InPro6900 sensors.



Typical wiring with InPro6800 or InPro6900 sensors

Nouveau à partir de la version 5.0 (Avril 2003):
Les appareils avec l'option 467 (communication HART®) supportent également le calibrage du produit via l'interface HART®.
Les nouveaux capteurs Mettler Toledo InPro6800 et InPro6900 sont disponibles pour les appareils Transmetteur O_2 4220X.



Exemple de câblage avec les capteurs InPro6800 ou InPro6900

Contents

Package contents

The package should contain:

- O_2 Transmitter 4220X
- This instruction manual
- Any accessories ordered with the Transmitter (For available accessories, see Chap. 9)

Information on this instruction manual

Warnings and notes

Warning

Warning means that ignoring the given instructions may lead to a malfunction of or damage to the instrument and to property damage or personal injuries.

Note

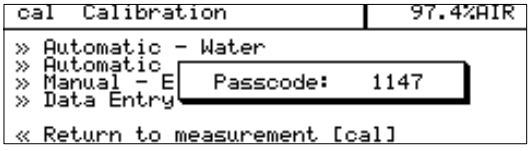
Notes provide important information that should be followed when using the instrument.

Typical representations

The keys of the O_2 Transmitter 4220X are shown like this in the text:

meas , **cal** , **maint** , **par** , **diag**

◀ , ▶ , ▲ , ▼ , **enter**



Menus shown in the instruction manual may differ somewhat from the display of your Transmitter. This depends on which options your Transmitter is equipped with.

If the behavior of your Transmitter deviates from the description in this manual, check whether the manual corresponds to the software version of your Transmitter: see Pg 6-3, Device Description.

Safety information

Be sure to read and observe the following instructions!

The safety instructions must always be followed for your own safety.
Failure to follow these instructions may result in injuries

The instrument has been designed in accordance with the state of the art and complying with the applicable safety regulations. When operating the instrument, certain conditions may nevertheless lead to danger for the operator or damage to the instrument.

Whenever it is likely that the protection has been impaired, the instrument shall be made inoperative and secured against unintended operation.

The protection is likely to be impaired if, for example:

- the instrument shows visible damage
- the instrument fails to perform the intended measurements
- after prolonged storage at temperatures above 70 ˚C
- after severe transport stress

Before recommissioning the instrument, a professional routine test in accordance with EN 61010 Part 1 must be performed. This test should be carried out by the manufacturer.

The O_2 Transmitter 4220X is approved for operation in hazardous locations. It has been developed and manufactured in compliance with the applicable European guidelines and standards.
The Declaration of Conformity confirms the compliance with the applicable European guidelines and standards.

The stipulations of EN 60 079-14:1996 and the following must be observed when installing the instrument in a hazardous location. The O_2 Transmitter 4220X may only be connected to certified intrinsically safe circuits. The electrical data are listed in the EC-Type-Examination Certificate (see Pg XII).

Before commissioning it must be proved that the intrinsic safety is maintained when connecting the instrument to other equipment, such as supply units including cables and lines.

When commissioning, a complete configuration must be carried out.

Manipulations of the instrument other than described in this manual are not permitted.

Assembly/dismantling, installation, operation and maintenance may only be carried out by qualified personnel as defined by the automation industry in compliance with the applicable regulations and this instruction manual. Be sure to observe the specified ambient conditions and installation instructions.

Proper use

The O_2 Transmitter 4220X is a 2-wire transmitter. The Transmitter is supplied with power from the 4 to 20 mA loop current, which also transmits the measured variable.

The O_2 Transmitter 4220X is used for continuous measurement of oxygen saturation, concentration and partial pressure, as well as for temperature measurement in liquids. The instrument is designed for industrial use. The enclosure is protected to IP 65 and allows direct wall mounting on the site.

The instrument shall not be used in a manner not specified by this manual. Any applications not specified in this manual are inadmissible.

Mettler-Toledo GmbH
Process Analytics

Adresse | Im Hackacker 15 (Industrie Nord), CH-8902 Urdorf, Schweiz
Briefadresse | Postfach 76, CH-8902 Urdorf
Telefon | 01-736 22 11
Telefax | 01-736 26 36
Internet | www.mt.com
Bank | Credit Suisse First Boston, Zürich (Acc.-No. 0835-370501-21)

Declaration of conformity
Konformitätserklärung
Déclaration de conformité

CE

We/Wir/Nous	Mettler-Toledo GmbH, Process Analytics Im Hackacker 15 8902 Urdorf Switzerland
	declare under our sole responsibility that the product, erklären in alleiniger Verantwortung, dass dieses Produkt, déclarons sous notre seule responsabilité que le produit,
Description Beschreibung/Description	O2-4220X
	to which this declaration relates is in conformity with the following standard(s) or other normative document(s). auf welches sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder Richtlinie(n) übereinstimmt. auquel se réfère cette déclaration est conforme à la (aux) norme(s) ou au(x) document(s) normatif(s).
Explosionsschutzrichtlinie Explosion Protection Protection contre les explosions	94/9/EG
Norm/Standard/Standard	EN 50 014: 1997 EN 50 020: 1994
EMC Directive/EMV-Richtlinie Directive concernant la CEM	89/336/EWG SR 734.5, VEMV
Norm/Standard/Standard	DIN EN 61326 / VDE 0843 Teil 20: 1998-01 DIN EN 61326 / A1 / VDE 0843 Teil 20 / A1: 1999-05
Place and Date of issue Ausstellungsort / - Datum Lieu et date d'émission	Urdorf, 14.06.2001

METTLER TOLEDO

Nr. 52 999 999C FL
Artikel Nr. 52960200 KE 4220X.DOC Version b

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

(1) # EC-TYPE-EXAMINATION CERTIFICATE

(Translation)

(2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres - **Directive 94/9/EC**

(3) EC-type-examination Certificate Number:

PTB 00 ATEX 2190

(4) Equipment: O2-Transmitter type 4220X Opt. ...

(5) Manufacturer: Mettler Toledo AG

(6) Address: Im Hackacker 15, CH-8902 Urdorf

(7) This equipment and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The Physikalisch-Technische Bundesanstalt, notified body No. 0102 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.

The examination and test results are recorded in the confidential report PTB Ex 00-20250.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 50014:1997 + A1 + A2 **EN 50020:1994**

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type-examination Certificate relates only to the design and construction of the specified equipment in accordance with Directive 94/9/EC. Further requirements of this Directive apply to the manufacture and supply of this equipment.

(12) The marking of the equipment shall include the following:

II 2 (1) G EEx ib [ia] IIC T6

Zertifizierungsstelle Explosionsschutz
By order:

Dr.-Ing. U. Johannsmeyer
Regierungsdirektor

Braunschweig, January 24, 2001

PHYSIKALISCH-TECHNISCHE BUNDESANSTALT 24

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

(13) # S C H E D U L E

(14) ## EC-TYPE-EXAMINATION CERTIFICATE PTB 00 ATEX 2190

(15) Description of equipment

The O_2-transmitter type 4220X Opt. ... is used preferably for detecting and processing electrochemical quantities and is equipped with an input for the partial pressure measurement of oxygen and an input for the measurement of temperature.

The application occurs within the hazardous area.

The maximum permissible ambient temperature is 50 °C.

Electrical data

Loop measuring circuit ..... type of protection Intrinsic Safety EEx ib IIC
(KL 9, 10) only for connection to a certified intrinsically safe circuit
maximum values:
U_i = 30 V
I_i = 100 mA
P_i = 0.8 W
C_i = 22 nF
L_i negligibly low

Output circuit 2 ..... type of protection Intrinsic Safety EEx ib IIC
(KL 11, 12) only for connection to a certified intrinsically safe circuit
maximum values:
U_i = 30 V
I_i = 100 mA
P_i = 0.8 W
C_i = 48 nF
L_i negligibly low

O_2-measuring circuit ..... type of protection Intrinsic Safety EEx ia IIC
(KL 1, 3, 4, 5) maximum values:
U_o = 10 V
I_o = 1.52 mA
P_o = 2 mW
R = 3.3 kΩ
linear characteristic
C_0 = 620 nF
L_0 = 1 mH

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

SCHEDULE TO EC-TYPE-EXAMINATION CERTIFICATE PTB 00 ATEX 2190

C_i = 25 nF
L_i negligibly low

Temperature measuring circuit ..... type of protection Intrinsic Safety EEx ia IIC
(KL 6, 7, 8) maximum values:
U_o = 10 V
I_o = 3 mA
P_o = 4 mW
R = 1.6 kΩ
linear characteristic
C_o = 475 nF
L_o = 1.8mH
C_i = 50 nF
L_i negligibly low

PA ..... for connection to the equipotential bonding system

The loop measuring circuit is safely electrically isolated from the other intrinsically safe circuits up to a voltage of 60 V.

The output circuit 2 is safely electrically isolated from the O_2- and from the temperature measuring circuit up to a voltage of 60 V.

The O_2-measuring circuit and the temperature measuring circuit are electrically interconnected.

(16) Test report PTB Ex 00-20250

(17) Special conditions for safe use

none

(18) Essential health and safety requirements

met by the standards mentioned above

Zertifizierungsstelle Explosionsschutz
By order:

Dr.-Ing. U. Johannsmeyer
Regierungsdirektor

Braunschweig, January 24, 2001

1 Assembly, installation, and maintenance

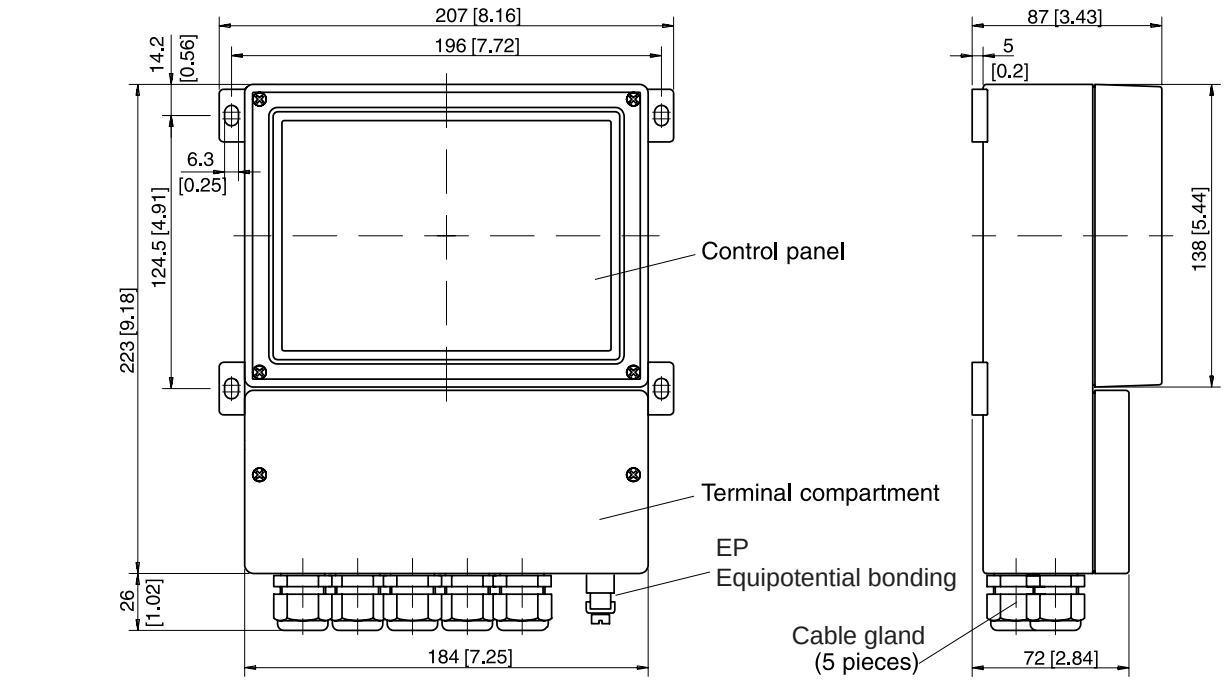
Assembly

- The weatherproof enclosure allows direct wall mounting. See dimension drawing, Fig. 1-1.

- With the ZU 0136 mounting plate and the ZU 0125 bracket kit, the instrument can also be mounted on a post or pipe.
  See dimension drawing, Fig. 1-2.

- The ZU 0157 protective hood provides additional protection against direct weather exposure and mechanical damage.
  See dimension drawing, Fig. 1-2
  For mounting the protective hood, you require the ZU 0136 mounting plate.

- The ZU 0158 protective case provides optimum protection against dust, moisture, and mechanical damage.
  See dimension drawing, Fig. 1-3.
  With the ZU 0220 bracket kit, the protective case can also be mounted on a post or pipe.



Note: All dimensions in mm [inches].

Fig. 1-1 Dimension drawing O_2 Transmitter 4220X

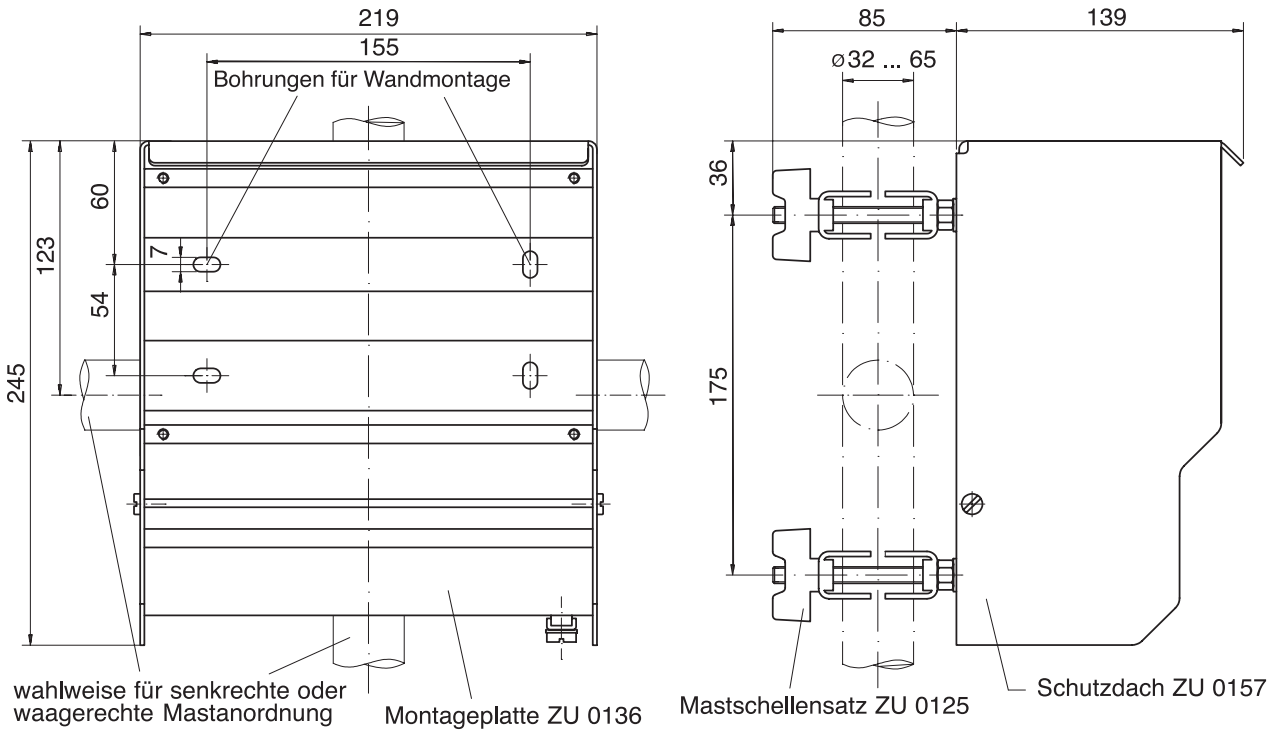
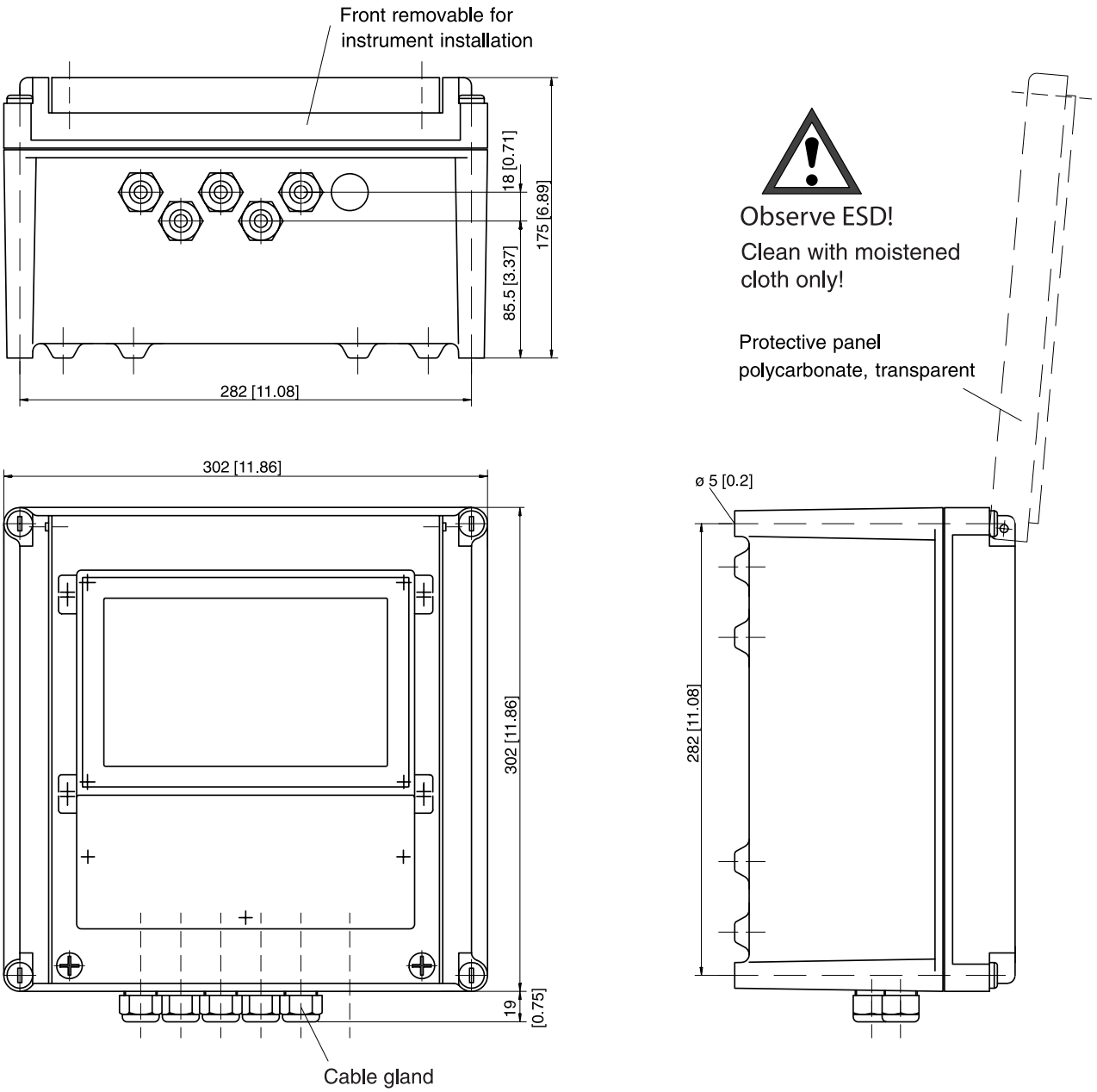
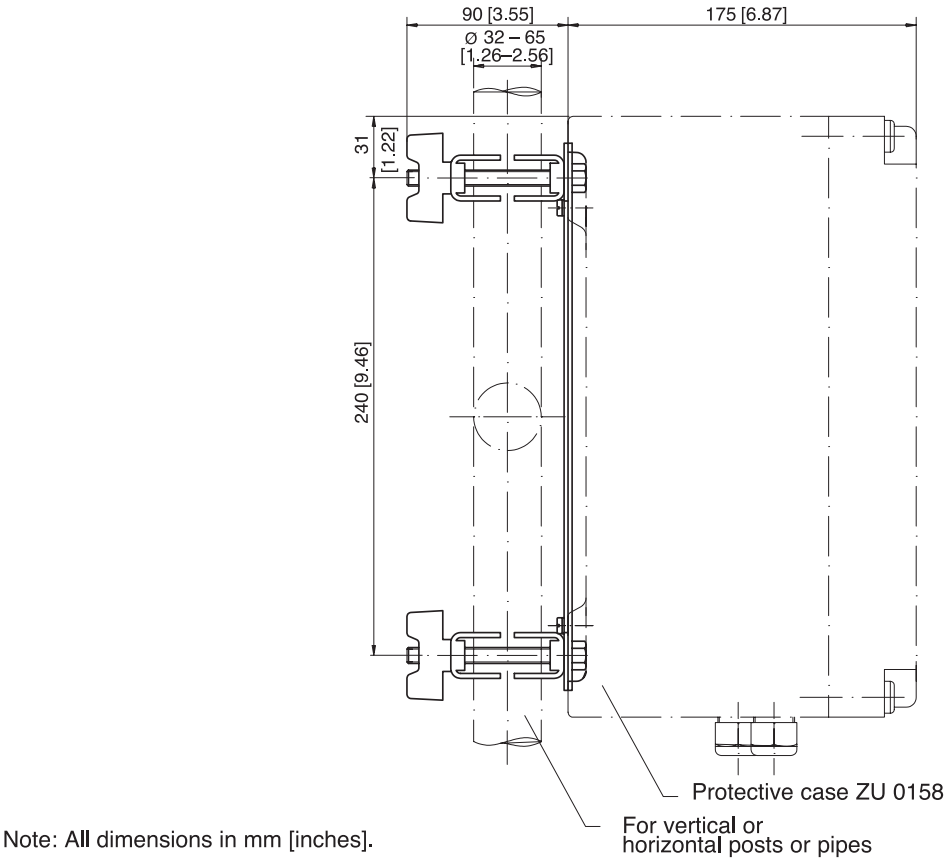


Fig. 1-2 ZU 0136 mounting plate, ZU 0157 protective hood and ZU 0125 bracket kit



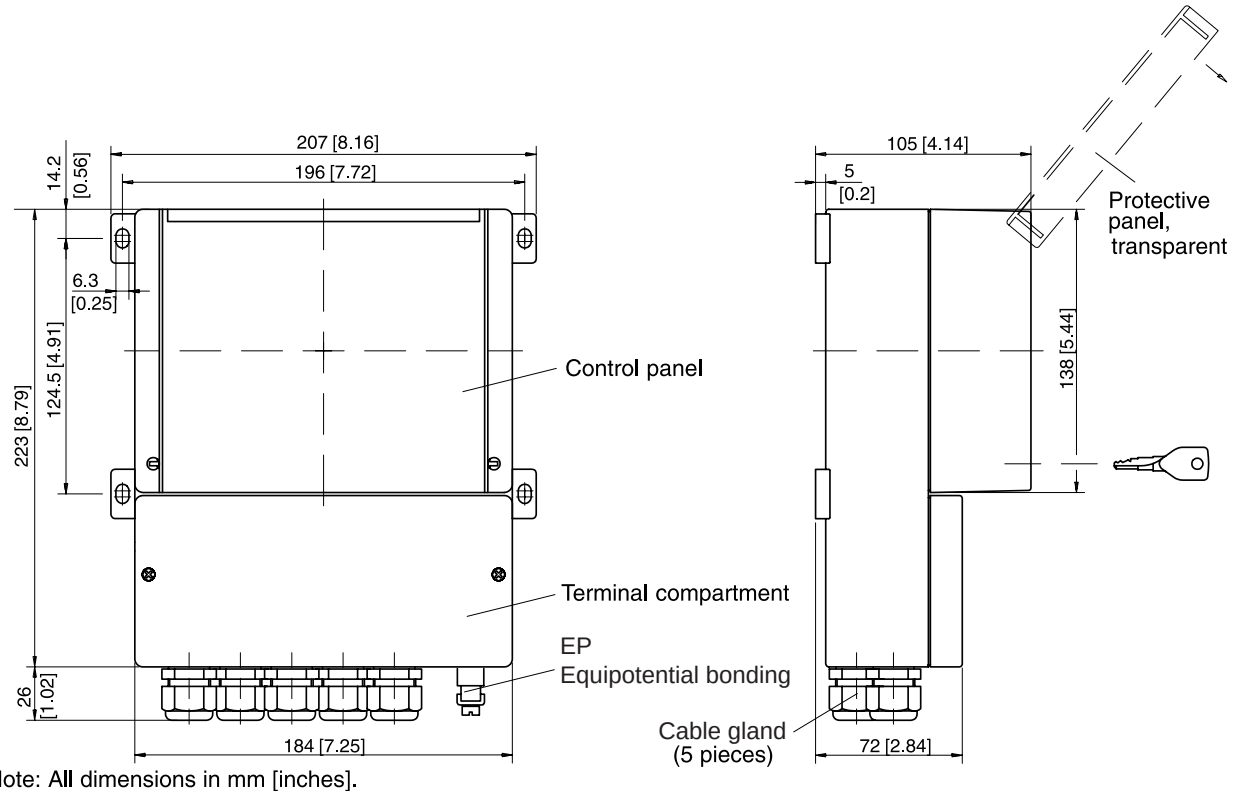
Note: All dimensions in mm [inches].

Fig. 1-3 Dimension drawing of ZU 0158 protective case



Note: All dimensions in mm [inches].

Fig. 1-4 ZU 0220 bracket kit for ZU 0158 protective case



Note: All dimensions in mm [inches].

Fig. 1-5 Instrument with lockable protective panel (Opt. 432)

Installation and commissioning

- Installation and commissioning of the O_2 Transmitter 4220X may only be carried out by trained experts in accordance with this instruction manual and as per applicable local and national codes. Be sure to observe the technical specifications and input ratings.
- All parameters must be set by a system administrator prior to commissioning.
- Be sure to observe the safety precautions on Pg VIII and the following!

Before connecting the O_2 Transmitter 4220X to a supply unit, make sure that it cannot output more than 30 V DC, 100 mA and 0.8 W.

To connect the O_2 Transmitter 4220X, open the cover of the terminal compartment (lower part of the instrument) by removing the two screws. The terminals are suitable for single wires and flexible leads up to 2.5 mm^2 (AWG 14). On the right-hand side next to the terminals there are two contact holes for connecting a HART® hand-held terminal.

As delivered, all terminals are open to allow easy insertion of the connecting wires. If the terminals are only half open, it may occur that the wire is pushed below the contacting element and does not make contact when the terminal is closed.
Connection examples are shown on Pg 2-4 and the following.

The outer EP terminal must be connected with equipotential bonding to divert electrostatic charges to the front panel overlay.

Notes concerning performance

At ambient temperatures below 0 °C the readability of the LC display may be reduced. This does not impair the instrument functions.

The real-time clock, logbook, cal record, and sensor statistics are battery-backed for approx. 1 year. After longer power outages these data can be lost. The instrument then displays the message “Warn Time/Date”, and the date is reset to 01/01/1990. Time and date must be reentered.

Maintenance and cleaning

The O_2 Transmitter 4220X contains no user repairable components.

To remove dust, dirt and spots, the external surfaces of the meter may be wiped with a damp, lint-free cloth. A mild household cleaner may also be used if necessary.

When operating the instrument in a hazardous area, pay attention to electrostatic discharge!

Only clean the instrument with a moistened cloth!

Also the ZU 0158 protective case and the lockable protective panel (Opt. 432) may only be cleaned with a moistened cloth!

2 Capabilities of O_2 Transmitter 4220X

Overview of O_2 Transmitter 4220X

Commissioning of the O_2 Transmitter 4220X may only be carried out by trained experts in accordance with this instruction manual. Be sure to observe the technical specifications and input ratings during installation.

All parameters must be set by a system administrator prior to commissioning.

The O_2 Transmitter 4220X is approved for operation in hazardous locations.

Membrane-covered oxygen sensors supply a current proportional to the oxygen partial pressure. With Henry's Law, the oxygen concentration can be calculated from the oxygen partial pressure via a solubility coefficient.
In the O_2 Transmitter 4220X the solubility coefficient is stored for the respective temperature from -5 °C to +60 °C as a table in accordance with EN 25814 1992. In addition, the influence of the salt content (salinity) of the medium on the solubility can be taken into account. The salt content is either specified directly as the salinity or chlorine content, or the conductivity and temperature of the medium are entered. The salinity is calculated from the conductivity and temperature using the International Oceanographic Tables, Unesco / National Institute of Oceanography of Great Britain Volume 2, Wormley/ Godalming/Surrey.

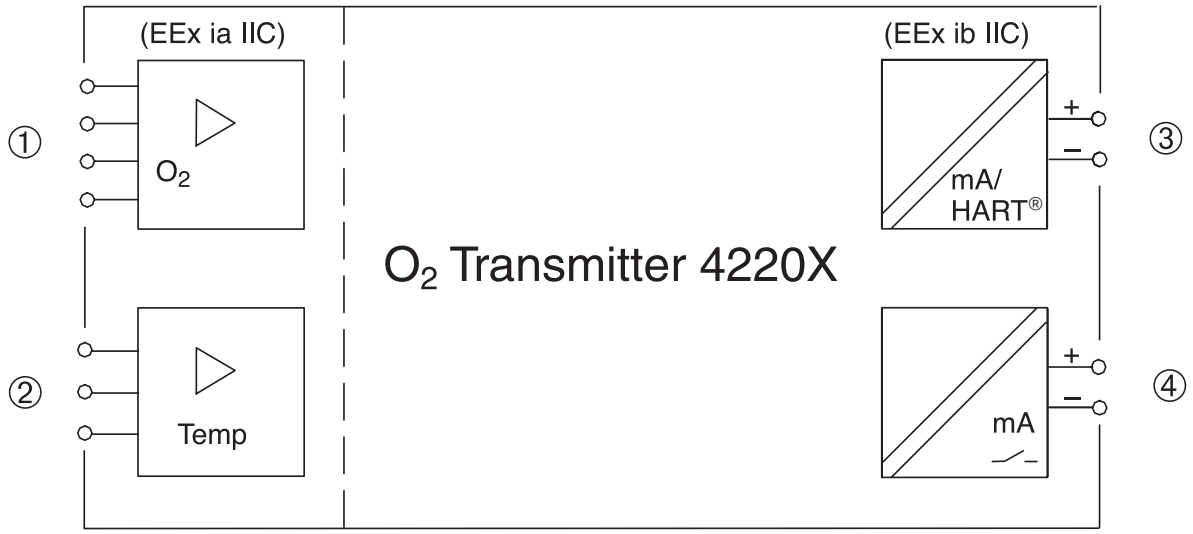
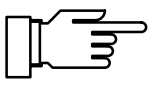


Fig. 2-1 System functions of O_2 Transmitter 4220X

Fig. 2-1 shows the system functions. The measuring inputs ① and ② are designed for the connection of all Mettler Toledo dissolved oxygen sensors.

Output 1 ③ is galvanically isolated and operates as a current sink for the 4 to 20 mA (22 mA) loop current (supply unit required).
It supplies the Transmitter with power from the loop current, analogously transmits the configured measured value and provides for digital HART® communication by overlaying an FSK* signal. This allows to read out all measured values and status messages from the O_2 Transmitter 4220X.

The galvanically isolated Output 2 ④ also operates as a current sink for the 0(4) to 20 mA (22 mA) loop current (supply unit required). It can transmit a further user-defined process variable or can be used as a switching or controller output.



Outputs 1 and 2 are additionally capable of transmitting alarm and warning messages as 22 mA signals. Parameter setting is described from Page 4-22 on in the “Alarm processing / NAMUR signals” chapter.

*) FSK: Frequency shift keying

Terminal assignments

Insert jumper 4, 5 if necessary!
(also see Pg 2-4)

Insert jumper 7, 8 if necessary!
(also see Pg 2-4)

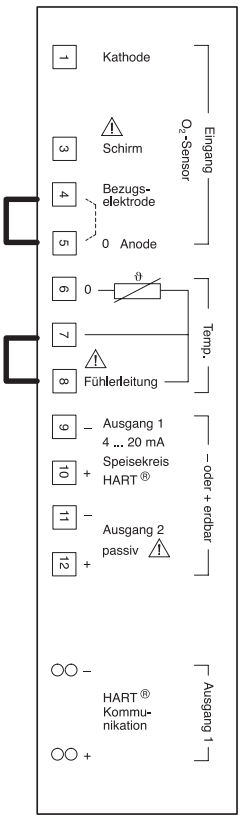


Fig. 2-2 Terminal assignments

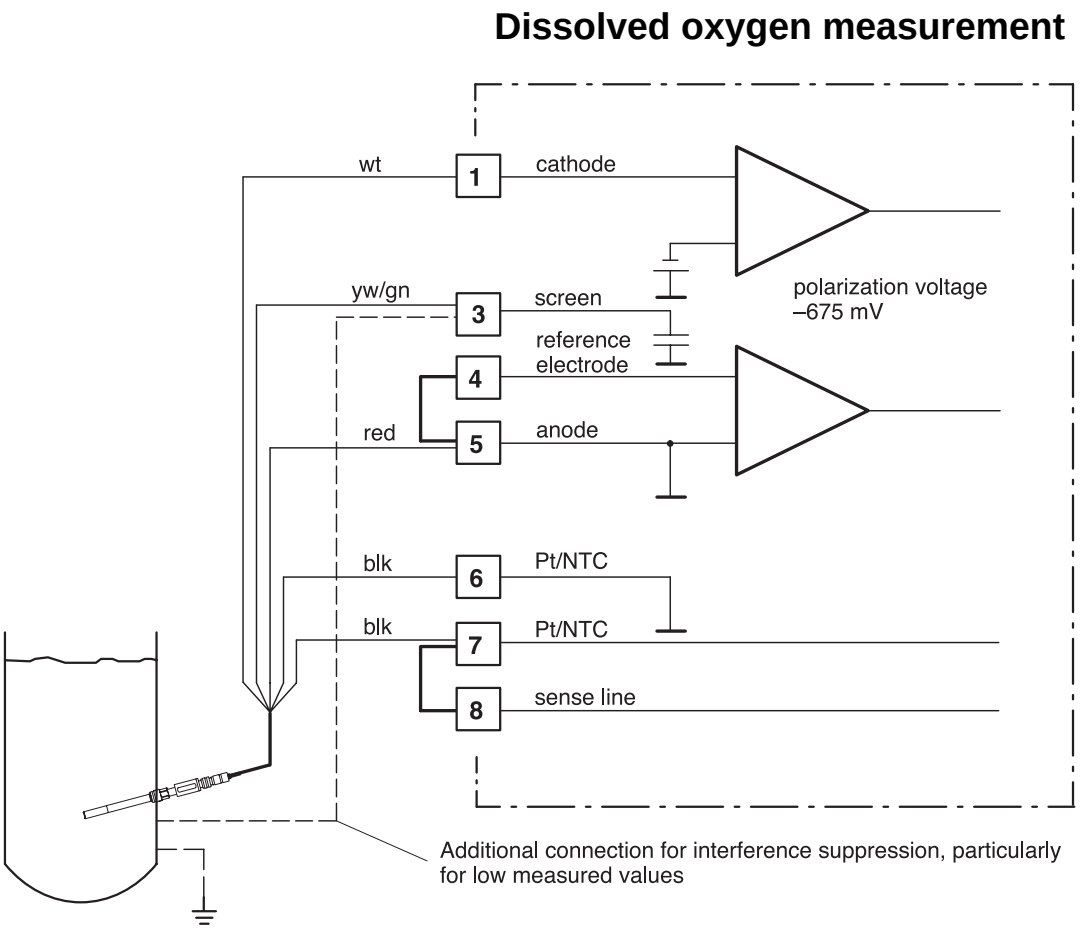


Fig. 2-3 Connection of the O_2 Transmitter 4220X to the Mettler Toledo DO sensors

Electrode connection

Grounding terminal 5 is not permitted. Terminals 4 and 5 must always be connected to each other.

Shielding

The shielding of the sensor cable (yw/gn at terminal 3) ends at the sensor connector.
On the connection side, it must end within the ESD shield (see Fig. 2-4). Terminal 3 may be grounded (as close to the measuring point as possible).

Possible measurement problems

Interferences can be injected into the sensor via the sensor body, which is particularly disturbing with low measured values. To remedy this problem, make an additional connection from terminal 3 to the sensor body or to a suitable point near the sensor, which is conductively linked to the sensor body. Do not connect terminal 5 to ground!

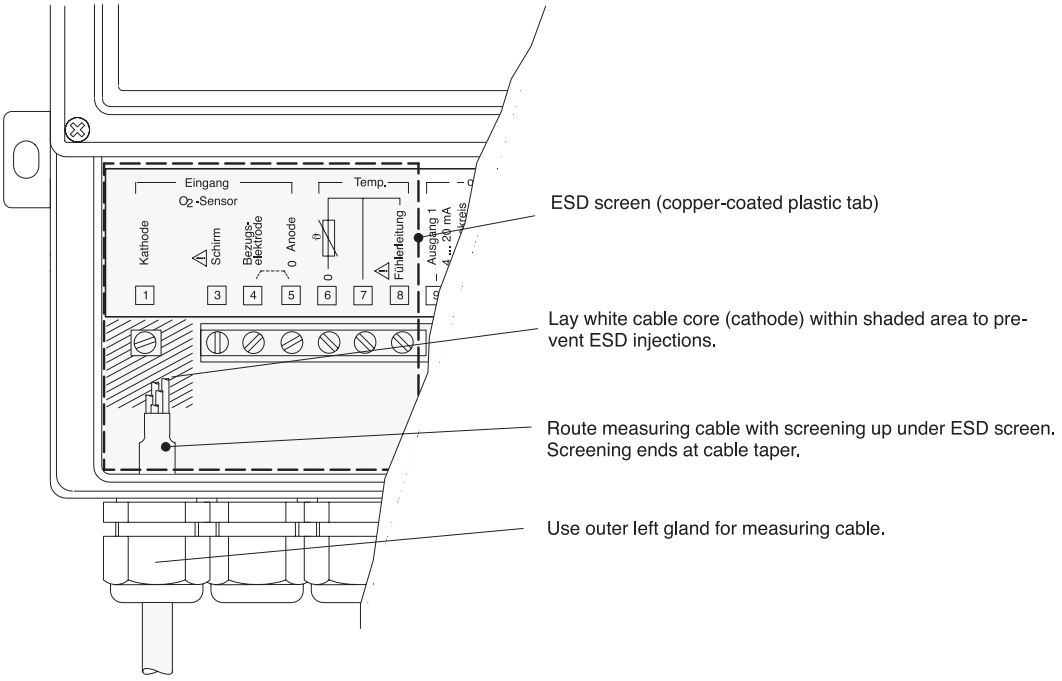


Fig. 2-4 Installation of sensor cable within O_2 Transmitter 4220X to prevent injection of electrostatic discharges (ESD)

Temperature detection

Why temperature compensation?

The detection of the temperature of the process or calibration solution is important for two reasons:

- Compensation of the temperature dependence of the sensor membrane: The oxygen permeability of the membrane increases as the temperature rises. Therefore, the temperature is detected and the measured value compensated.
- Temperature-corrected display of oxygen concentration: The oxygen solubility in water and the water-vapor partial pressure are temperature-dependent.

Temperature compensation

The temperature is automatically detected with the temperature probe integrated in the sensor (Mettler Toledo DO sensors: NTC 22 kΩ) and included in the measured-value calculation (see Fig. 2-3). The O_2 Transmitter 4220X allows to work with manual temperature specification or with a separate Pt 100 / Pt 1000 temperature probe.

Passive output 2

If your Transmitter is equipped with Option 487 (second current output, passive), an additional output is available to you.
This output is passive. It must be supplied by an additional power supply (e.g. WG 20 isolated supply).

Output 2 can be used either as 0 – 20 mA (22 mA) current output or as switching output (alarm contact or limit contact).

As a current output it can be defined for the various process variables. In addition, a message for failure, warning, and functional check can be output as 22 mA signal.

If your Transmitter is also equipped with Option 353 (Controller function), you can use the output as an analog or switching controller output .

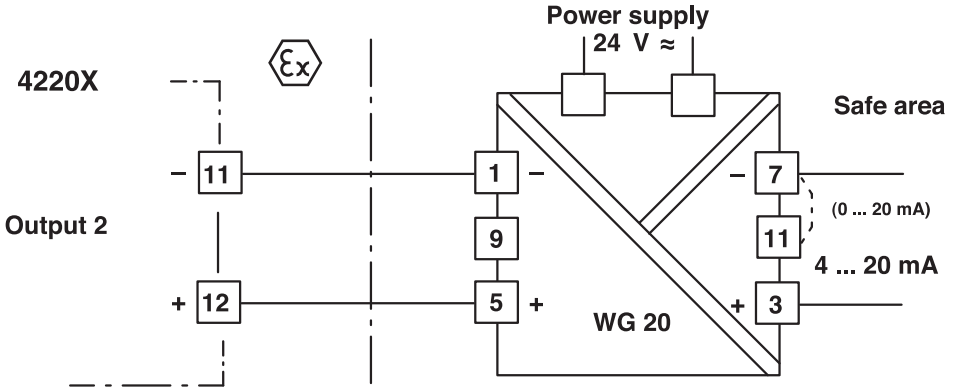


Fig. 2-5 Connection of output 2 as current output with WG 20

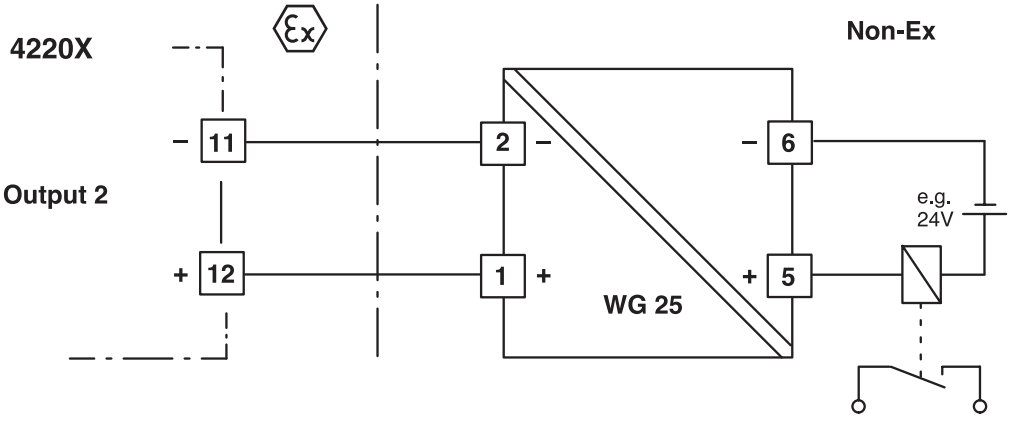


Fig. 2-6 Connection of output 2 as switching output with WG 25
(Observe the technical specifications of WG 25.)

Typical wiring

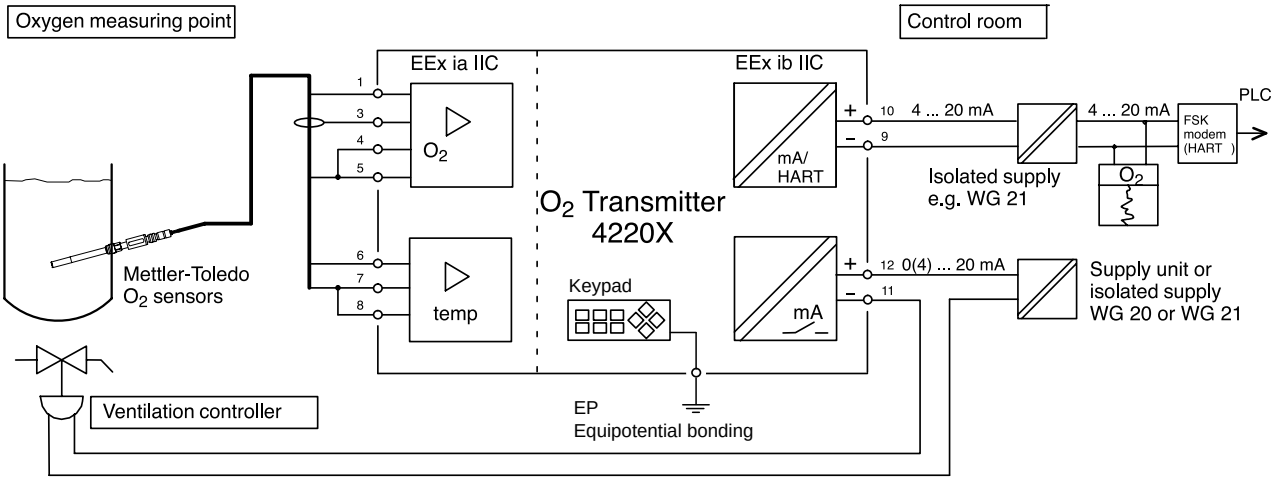


Fig. 2-7 Dissolved oxygen measurement with recorder evaluation, control and connection to a process control system

Connect EP terminal to equipotential bonding!
See Fig. 1-3 and Fig. 1-5 on Pg 1-3 and the following.

This page has been left empty for technical reasons.

3 Operating O_2 Transmitter 4220X

The O_2 Transmitter 4220X may only be commissioned by trained experts in accordance with this instruction manual and as per applicable local and national codes.

All parameters must be set by a system administrator prior to commissioning.

User interface

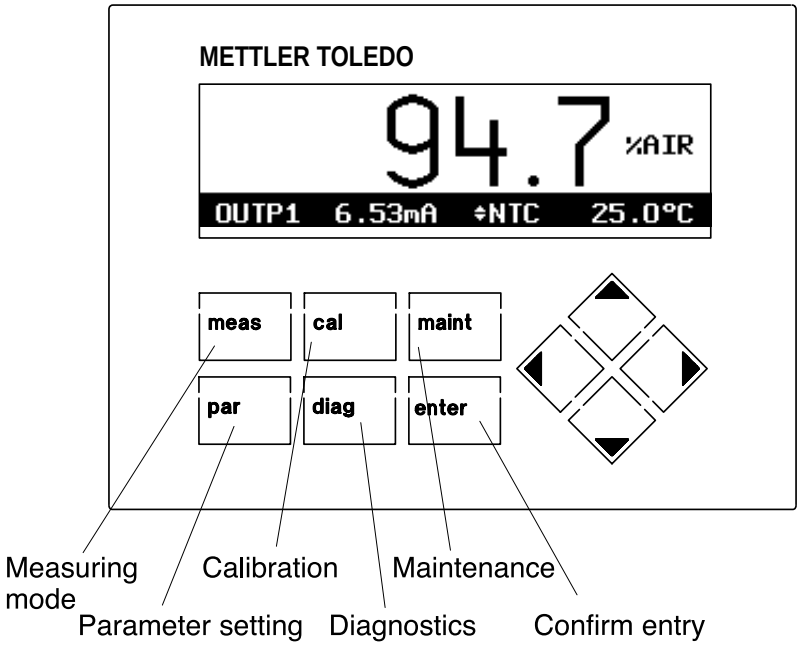
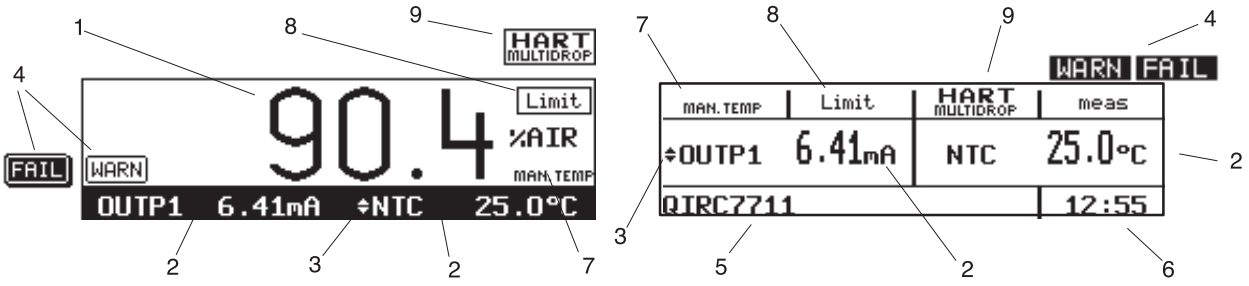


Fig. 3-1 User interface of the O_2 Transmitter 4220X

Measuring mode

In the measuring mode, two different types of numerical displays are available. If your unit is equipped with Option 448 (Measurement recorder), the variation of any two measured values can also be represented graphically. By pressing **meas** you can switch between the different display types.



The display consists of the following elements:

1 The measured value in the main display is selected during Parameter Setting (see Pg 4-3).

2 The measured values in the secondary displays are selected using ▲ and ▼ .

3 The selection symbol ⇕ indicates which secondary display can be edited.
By pressing ◀ or ▶ you can switch between the two secondary displays.

4 NAMUR messages: Warning (maintenance required) and failure

5 Tag number or note (Switch with **enter**)

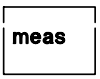
6 Current time

7 Reference to dependencies of process variables

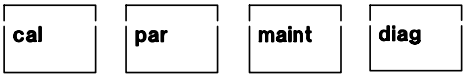
8 Limit values exceeded

9 HART® Multidrop mode is active. Output current 1 is permanently set to 4 mA. The FSK (HART®) signal is modulated onto the current.

Keypad assignment in measuring mode

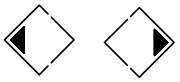


switches between the two different types of measured value display. With Option 448 also to the measurement recorder.

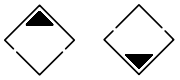


activates Calibration, Parameter Setting, Maintenance, or Diagnostics.

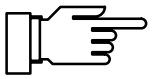
switches between tag number and note.



select secondary display for changing the process variable.



change process variable in the secondary display.

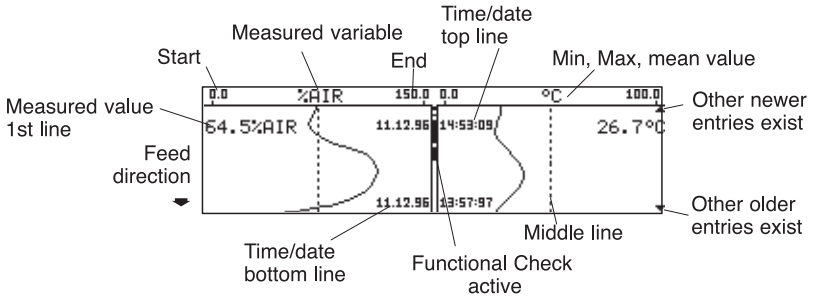


Refer to Page 4-3 for an overview of the process variables that can be displayed.

Measurement recorder

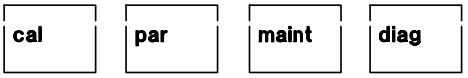
With the integrated measurement recorder (Option 448), the O_2 Transmitter 4220X provides you with a two-channel “on-site recorder”. For process visualization or, for example, for controller optimizing, the measurement recorder continuously registers two user-defined process variables and simultaneously displays them graphically next to each other in the system display. Process variable, measurement range, recording method, and time feed (scanning interval) parameters can be set within broad limits see Pg 4-3. The last 500 measured values are stored with time and date in the recorder memory of your unit. You can also display them numerically (see Pg 6-5).

The option (Measurement recorder) can be retrofitted via TAN (see Pg 4-29).



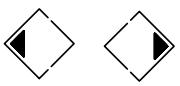
Keypad assignment for measurement recorder

switches to measurement display.

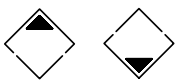


activates Calibration, Parameter Setting, Maintenance, or Diagnostics.

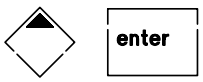
jumps to current entry.



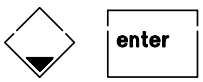
scroll to next or previous page.



scroll to next or previous line.



jumps to current entry.



jumps to oldest entry.

Menu structure

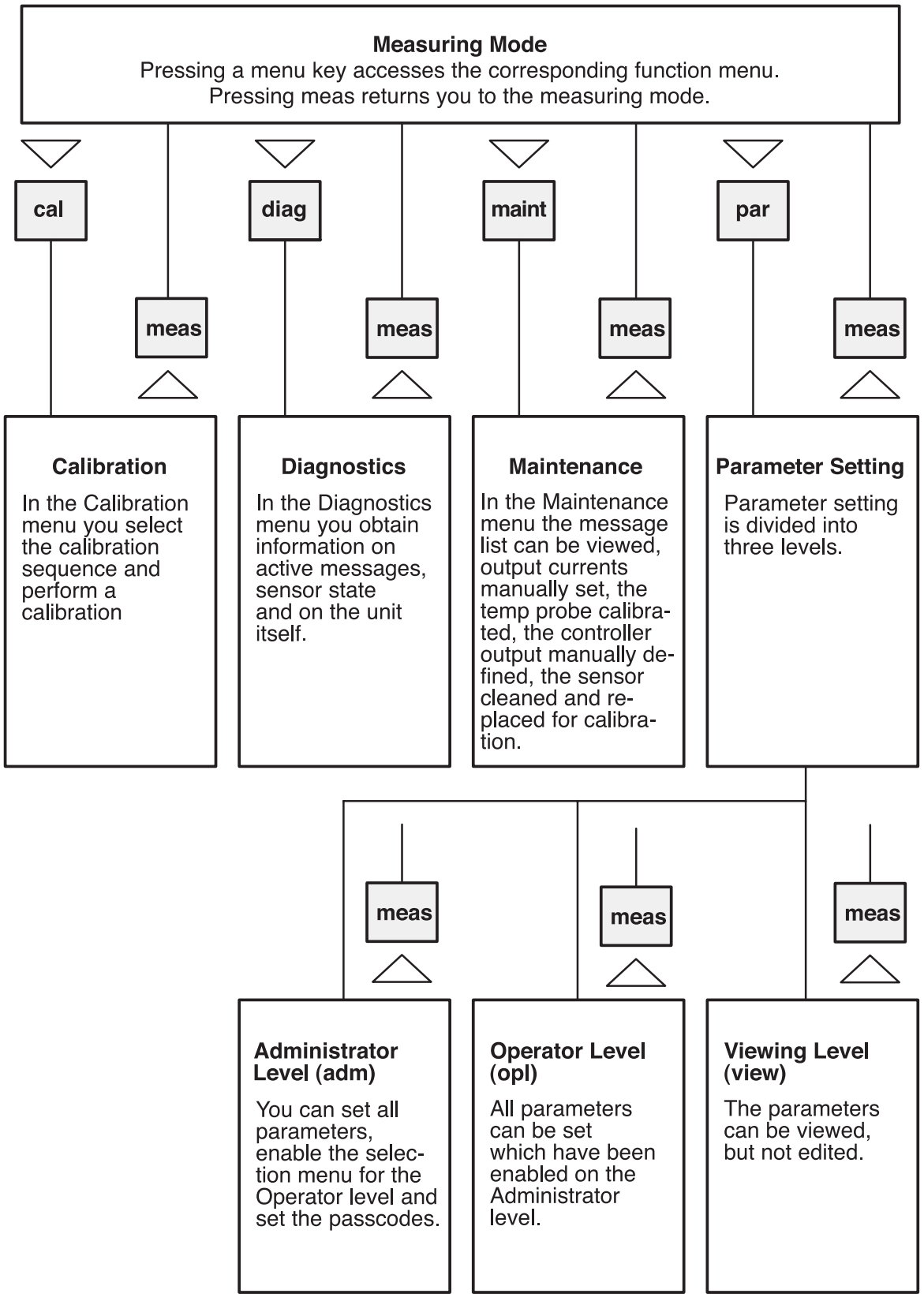
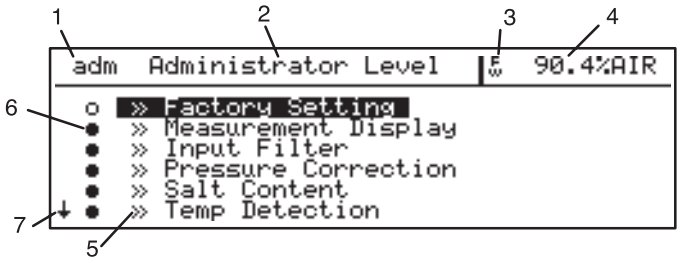


Fig. 3-2 Menu structure

Menu operation

When Calibration, Maintenance, Parameter Setting or Diagnostics are active, the display shows the respective menu for operating the functions.

Operator guidance is supported by a 7-line plaintext display with information texts. During operation, the measured value display (4) and the active status messages (3) remain visible.



The menu display consists of the following elements:

1 The abbreviation shows you which menu you are in:

cal	Calibration menu
maint	Maintenance menu
view	Parameter Setting, Viewing level
opl	Parameter Setting, Operator level
adm	Parameter setting, Administrator level
diag	Diagnostics menu
par	Parameter setting, language selection

2 The heading indicates the current menu level.

3 The status display shows active warning ($_W$) and/or failure messages (^{F}).

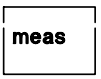
4 The measured value is also visible in the menus.

5 The » symbol indicates that this menu item contains a submenu.

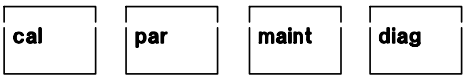
6 The marker setting is only visible in the Parameter Setting menu. At the Administrator level you can block individual menu items for the Operator level (see Pg 4-2).

7 In longer menus it is not possible to display all lines at the same time. The ↑ and ↓ symbols indicate that there are further menu lines.

Keypad assignment for menu operation:

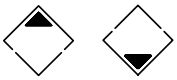


Exits the menu system and returns to measuring mode. In the Calibration or Maintenance menus you are prompted to confirm that your equipment is ready for measurement.



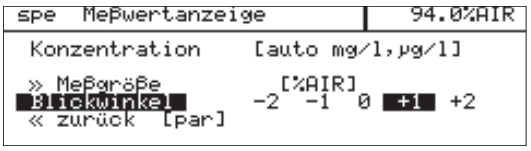
Cancel: To cancel an entry (without storing) or to exit a submenu, you can use the corresponding menu key. That means: Parameter Setting can be canceled by pressing **par** , Diagnostics by pressing **diag** , etc.

How to select a menu item:

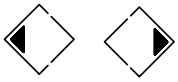


Select the desired menu item using the scrolling keys. The selected line is marked by a dark bar (reverse video).
The scrolling keys provide a repeat function: When a key is held down, the lines are scrolled through.

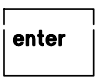
Pressing ▶ or **enter** accesses the next (lower) menu level.



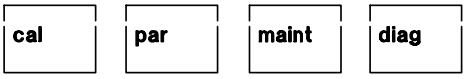
How to change a setting:



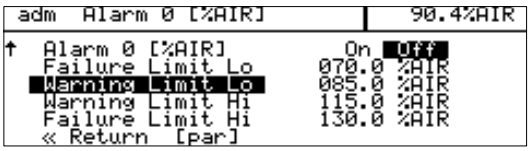
Pressing a cursor key changes the setting. The selected position is shown in reverse video.
The entry position flashes, as it has been modified but not yet stored.



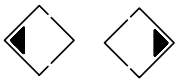
Pressing **enter** stores the new setting. Flashing stops.



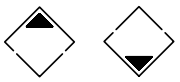
Pressing the menu key (e.g. **par**) instead of **enter** restores the old setting.



How to change numerical values:

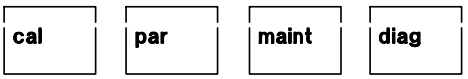


Moves the cursor within the entry area. With these keys, you select the entry position.
When the entry value has a sign, it can be selected by pressing ◀.
If you edit a numerical value with an entry area covering several decades (e.g. conductivity), the ⇆ symbol appears in front of the numerical value. Now you can displace the decimal point using the cursor keys.

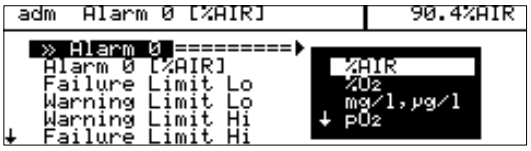


Pressing a scrolling key scrolls the numbers from 0 through 9 or changes the sign.

Pressing **enter** stores the edited setting.

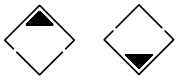


Pressing the menu key (e.g. **par**) instead of **enter** restores the old setting.



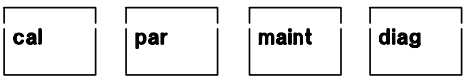
How to select parameters in a pull-down menu:

Pressing ▶ or **enter** accesses pull-down selection. An inverted menu is displayed.



Select the desired menu line using the scrolling keys. The selected line is highlighted.
The entry line flashes, as it has been modified but not yet stored.

Pressing **enter** stores the edited setting.



Pressing the menu key (e.g. **par**) instead of **enter** restores the old setting.

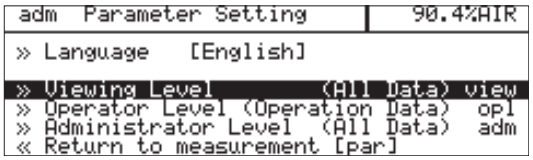
4 Parameter setting

Commissioning of the O_2 Transmitter 4220X may only be carried out by trained experts in accordance with this instruction manual.
All parameters must be set by a system administrator prior to commissioning.

Language selection

When you access the Parameter Setting level, you can select the language for the displays and menu texts. German, English, French, Italian and Spanish are available.
(Optionally Swedish instead of Spanish)

The three levels of parameter setting



The Parameter Setting menu is divided into the Viewing, Operator and Administrator levels according to the user's degree of specialization.

- At the Viewing level the settings can be displayed but not edited.
- At the Operator level only the marked menu items can be edited.
- At the Administrator level all parameter setting functions can be accessed. In addition, markers can be set for each menu item to create an optimal user menu for the Operator level.
  Passcodes protect the Operator and Administrator level against unauthorized access. The passcode protection for the Operator level can be switched off if required.

The levels are identified by abbreviations in the upper left corner of the display.

view – Viewing level
opl – Operator level
adm – Administrator level

Access to the Operator level can be protected with a passcode if necessary. Access to the Administrator level is always protected with a passcode.

Viewing level

At the Viewing level you can have a look at all settings of the Transmitter.
The settings cannot be edited!

Operator level

At the Operator level you can only edit those parameters (menu items) which have been enabled at the Administrator level.

Whether a menu item has been enabled is indicated by the dot preceding the corresponding menu line.

- ● This menu item can be edited.
- ○ This menu item is locked: It cannot be edited. The menu item is skipped during scrolling. However, it can be accessed at the Viewing level.

Access to the Operator level can be protected with a passcode if necessary.

Administrator level

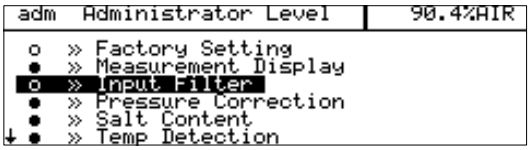
At the Administrator level you can edit all instrument settings including the passcodes. In addition, the marker function allows you to lock individual menu items to prevent access from the Operator level.

As delivered, all menu items are enabled.
Access to the Administrator level is always protected with a passcode.

Marker setting

An information text explains the marker setting at the Administrator level.
By setting markers you can enable or lock individual menu items at the highest level of the Parameter Setting menu (except “Passcode Protection”) for the Operator level:

- ● This menu item has been enabled:
  It can be edited at the Operator level.
- ○ This menu item is locked:
  It cannot be edited at the Operator level.
  However, it can be accessed at the Viewing level.



How to set a marker

Press ◀ to select the marker.
Press ▼ or ▲ to enable (●) or lock (○) the menu item. Confirm the setting with **enter** .

Factory setting

At the Administrator level, you can reset all settings to the initial factory setting.

Before the O_2 Transmitter 4220X is started again, a complete parameter setting procedure must be performed by a system administrator.

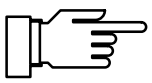
Measurement display

During parameter setting you can define which measured value is to appear in the large display in measuring mode. The following process variables can be displayed:

- Oxygen saturation (referred to air) (%AIR)
- Oxygen saturation (referred to pure oxygen) (%O_2)
- Oxygen concentration (mg/l or ppm)
- Oxygen partial pressure (mbar)
- Temperature (°C)
- Time

The following variables can be shown in the secondary displays:

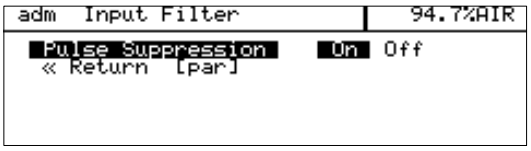
- MAN Manual measuring temp (°C)
- p Barometric pressure, manual
- OUTP1 Output current 1
- OUTP2 Output current 2 (with Option 487 only)
- Sensor current in nA
- CTIME Calibration timer in h
- Xw Controller setpoint (with Option 483 and active controller)
- CTL-Y Controller output (with Option 483 and active controller)
- DATE Date



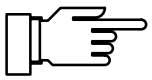
See Pg 3-2 for how to select the process variables for the secondary displays.

The “Viewing Angle” menu item allows you to adjust the viewing angle of the display.
When the Transmitter is mounted at a very high or a very low position, you can adjust the viewing angle for optimum display readability.
Select the desired viewing angle (+ means viewing angle upwards and – means viewing angle downwards) and confirm your choice. You see the change immediately in the display.

Input filter



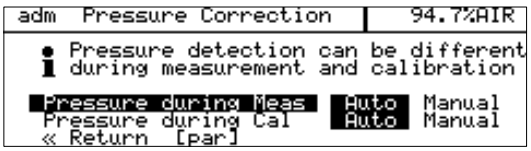
To increase the immunity to interference during measurement, an input filter can be switched on. When the filter is switched on, momentary interference pulses will be suppressed, slow changes in the measured value will be detected.



If fast measured-value changes are to be detected, you must switch off the input filter.

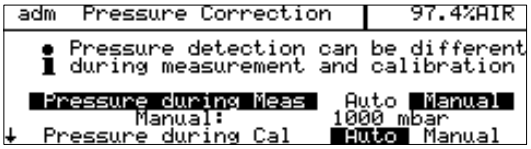
Pressure correction

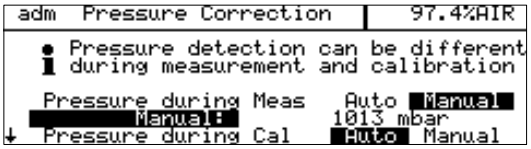
The signal delivered by the DO sensor is directly proportional to the oxygen partial pressure. Since the partial pressure changes with the total pressure (barometric pressure), the O_2 Transmitter 4220X must detect the total pressure and take it into account to obtain the percent saturation as a pressure-independent process variable.



Automatic pressure detection

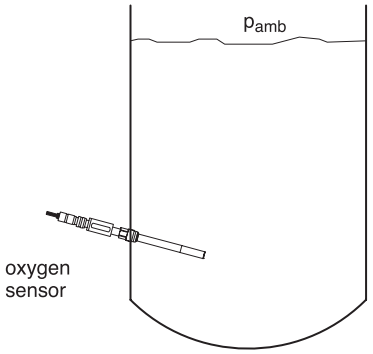
The pressure detection methods used during measurement and during calibration can be set independently. Select whether pressure detection during measurement or during calibration is to be set.



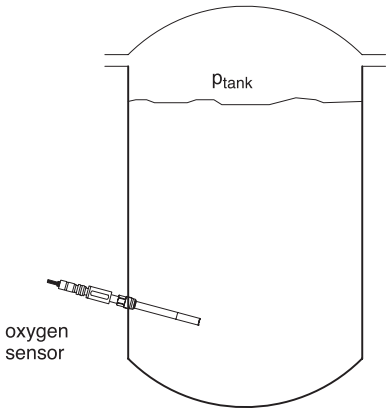


Manual pressure specification

If “manual” has been selected, the pressure can be entered and confirmed with **enter**.



open container



closed container

The integrated pressure sensor detects the ambient air pressure (p_{amb}).

In closed containers the pressure must be measured directly in the gas-filled space of the container. You can enter the pressure value manually.

Measurement in an open container:

$p = p_{amb}$ [p_{amb} = ambient air pressure]

p_{amb} is automatically detected by the integrated pressure sensor.

Measurement in a closed container:

$p = p_{tank}$ [p_{tank} = pressure in gas-filled space of container]

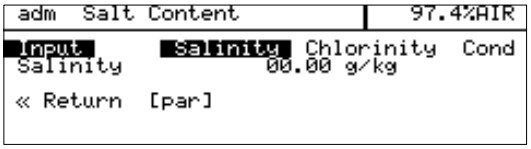
The pressure in the gas-filled space of the container p_{tank}) can be entered manually in the Transmitter.

Salt content

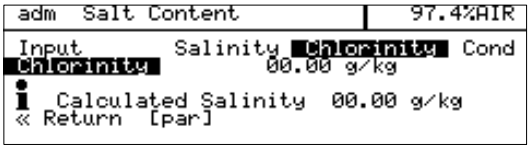
Membrane-covered oxygen sensors supply a current proportional to the oxygen partial pressure. With Henry's Law, the oxygen concentration can be calculated from the oxygen partial pressure via a solubility coefficient. The solubility coefficient is dependent on both the medium in which the oxygen is dissolved and on the salt content and temperature of the medium.
The influence of the medium's salt content (salinity to EN 25814 1992) on the solubility can be taken into account by the O_2 Transmitter 4220X.
The salt content is either specified directly as the salinity or chlorine content, or the conductivity and temperature of the medium are entered. The salinity is calculated from the conductivity and temperature using the International Oceanographic Tables, Unesco / National Institute of Oceanography of Great Britain Volume 2, Wormley/ Godalming/ Surrey.

How to set the salt content parameters

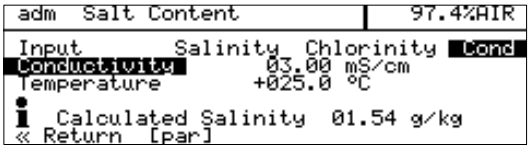
Open a Parameter Setting menu and select “Salt Content”.



Select whether you want to enter the salinity directly or specify the chlorine content or a conductivity value (Cond).



Enter the selected value.



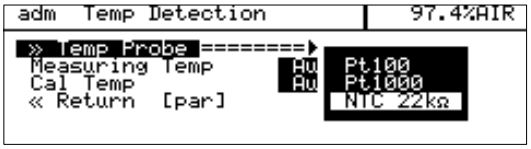
If you specify a conductivity value, you can also enter the temperature value.

The corresponding salinity value is calculated from the chlorine content or the conductivity value and then used for correcting the oxygen concentration value.

Temperature detection

The temperature is automatically detected with the temperature probe integrated in the sensor (Mettler Toledo DO sensors: NTC 22 kΩ) and included in the measured-value calculation.

Automatic temperature compensation

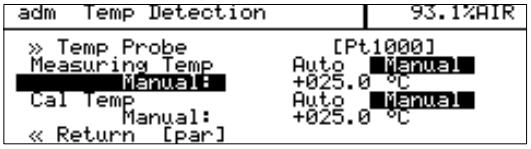


The Mettler Toledo dissolved oxygen sensors have an integrated NTC 22 kΩ temperature probe.

Select the NTC 22 kΩ probe in the Temp Probe menu.

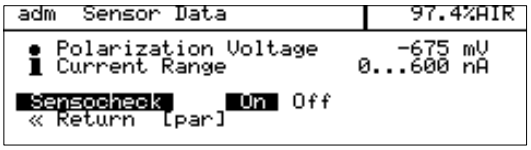
The process temperature is automatically detected with the integrated temperature probe and taken into account for compensation.

Manual temperature compensation



The O_2 Transmitter 4220X allows to work with manual temperature specification or with a separate Pt 100 / Pt 1000 temperature probe.

Sensor data



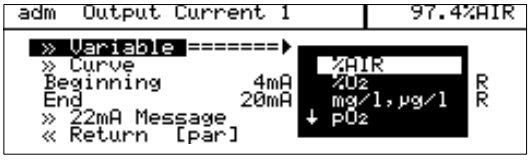
The sensor data for the Mettler Toledo dissolved oxygen sensors are preset in the O_2 Transmitter 4220X.

- Polarization voltage
  During amperometric oxygen measurement the oxygen is cathodically reduced. Therefore, the required polarization voltage is negative. It is -675 mV.

- Temperature probe
  (Default setting: NTC) The SE 704 and SE 705 sensors are equipped with an NTC 22 kΩ.

- Sensocheck®
  (Default setting: Off)
  The Sensocheck® sensor monitoring function has been optimized for the Mettler Toledo dissolved oxygen sensors.
  With Sensocheck® switched on, the impedance between the anode and cathode is monitored. Rapid impedance changes, e.g. due to mechanical stress on the membrane, trigger the message “Warn Sensocheck”. You can acknowledge (reset) this message in the Maintenance menu or perform a new calibration (and maintenance, if required) of the DO sensor. Appearance and disappearance of this message is recorded in the logbook. Slow impedance changes have no effect.

Sensocheck® has been optimized for automatic temperature compensation. When using manual temperature compensation, Sensocheck® should be switched off to prevent false alarms.



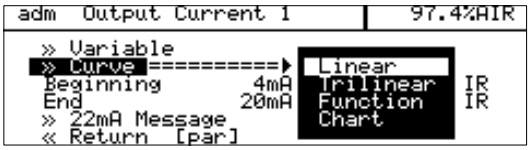
Output 1

Output 1 is galvanically isolated and operates as a current sink for the 4 to 20 mA loop current (supply unit required).
It supplies the Transmitter with power from the loop current and analogously transmits the configured process variable.
The output current can be shown in a secondary display (see Pg 3-2).
The output current can be assigned to one of the following process variables:

- Oxygen saturation (referred to air) (%AIR)
- Oxygen saturation (referred to pure oxygen) (%O_2)
- Oxygen concentration (mg/l or ppm)
- Oxygen partial pressure (mbar)
- Measured temperature (°C)

The output current is frozen at its last value:

- during calibration
- in the current source function (manual entry)
- in the “**maint** Meas. Point Maint.” menu
- during a wash cycle

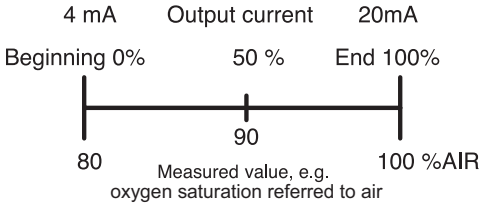


Output curves of the current output

There are four output curves to choose from for the current output:

- Linear
- Trilinear (bilinear)
- Function
- Chart (Option 449)

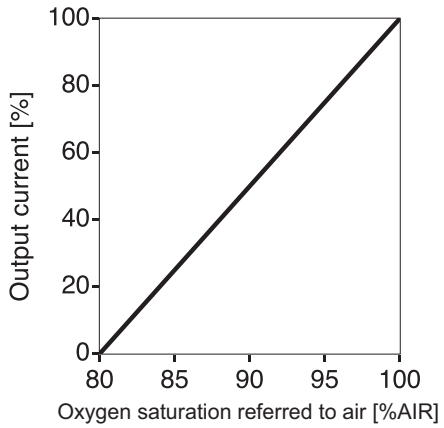
If the initial value is lower than the end value, a rising output curver will result.
To define a falling output curve, set the lower value as the end value and the higher value as the initial value of the process variable.

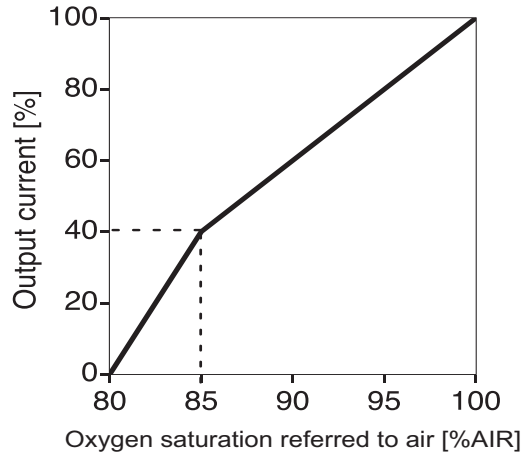


Linear output curve

To determine the span corresponding to the current range 4 – 20 mA, set an initial and an end value for the process variable.

For permissible spans, refer to the Specifications, Chapter 11.



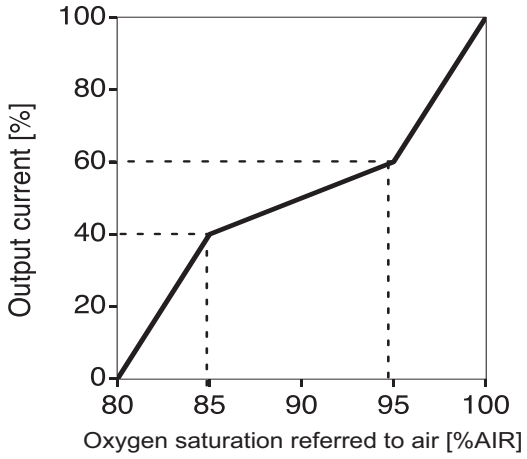


Bilinear output curve

To define a bilinear output curve, set the same X and Y values for the two corner points of a trilinear curve.
To determine the span corresponding to the current range 4 – 20 mA, set an initial and an end value for the process variable.
In addition, you can define a corner point. It divides the output curve into two regions of different slopes.

Example:

Start:	80 %AIR
1st corner X:	85 %AIR
1st corner Y:	40 %
2nd corner X:	85 %AIR
2nd corner Y:	40 %
End:	100 %AIR

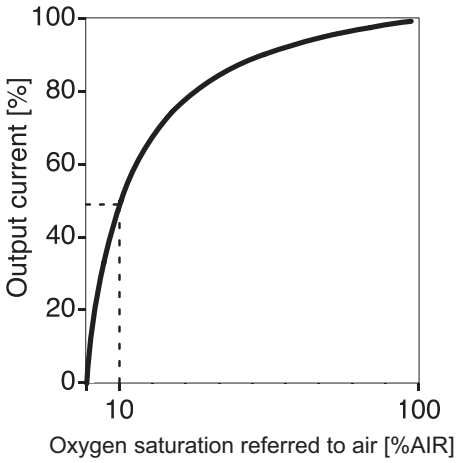


Trilinear output curve

To determine the span corresponding to the current range 4 – 20 mA, set an initial and an end value for the process variable.
In addition, you can define two corner points. They divide the output curve into three regions of different slopes.

Example:

Start:	80 %AIR
1st corner X:	85 %AIR
1st corner Y:	40 %
2nd corner X:	95 %AIR
2nd corner Y:	60 %
End:	100 %AIR



Output curve “function”

If low oxygen values are to be measured with a high resolution but also high oxygen values are to be detected, it is advisable to measure over several decades.
With the output curve “function”, a nonlinear output current characteristic can be implemented. By defining a 50% point, you can spread the beginning and compress the end of the range as required. This allows you to create a good approximation of a logarithmic output curve.

To determine the span corresponding to the current range 4 – 20 mA, set an initial and an end value for the process variable. In addition, you can define a 50% point (at 12 mA).

Between the initial and end value, the output current is calculated from the following equations:

$$\text{Output current (4 to 20 mA)} = \frac{(1 + K)\,x}{1 + K\,x}\ 16\text{ mA} + 4\text{ mA}$$

$$K = \frac{E + I - 2\,X50\%}{X50\% - I} \qquad x = \frac{M - I}{E - I}$$

I:	Initial value at	4 mA
X50%:	50% value at	12 mA
E:	End value at	20 mA
M:	Measured value	

Example:
logarithmic output curve over one decade

Approximation of a logarithmic output curve in the range 10 to 100%AIR (one decade):

Start:	10.0 %AIR
50% point:	31.6 %AIR
End:	100.0 %AIR

Example:
logarithmic output curve over two decades

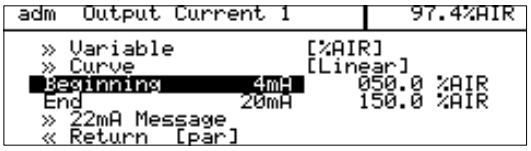
Approximation of a logarithmic output curve in the range 1 to 100%AIR (one decade):

Start:	1.00 %AIR
50% point:	10.0 %AIR
End:	100.0 %AIR

Output curve via user-defined chart (Option 449)

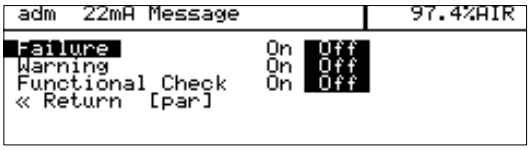
If your O_2 Transmitter 4220X is equipped with Option 449, you can enter the parameters of the current output curve in this chart in 1 mA steps.
The slope of the entered curve must be either positive (rising) or negative (falling) throughout its whole length. The O_2 Transmitter 4220X checks whether there are points of inflection in the curve and gives a warning if the case arises.

Setting beginning and end of output current



In addition to the process variable and curve, the start and end values for the output current must be defined.

22mA message

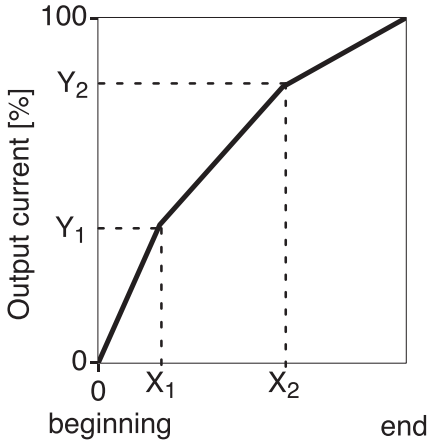


Current output 1 can be defined for output of the NAMUR signals Failure, Warning and Functional check (22 mA message). The output current is then set to 22 mA in the case of a message.
(Also see Alarm processing on Pg 4-22)

During Multidrop mode of the HART® interface output current 1 is permanently set to 4 mA.
In Multidrop mode the Transmitter momentarily draws a current of approx. 22 mA when switched on.

Error messages for output settings

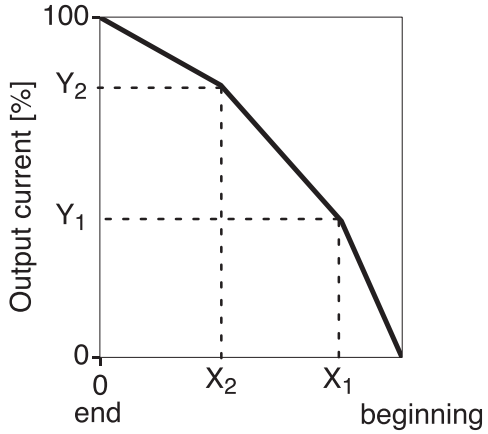
The output current is linearly output (determined only by initial and end value). The alarm message “Warn Current Para” is generated if the settings fulfil one of the following conditions:



Trilinear (bilinear) curve
(rising, beginning < end):
- 1st corner X ≤ beginning
- 2nd corner X ≥ end
- 1st corner X > 2nd corner X
- 1st corner Y ≤ 0 %
- 2nd corner Y ≥ 100 %
- 1st corner Y > 2nd corner Y

Bilinear curve (rising, beginning < end):

- 1st corner X = 2nd corner X and
  1st corner Y ≠ 2nd corner Y



Trilinear (bilinear) curve
(falling, beginning > end):

(Beginning is always at 0 %
End is always at 100 %
1st corner X is always at beginning
2nd corner X is always at end)
- 1st corner X ≥ beginning
- 2nd corner X ≤ end
- 1st corner X < 2nd corner X
- 1st corner Y ≤ 0 %
- 2nd corner Y ≥ 100 %
- 1st corner Y < 2nd corner Y

Bilinear curve (falling, beginning > end):

- 1st corner X = 2nd corner X and
  1st corner Y ≠ 2nd corner Y

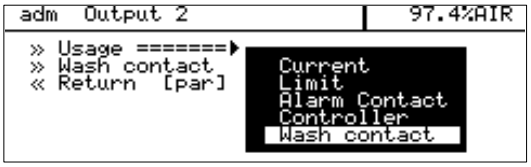
Curve “function” (rising, beginning < end):

- 50% point ≤ beginning
- 50% point ≥ end

Curve “function” (falling, beginning > end):

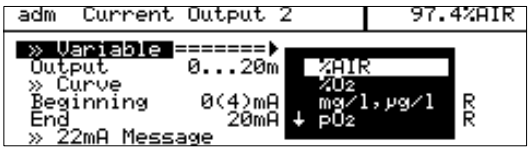
- 50% point ≥ beginning
- 50% point ≤ end

Output 2

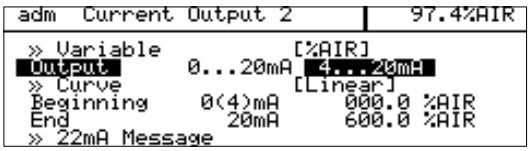


If your Transmitter is equipped with Option 487, you can use an additional output. The galvanically isolated output 2 also functions as a 0 (4) – 20 mA current sink (supply unit required). It serves to transmit an additional definable process variable, can be used as a switching output for limits or alarms or as wash contact.
If your Transmitter is also equipped with Option 353 (Controller function), you can use the output as a controller output.

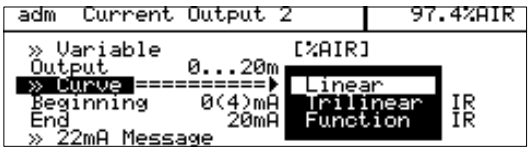
Set as a current output



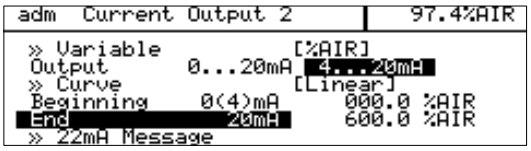
If output 2 is set as a current output, one of the following process variables can be output:
- Oxygen saturation (referred to air) (%AIR)
- Oxygen saturation (referred to pure oxygen) (%O_2)
- Oxygen concentration (mg/l or ppm)
- Oxygen partial pressure (mbar)
- Measured temperature (°C)



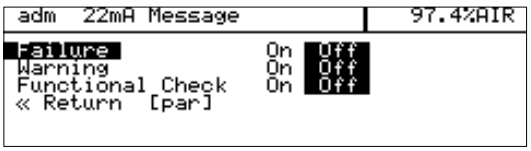
Select the output current range 0 - 20 mA or 4 - 20 mA



You can define the curve as linear, trilinear, or as a function (also see Pg 4-9 and the following).

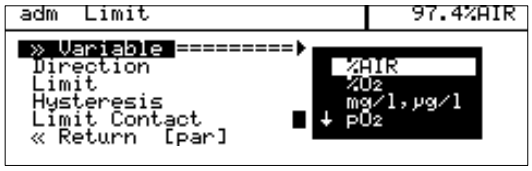


Define the beginning and end of scale for the desired process variable.



Current output 2 can be defined for output of the NAMUR signals Failure, Warning and Functional check (22 mA message). The output current is then set to 22 mA in the case of a message.
(Also see Alarm processing on Pg 4-22)

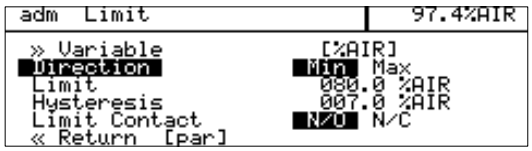
Output 2 is passive. It must be supplied by an additional power supply (e.g. WG 21 isolated supply).



Set as a limit contact

If output 2 is set as a limit contact, it can be controlled by the following process variables:

- Oxygen saturation (referred to air) (%AIR)
- Oxygen saturation (referred to pure oxygen) (%O_2)
- Oxygen concentration (mg/l or ppm)
- Oxygen partial pressure (mbar)
- Measured temperature (°C)

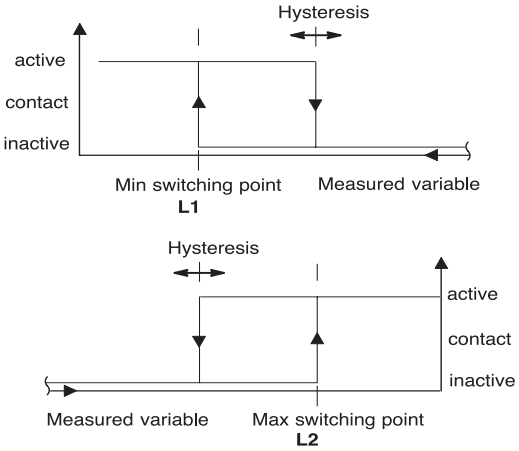


You can define the contact as follows:

- The variable
  controls the limit contact.

- The effective direction
  specifies whether the contact will be activated when the measured value falls below (Min) or exceeds (Max) the limit value.

Limits and Hysteresis

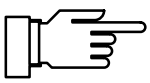


- The limit
  define the switching threshold.

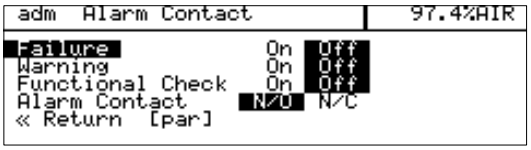
- The hysteresis
  specifies how far the measured value must fall below (Max) or exceed (Min) the limit value before the contact switches back.

- N/O or N/C contact
  specifies whether the active contact is closed (N/O) or open (N/C).

When the measured value falls below or exceeds the set limit, “Limit” appears in the display. Output 2 is active.



During calibration the limit contact is inactive!

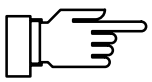


Set as an alarm contact

The alarm contact is used to output the NAMUR signals Failure, Warning and Functional check. These are triggered by alarm processing.
You can choose between a normally-open and a normally-closed contact.

(Also see Alarm processing on Pg 4-22)

Set as an analog controller

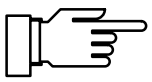


You can only make use of the controller function if your Transmitter is equipped with Option 483.

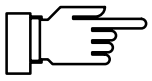
The analog controller can only operate unilaterally because only output 2 is available for outputting the manipulated variable. Therefore, you must select the range in which the controller is to operate:

- Range below setpoint: 0 to +100 %
- Range above setpoint: 0 to –100 %

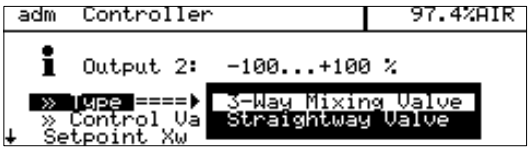
The controller only operates bilaterally when actuating a 3-way mixing valve.



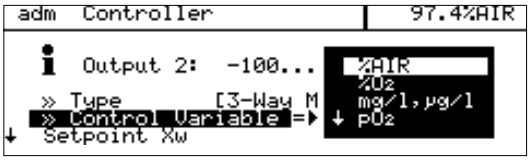
For a pure P controller (reset time = 0), you only need to define the control range used. For the range not used, however, it is necessary to enter reasonable parameters as otherwise the error message “Warn Control Para” will be output.



When using the controller as a PI controler (reset time ≠ 0), it is absolutely necessary to define the unused range. The manipulated variable (controller output) is influenced by both control ranges due to the integration time.

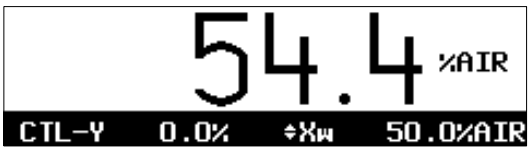


The following controller types are available:
- 3-way mixing valve
- Straightway valve



The following **controlled variables** can be defined:

- Oxygen saturation (referred to air) (%AIR)
- Oxygen saturation (referred to pure oxygen) (%O_2)
- Oxygen concentration (mg/l or ppm)
- Oxygen partial pressure (mbar)
- Measured temperature (°C)



The current value of the controller output (CTL-Y [%]) and the controller setpoint (X_w) can be shown in the secondary display in measuring mode.

With the definable feed time alarm, you can monitor the time during which the controller output is at +100 % or –100 %, i.e. how long the valve is fully open.
If this time is exceeded, this may be due to a shortage of air flow or a defective valve, for example.

Control characteristic

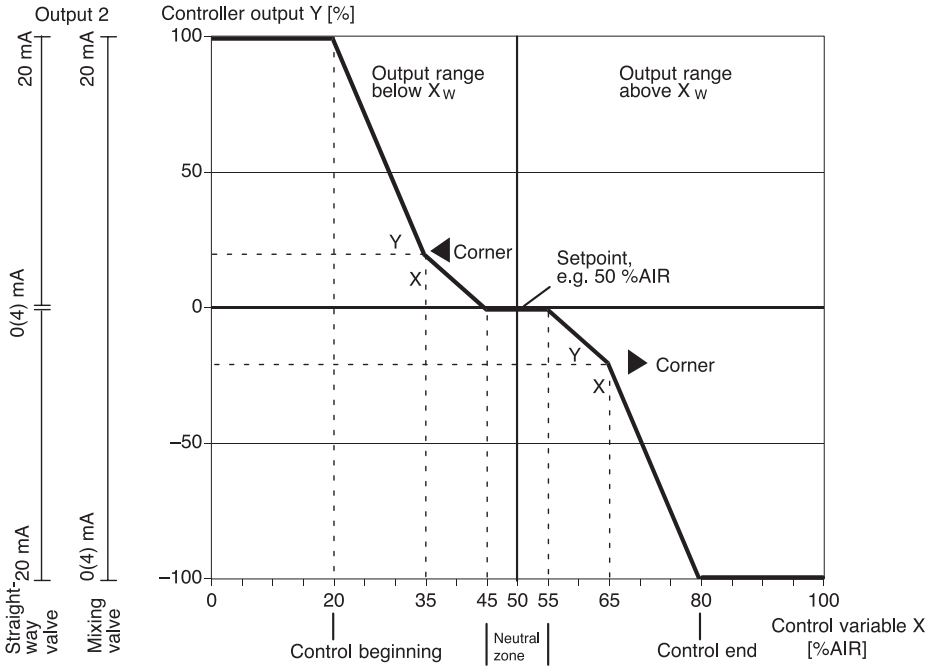


Fig. 4-1 Control characteristic

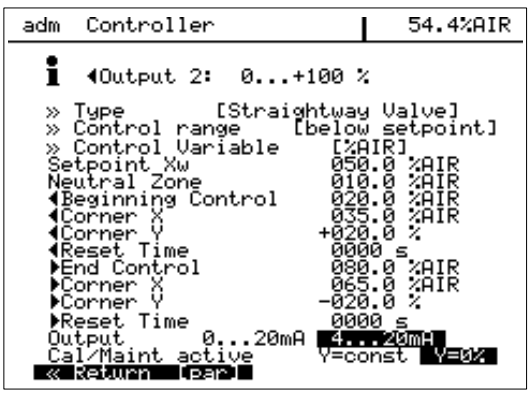
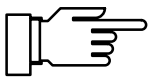


Fig. 4-1 shows the characteristic of the controller in the O_2 Transmitter 4220X. All points of the curve can be defined.

- The control range specifies the range in which the controller is active: above or below the setpoint X_w (not for 3-way mixing valve)
- Values are adjusted toward the setpoint.
- Beginning of control and
- End of control

  define the control range.
  Outside the control range the controller output remains at +100 % or -100 %.

- In the neutral zone no control takes place. The neutral zone is symmetrical to the setpoint and its width can be defined.
- With corner X and corner Y you can define a corner point for each control range (◀ : controlled variable < setpoint and ▶ : Controlled variable > setpoint). This allows you to define two different slopes to obtain an optimal control characteristic for strongly nonlinear curves, for example.
- The reset time specifies the I-action component of the controller. If you set " Reset Time 0000 s", the I-action component is turned off. The reset time can be defined separately for both control ranges (◀ : Controlled variable < setpoint and ▶ : Controlled variable > setpoint).
- With Cal/Maint active, you select whether the controller output is frozen at its last value (Y = const) or whether it goes to 0 % (Y = 0 %) during calibration and maintenance.



For test purposes, you can manually enter the controller output Y in the Maintenance menu (see Pg 7-3).

Controller output (manipulated variable)

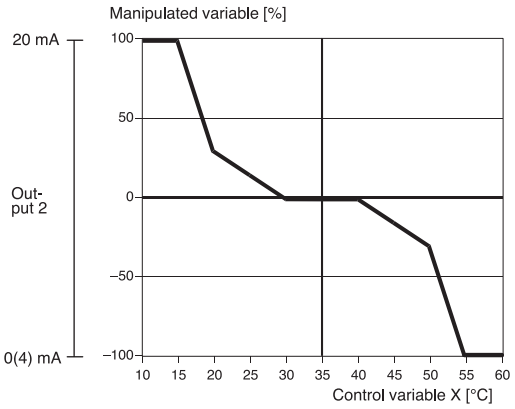
The manipulated variable (controller output) is output via output 2 as a current of either 0 to 20 mA or 4 to 20 mA. The valve type determines the behavior of the output current. You can choose between a 3-way mixing valve or a straightway valve.

With the 3-way mixing valve, output 2 operates over the entire control range:
- Y = –100 to +100 %
  corresponds to 0 (4) to 20 mA

When set as a straightway valve, you must select the output range:

- Control range below setpoint X_W:
  Controller output range 0 to +100 %
  corresponds to 0 (4) to 20 mA
- Control range above setpoint X_W:
  Controller output range 0 to -100 %
  corresponds to 0 (4) to 20 mA

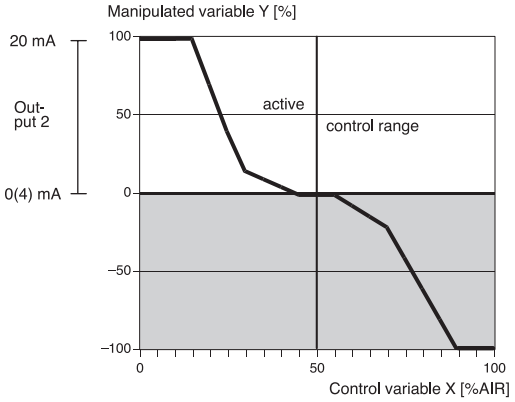
The current controller output and the setpoint can be shown in the secondary display (see Pg 3-2).



3-way mixing valve

For the 3-way mixing valve, output 2 is used for the entire control range. A controller output Y = 0 % then corresponds to a current of 10 or 12 mA, resp.

For example: For temperature control



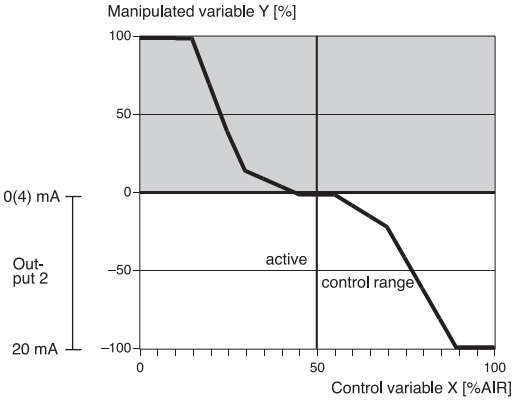
Straightway valve

In the straightway valve mode an analog control valve or a pump is actuated with 0 (4) to 20 mA. You define the output range in the Parameter Setting menu.

Output range below setpoint X_W

The analog controller output then operates in the range 0 to +100 % with +100 % corresponding to a current of 20 mA. The controller only outputs the manipulated variable below the setpoint. Above the setpoint the manipulated variable cannot be output and the output remains at 0 (4) mA.

For example: For controlling the air flow in fermentors



Output range above setpoint X_W

The analog controller output then operates in the range 0 to -100 % with -100 % corresponding to a current of 20 mA.
The controller only outputs the manipulated variable above the setpoint. Below the setpoint the manipulated variable cannot be output and the output remains at 0 (4) mA.

Error messages for controller settings

The controller will be switched off (manipulated variable Y = 0 %) and the alarm message “Warn Control Para” will be activated if any of the following conditions applies:

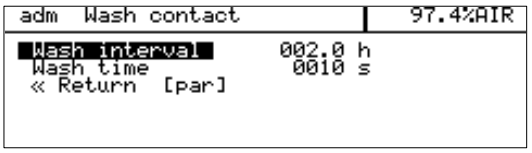
All controller types:

- Beginning ≥ setpoint – neutral zone / 2
- ◀ Corner X < beginning
- ◀ Corner X > setpoint – neutral zone / 2
- End ≤ setpoint + neutral zone / 2
- ▶ Corner X < setpoint + neutral zone / 2
- ▶ Corner X > end
- ◀ Corner Y>100 %
- Neutral zone < 0
- ▶ Corner Y>100 %

With the definable feed time alarm (see Pg 4-21) you can monitor the time during which the controller output is at +100 % or –100 %, i.e. how long the valve is fully open. If this time is exceeded, this may be due to a shortage of air flow or a defective valve, for example.

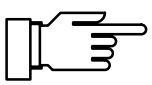
Set as a wash contact

If output 2 is set as a wash contact, the DO sensor can be automatically cleaned using an appropriate probe.



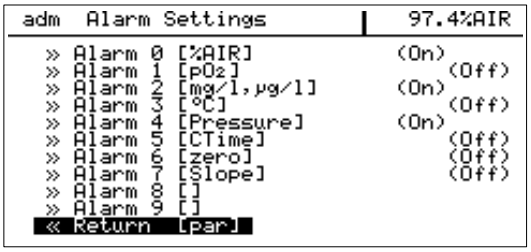
Wash interval and wash time are freely definable. If either of the two parameters is set to 0, the function is disabled.

During calibration and maintenance a wash interval is not started.

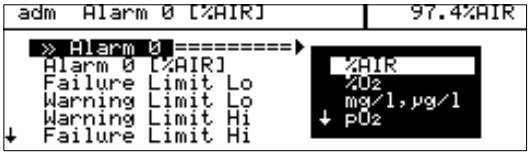


During the wash time the NAMUR Functional Check signal is active, the output currents are frozen at their last values or set to 22 mA.

Alarm settings

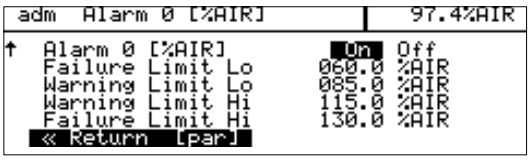


The O_2 Transmitter 4220X allows you to monitor up to 10 different measured values by warning and failure messages. These alarms are numbered from 0 through 9. For each alarm, you can separately define the process variable and the high and low limits for warning and failure messages. In addition, each alarm can be switched on or off. The alarm limits remain stored even when the alarm is switched off.



You can set warning and failure limits for each of the following process variables:

- Oxygen saturation (referred to air) (%AIR)
- Oxygen saturation (referred to pure oxygen) (%O_2)
- Oxygen concentration (mg/l or ppm)
- Oxygen partial pressure (mbar)
- Measured temperature (°C)
- Pressure (mbar)
- Calibration timer (h)
- Zero point (nA)
- Slope (pA/mbar)



You can define four independent alarm limits for each of these variables:

- Failure Limit Lo
  If the measured value falls below the defined limit, “FAIL” appears in the display.
- Warning Limit Lo
  If the measured value falls below the defined limit, “WARN” appears in the display.
- Warning Limit Hi
  If the measured value exceeds the defined limit, “WARN” appears in the display.
- Failure Limit Hi
  If the measured value exceeds the defined limit, “FAIL” appears in the display.

You can view the currently active alarm messages in the “Message List” of the Diagnostics menu (see Pg 6-1).

Alarm processing / NAMUR signals

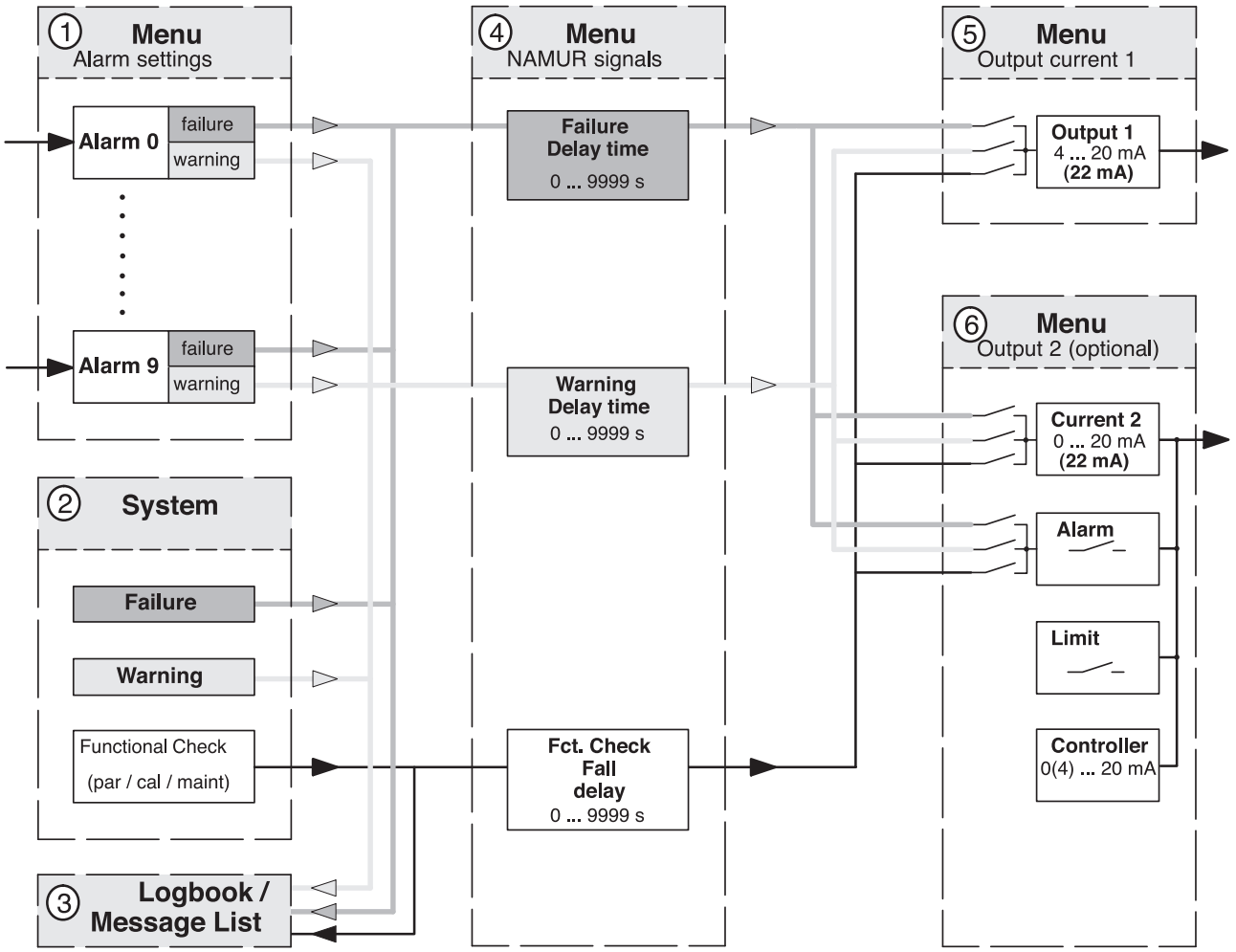
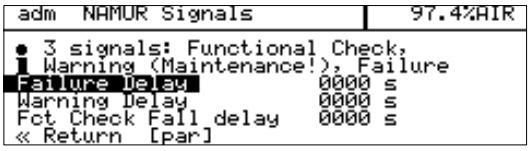


Fig. 4-2 Alarm processing

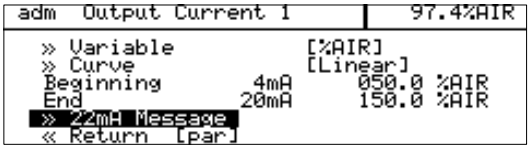
The defined alarms 0 to 9 ① and the system ② generate the NAMUR signals Failure and Warning. In addition, the system ② also generates the Functional Check signal during parameter setting, calibration and maintenance.

These signals are immediately entered in the message list and logbook ③ (Opt. 354).

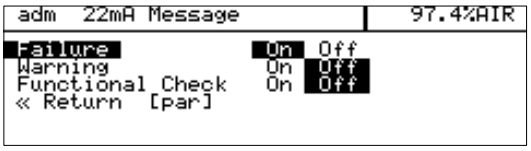


In the NAMUR Signals menu ④, you can define individual delay times for these messages.

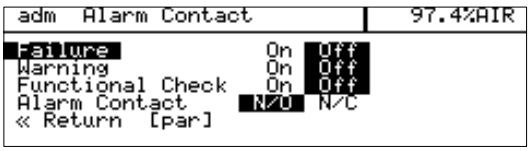
For functional check, the defined delay time acts as a fall delay!
This has the advantage that, for example, any temperature or measurement settling times following a sensor calibration can be bridged with a correspondingly defined fall delay time.



The messages can be output via output current 1 ⑤ or output 2 ⑥ (if current 2 is active) as a 22 mA signal.

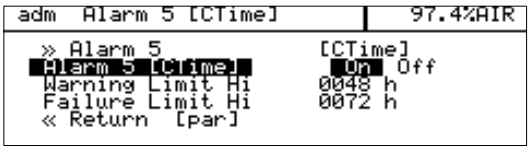


To do so, all three messages can be activated separately or in any combination in the 22 mA Message submenu.



If output 2 is set as an alarm contact, it can be used to output these messages. In this menu the alarm contact can be set as a normally open or a normally closed contact.

Cal timer



The cal timer allows you to monitor whether the sensor is calibrated regularly.
The cal timer counts the time passed since the last calibration. When the preset time is reached, a message is released.
In the “Alarm Settings” menu you can preset one interval each for a warning and a failure message.

The cal timer count can be shown in the secondary display (see Pg 3-2).

HART® Communication

With Option 467 “HART® Communication” you can, for example, communicate with the O_2 Transmitter 4220X via the loop current using a handheld terminal or from the control room. Device data, measured values, messages and parameters are retrievable.

The O_2 Transmitter 4220X can be addressed from the master in two different ways: via a long, permanent address, which is unique world-wide, or via a selectable short address.

Device address

The device address is unique world-wide for each device. It is composed of the manufacturer ID, the device type and the serial number.

Short address

The short address has two functions. You select the address 00 for a point-to-point connection. The output current then continues to be controlled by the measurement signal. In the bus mode (multidrop) each connected device must have a unique short address. The addresses 01 to 15 are used for this purpose. All devices supply a constant 4 mA at the current output. The data are transmitted completely via the HART® signal.

Write protection

The write protection protects the settings from being changed via the HART® interface. The write protection can only be switched on or off via the menu.

When activated, the write protection also prevents the short address from being changed with the HART® commands.

You can select the short address of the Transmitter and activate or deactivate the write protection. From pull-down menus, you can select the respective process variables for the HART® “Secondary Variable”, “Tertiary Variable” and “4th Variable”. The “Primary Variable” is always assigned to the process variable of output current 1.

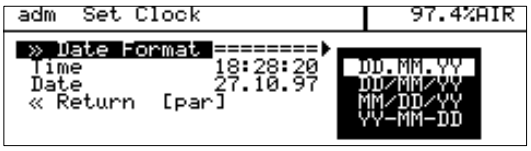
The selected process variables can be read out with the HART® command #3 (Read Dynamic Variables and P.V. Current). This allows to transmit and evaluate up to four selectable process variables using standard HART® programs (without Device Description).

HART®* commands

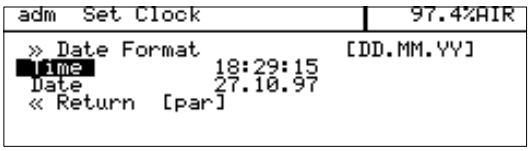
A list of the HART® commands for the O_2 Transmitter 4220X can be found in the enclosed “Process Unit 77 (X)... Transmitter-Specific Command Specification” (with Option 467 only).

*) HART® is a registered trademark of the HART Communication Foundation

Setting the clock

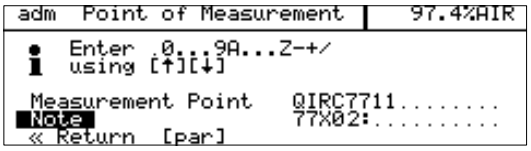


In the Date Format pull-down menu, you can select the desired type of display.



On pressing **enter** , the clock starts running at the entered value.
Pressing **par** cancels the entry (Undo). The clock then keeps the old time.

Point of measurement/note

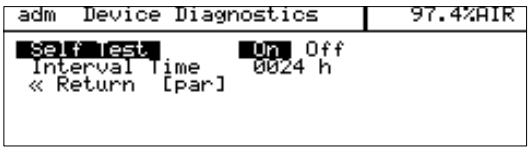


In the Point of Measurement menu, you can specify the point of measurement according to DIN 19227 (ISO 3511) by entering a tag number. In addition, you can enter a note.
Each entry may be up to 16 characters long.
In measuring mode, there is a display with the tag number or note beneath the secondary displays.
Pressing **enter** switches between the displays.

With the “HART® Descriptor” you can, for example, enter operating instructions as a note, which is then shown in the display. With HART® communication, only the first 8 characters of the tag number are used (HART® Specification).

Unit	HART®	Char. length
Meas. pt.	TAG	16 (HART®: 8)
Note	DESCRIPTOR	16
–	MESSAGE	32

Device diagnostics



The O_2 Transmitter 4220X can perform an automatic self test (memory test) at regular intervals. In the case of a defective memory, the “Warn Device Diagnostics” message is output.
The automatic self test is only carried out when the Transmitter is in measuring mode and the interval time is not set to 0000 h. During the testing, measurement is countinued in the background. All outputs remain active.

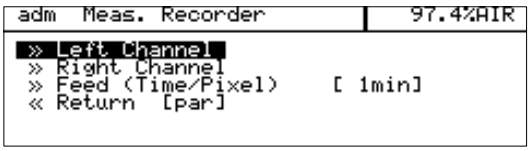
The device tests can be executed manually in the “Device Diagnostics” menu. The respective results are displayed (see Pg 6-4).

Measurement recorder

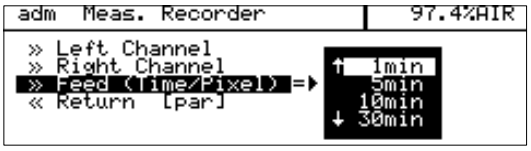
If you want to use the measurement recorder, but your Transmitter is not equipped with Option 448, you can retrofit the option.
See Release of options on Page 4-29.

“On-site recorder”

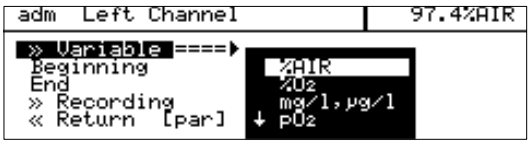
For process visualization or, for example, for controller optimizing, the measurement recorder continuously registers two user-defined process variables and simultaneously displays them graphically next to each other in the system display. Process variable, measurement range, recording method and time feed (scanning interval) parameters can be set within broad limits. The last 500 measured values are available with time and date in the form of a graph and as numerical values.



The measurement recorder can be adjusted like an ordinary recorder: The right and left channel can be separately defined. The feed (scanning interval) applies to both channels.

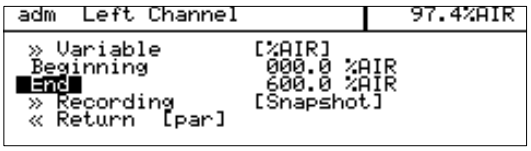


You can choose feed rates from 2 seconds up to 10 hours per recorder entry. With a rate of 2 seconds, the recorder shows the data of the last 16 minutes, with a 10 hour rate, it shows the data of the last 7 months.

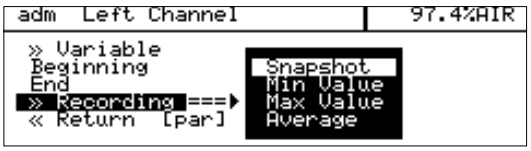


Right and left channel:
Select the controlling process variable from the Variable pull-down menu.
The following process variables are available:

- Oxygen saturation (referred to air) (%AIR)
- Oxygen saturation (referred to pure oxygen) ($\%O_2$)
- Oxygen concentration (mg/l or ppm)
- Oxygen partial pressure (mbar)
- Measured temperature (°C)
- Pressure
- OUTP1 Output current 1
- OUTP2 Output current 2 (with Option 487 only)



Beginning and End define the recorder range. These value only refer to the graphic representation in the display. All measured values are stored with their complete number of digits.



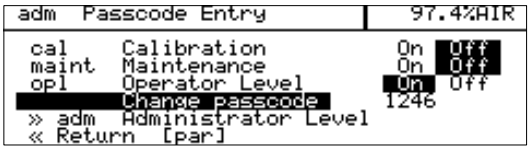
In the Recording pull-down menu, you can choose between four methods:

- **Snapshot**
  The currently measured value is recorded after expiration of the feed time.
- **Min Value**
  Each measured value is checked in the measurement recorder. The lowest value within the feed time is entered in the recorder memory.
- **Max Value**
  Each measured value is checked in the measurement recorder. The highest value within the feed time is entered in the recorder memory.
- **Average**
  The measurement recorder calculates a mean value of all values measured, i.e. the value entered in the recorder memory is the arithmetical mean of all values measured within the feed time.

Passcode entry

Access to the Calibration and Maintenance menus and to parameter setting at the Operator and Administrator levels can be protected with passcodes. You can set or disable each passcode individually (the Administrator passcode cannot be disabled).

When a passcode is disabled, there is no protection against unauthorized access to the corresponding menu!
For safety reasons, you should not use the standard passcodes!
The factory-set passcodes are the same for all Transmitters. Therefore, you should define your own passcodes.



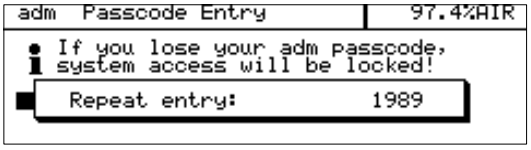
The “Change passcode” line only appears when a passcode is enabled. The passcode remains stored even if it has been disabled.

Setting the Administrator passcode

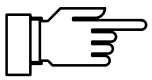
If you have lost the Administrator passcode, system access is locked! The Administrator level cannot be accessed for parameter setting. All menu items locked for the Operator level can no longer be edited.

In this case, please contact:

Mettler-Toledo GmbH
Hotline
Im Hackacker 15
8902 Urdorf/Switzerland
Phone: +41-1-736 22 14
Telefax: +41-1-736 26 36



After having entered the Administrator passcode, you are prompted to repeat the input for safety reasons.
If the second entry does not correspond to the first entry or if you cancel by pressing **par** , the Administrator passcode will not be changed.



When you set the Administrator passcode to “0000”, the Administrator level can be accessed without passcode entry by pressing **enter** at the passcode prompt.

When you set the Administrator passcode to “0000”, menus and device settings will not be protected against unauthorized access!
Improper changing of the device settings may lead to malfunctions of the O_2 Transmitter 4220X and to incorrect measured-value outputs!

Factory-set passcodes

As delivered, the following passcodes are set in the O_2 Transmitter 4220X:

- Calibration passcode: 1147
- Maintenance passcode: 2958
- Operator passcode: 1246
- Administrator passcode: 1989

Release of options

You can retrofit software options at any time on the site without dismantling the Transmitter. To do so, you require a device-specific, unique transaction number (TAN).

To release an option, you require:

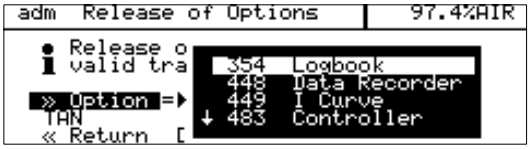
- the desired option number,
- the model designation (O_2 Transmitter 4220X)
- and the serial number of your Transmitter.

Please refer to the Diagnostics/Device Description menu (see Pg 6-3) for this information. The price of the option depends on the currently valid price list.

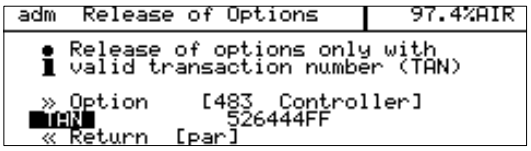
A list of available options is provided on Page 9-1.

The transaction number (TAN) can be obtained from your Mettler Toledo representative.

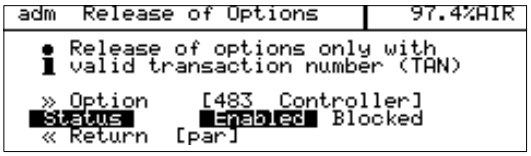
Option release with transaction number (TAN):



1: Select the desired option from the Option pull-down menu. Contact your Mettler Toledo representative specifying the option number, model designation and serial number.



2: Enter the transaction number you have received and confirm your entry by pressing **enter**.



3: With the correct TAN you can enable or disable the option. The transaction number can be used repeatedly with this O_2 Transmitter 4220X to enable or disable the option at any time.

This page has been left empty for technical reasons.

5 Calibration

Why do you have to calibrate?

Every dissolved oxygen sensor has its individual slope and zero point. Both values are altered, for example, by electrolyte consumption. For sufficiently high accuracy of oxygen measurement, the Transmitter must be regularly adjusted for the sensor data (calibration).

Calibration medium is water with a known oxygen saturation (referred to air) or air. The sensor is immersed in the calibration medium.
Then the O_2 Transmitter 4220X measures the sensor current and medium temperature and automatically calculates the sensor slope and zero point.

Without calibration every dissolved oxygen meter delivers an imprecise or wrong output value! Particularly after having replaced the sensor, electrolyte or sensor membrane, you must perform a calibration.

Monitoring functions for calibration

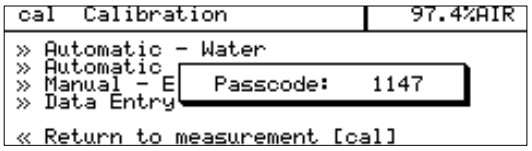
The O_2 Transmitter 4220X provides functions for monitoring proper calibration performance and the sensor condition. This allows documentation for quality management to ISO 9000 and GMP.

- Sensocheck® recognizes mechanical stress of the membrane that might modify the calibration data.
- Regular calibration can be monitored by the cal timer (see Pg 4-23).
- The calibration record provides all relevant data of the last calibration (GMP) (see Pg 6-1).
- The sensor statistics show the behavior of the sensor parameters during the last three calibrations compared to the first calibration (see Pg 6-2).
- The logbook provides time and date stamped records of calibrations performed within the last 200 events (see Pg 6-3).

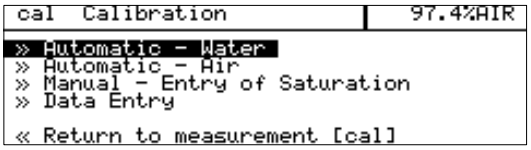
- You can define limits for warning and failure messages for the sensor slope and zero point (see Pg 4-21). This permits automatic monitoring of the sensor state using the calibration data.

Calibration menu

Pressing **cal** accesses the Calibration menu.



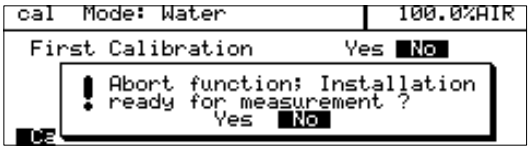
If calibration is protected with a passcode, you must enter the correct passcode to access the Calibration menu. The calibration passcode can be defined or disabled at the Administrator level.
(see Pg 4-27).



Four different calibration methods are available:

- Automatic calibration in water
- Automatic calibration in air
- Manual entry of saturation
- Calibration be data entry

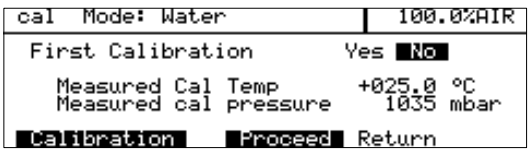
The NAMUR “functional check” signal is active during calibration.



If you press **meas** before having performed a calibration, you are prompted to confirm your decision to abort calibration.

If you abort, the old calibration data remain valid.

What does “First Calibration” mean?



During first calibration, the sensor data are stored as reference values for sensor statistics.
The “Sensor Statistics” Diagnostics menu shows the deviations in the slope and zero point, as well as the values for calibration temperature, calibration pressure and response time of the last three calibrations with date and time with respect to the reference values of the first calibration. This allows evaluation of the drift behavior and aging of the sensor.

When do you have to perform a First Calibration?

Each time the sensor, electrolyte or membrane is replaced, a First Calibration must be performed.

How do you perform a First Calibration?

Select the corresponding calibration method, set “First Calibration Yes” and confirm with **enter** .

If you do not want to perform a First Calibration, press **enter** to proceed to the next step of the calibration sequence.

One-point or two-point calibration?

For the calibration methods

- Automatic – Water
- Automatic – Air

you can choose between one- and two-point calibration.

One-point calibration

The sensor is only calibrated using 100 % medium. This determines the present slope of the sensor. The old zero point remains unchanged.

One-point calibration is sufficient for most of the cases.

Two-point calibration

The sensor is calibrated using two media with different oxygen saturation values (100 % and 0 %). This determines the slope and zero point of the sensor.

Two-point calibration is only necessary if the measured oxygen value is low or near the sensor zero.

Automatic calibration in water or air

Calibration can be performed as one- or two-point calibration either in water or in air.
The calibration value is always the oxygen saturation (referred to air).
First, the slope is corrected using the 100 % value. Then, also a zero-point correction can be carried out using the 0 % value.

All calibration data are converted using a reference temperature of 25 °C.
During calibration, the NAMUR functional check signal is active, the output currents are frozen at their last values, the limit contact is inactive, the controller output can either be frozen or set to zero (see Pg 4-18), a wash interval is not started.

What you have to know for calibration

For calibration in water:

- Ensure sufficient medium flow to the sensor.
- The calibration medium must be in equilibrium with air. Oxygen exchange between water and air is very slow. Therefore, it takes a relatively long time until water is saturated with atmospheric oxygen.

For calibration in air:

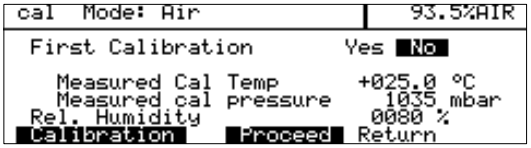
- The sensor membrane must be dry, as adhering water drops falsify the measured oxygen value.

Make sure that the oxygen saturation of the calibration medium is correct and remains constant during calibration.
Ensure that all other parameters, e.g. temperature and pressure, are constant.

If there is a temperature difference between the calibration medium and the measured medium, the sensor must be kept in the respective medium for several minutes before and after calibration in order to deliver stable measured values.

The type of calibration pressure detection is preset during parameter setting (see Pg 4-4).

Automatic calibration in air

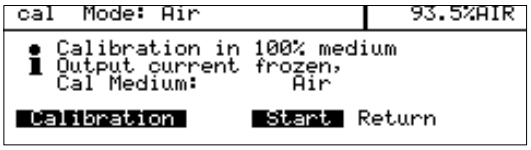


In the “Automatic – Air” submenu you can correct the calibration pressure manually preset at the Parameter setting level (see Pg 4-4).
In addition, you can specify the relative humidity of the air.

If you do not know the exact value of the relative humidity of the air used, you can take the following standard values for a sufficiently precise calibration:

- Normal ambient air: 50 %
- Bottled gas: 0 %

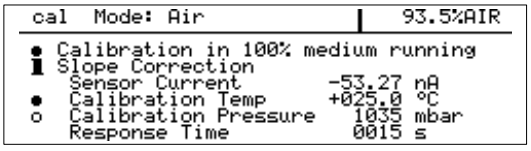
If you do not want to perform a First Calibration (see above), press **enter** to proceed to the information text.



The information text again shows calibration medium used and the corresponding oxygen saturation referred to air.

To start calibration, select “Calibration Start” using **enter** .

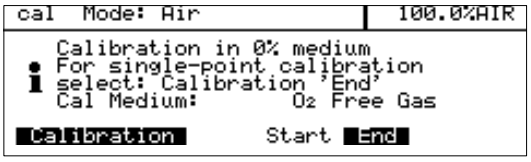
The oxygen saturation indicated for air calibration is a hypothetical value which, however, corresponds (at 100 % relative air humidity) to the oxygen saturation of water (equilibrium between water and air).



The Transmitter automatically recognizes when the sensor current is stable. The response time indicates how long it takes for the sensor to provide a stable current value. After a minimum response time of 1 min the sensor drift is checked and calibration is stopped if appropriate.
If you are sure that the sensor current has stabilized earlier, you can stop calibration after 10 sec by pressing **cal**.
An unstable sensor current reduces the accuracy of the calibration values!

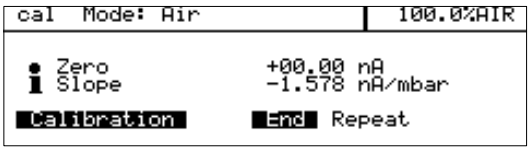
If the sensor current fluctuates or drifts strongly, calibration is stopped after 10 min. This may be caused by:

- insufficient sensor polarization (see operation instructions for sensor)
- unstable measured values
- insufficient temperature equalization between sensor and environment (observe equalization time, see Pg 5-5)



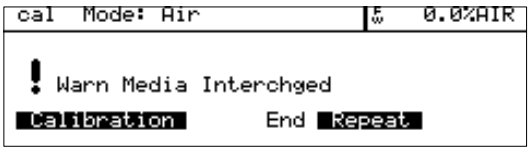
For one-point calibration, press **enter** to select "Calibration End".

For two-point calibration, place the sensor in oxygen-free medium (e.g. 99.98 % nitrogen) and confirm "Calibration Start" with **enter** .



After a successful calibration the values calculated for slope and zero point are displayed.
End the calibration or repeat it if necessary with "Calibration Repeat".

Dissolved oxygen sensors often demonstrate a minor drift at the zero point over a longer period of time. However, the automatic calibration stops the zero-point calibration at a relatively early point in time due to the specified drift criterion and to avoid extremely long calibration times. The accuracy achieved in this way is sufficient for most applications. If a more exact and stable zero point value is required, the zero point should be calibrated as described under "Calibration by data entry".



If an error message appears, you have to repeat calibration (service the sensor if necessary).

Automatic calibration in water

The calibration sequence in air is identical to the calibration sequence in air. Only adjustment of the relative humidity is omitted.
The calibration media are 100% air-saturated water and O_2-free water (water flown through by inert gas such as N_2, Ar etc.).

Calibration with manual entry of saturation

When calibrating with manual entry of saturation, you can correct the measured value by directly entering the actual process value.
This permits a fast correction of slope without starting a complete calibration sequence.

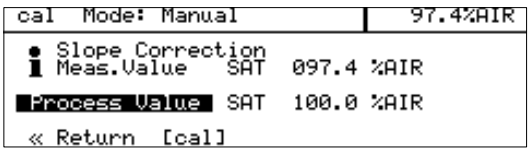
With manual entry of saturation, slope is corrected without checking the drift. Therefore you should only make use of this method for corrections between two calibrations.
It cannot replace regular calibrations!

All calibration data are converted using a reference temperature of 25 °C.
During calibration, the NAMUR functional check signal is active, the output currents are frozen at their last values, the limit contact is inactive, the controller output can either be frozen or set to zero (see Pg 4-18), a wash interval is not started.

What you have to know for calibration

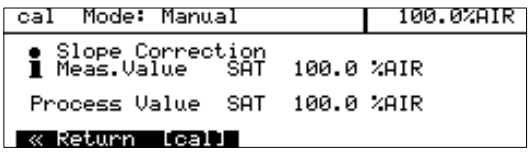
Make sure that the oxygen saturation of the solution is correct and remains constant during calibration. Ensure that all other parameters, e.g. temperature and pressure, are constant.

Calibration sequence



Place the sensor in a medium with known oxygen saturation. Select “Manual – Entry of Saturation” from the Calibration menu and confirm with **enter** .

The currently measured value for oxygen saturation referred to air is displayed.



Enter the actual process value.
The O_2 Transmitter 4220X stores the value and displays it in the measured value display.

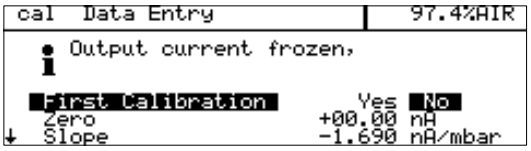
Calibration by data entry

If the current values for slope and zero point of a sensor are known, they can be entered directly.

Data entry may be of particular advantage for calibrating the zero point when measuring in the range of low oxygen concentrations. Place the DO sensor in an oxygen-free medium (such as 99.98 % nitrogen) and watch the sensor current. When the current sensor is stable (this may take more than 10 minutes), enter it as a zero point in the Data entry menu.

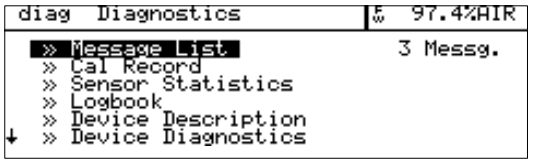
All calibration data are converted using a reference temperature of 25 °C.
During calibration, the NAMUR functional check signal is active, the output currents are frozen at their last values, the limit contact is inactive, the controller output can either be frozen or set to zero (see Pg 4-18), a wash interval is not started.

Calibration sequence



Enter the data for zero point and slope in the Data Entry menu and confirm with **enter** .

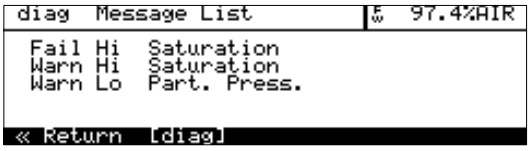
6 Diagnostics menu



The Diagnostics menu provides all relevant information on the instrument status.
During diagnostics all measuring functions of the O_2 Transmitter 4220X continue to be active. All outputs continue to be operated and warning and failure message are output.

If no key is pressed within **20 minutes**, the Diagnostics menu is automatically exited.

Message list



The message list shows the number of currently activated messages and the individual warning or failure messages in plain text.

For explanations of the individual messages please refer to Chapter 8.

Cal record

The Cal Record displays all relevant data of the last sensor calibration for preparing documentation in accordance with ISO 9000 and GMP.

- Date and time of last calibration
- Calibration mode (e.g. Manual)
- Zero point
- Slope
- Relative humidity
- 1st sensor current
- 1st calibration temperature
- 1st calibration pressure
- Response time
- 2nd sensor current
- 2nd calibration temperature
- 2nd calibration pressure
- Response time

For some calibration procedures, such as Data Entry, not all measured values are available. The respective positions are then covered with a gray bar.

Sensor statistics

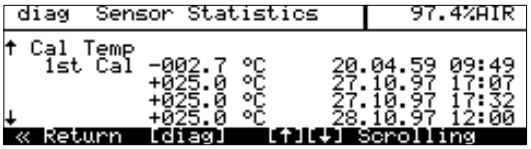
When you perform a First Calibration (see Pg 5-2), the following values are stored as **reference values**:

- Date and time of first calibration
- Sensor zero point
- Sensor slope
- Calibration temperature
- Calibration pressure
- Response time

When you then perform further calibrations, the following data will be listed in the sensor statistics for the last three calibrations:

- Date and time of calibration
- Deviation of sensor zero point
- Deviation of sensor slope
- Calibration temperature
- Calibration pressure
- Response time

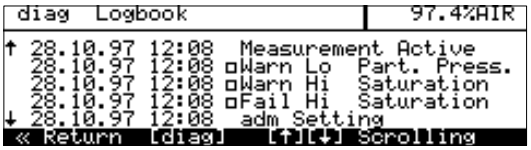
This provides you with important information on sensor condition, aging and the time for the next due calibration.
If the time between two calibrations is less than 6 minutes, the Transmitter interprets the second calibration as repetition of the first one (e.g. when an error has occurred). It does not create a new record. The last calibration record is overwritten with the new values.



In the Sensor Statistics menu you can read the the respective statistics from the First Calibration and the last three calibrations.

Logbook

This option (Logbook) can be retrofitted via TAN (see Pg 4-29).



The logbook contains the last 200 events with date and time and displays them.
Error messages occurring during parameter setting, calibration or maintenance are ignored.

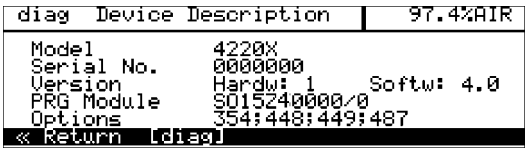
The following events are recorded:

- Transmitter in measuring mode
- Transmitter turned on/off
- ■ : Start of warning and failure messages
- □ : End of warning and failure messages
- Calibration messages
- Parameter setting, calibration, maintenance or diagnostics active
- Entry of a wrong passcode

The logbook entries can be used for quality management documentation to ISO 9000 and GMP.

Logbook entries cannot be edited!

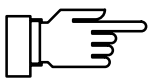
Device description



The Device Description contains information on the model designation, serial number and instrument options.

The display indicates:

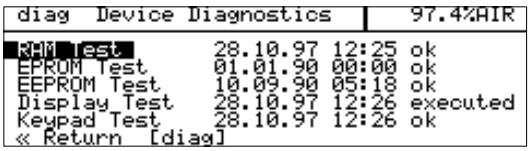
- Model designation
- Serial number
- Hardware and software version
- Program module code
- Options



The software version must correspond to the version indicated at the bottom right of the second page of this manual.

Device diagnostics

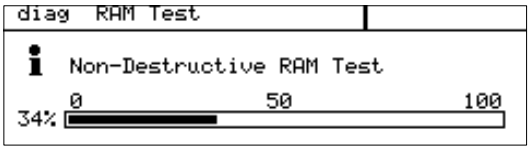
The Device Diagnostics feature allows you to perform extensive tests to check the function of the O_2 Transmitter 4220X.
This permits quality management documentation to ISO 9000.
Instrument settings and parameters are not affected.



In the Device Diagnostics menu you see when each test was performed and what the result was.

Start the selected test with **enter** .

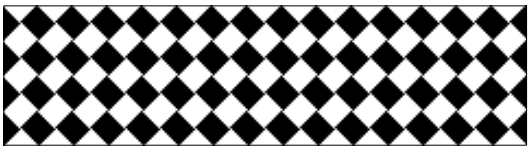
Memory test



Select “RAM Test”, “EPROM Test” or “EEPROM test”.
The Transmitter forms a CRC checksum for the calculated data and compares it with the setpoint.

If “Failure” appears in the menu after the test is completed, the Transmitter must be sent in to the manufacturer for repair.

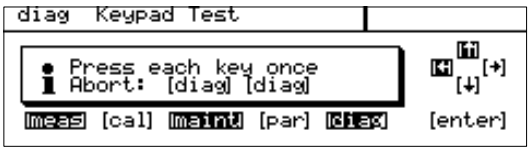
Display test



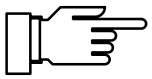
Several test patterns will be displayed allowing you to check whether all pixels, lines and columns function properly.

If there are disturbances in the test patterns, the Transmitter should be sent in to the manufacturer for repair.

Keypad test



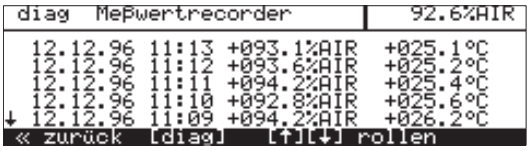
Each key must be pressed once during keypad testing. Keys that have been pressed are highlighted.



If “Keypad Test Failure” appears in the menu after the test, the Transmitter must be sent in to the manufacturer for repair.

Measurement recorder (listing)

This option (Measurement recorder) can be retrofitted via TAN (see Pg 4-29).

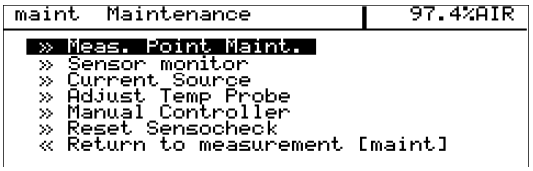


In addition to the graphic display of the measurement recorder (see Pg 3-4), the Diagnostics menu provides the last 500 measured value pairs from the recorder memory as a listing. Each recorder entry occupies one display line. The measured values of both channels are recorded with date and time. The symbols for min (▼), max (▲) or mean value (~) are displayed after the measurement symbol, if applicable.

Entries in the measurement recorder cannot be edited!

This page has been left empty for technical reasons.

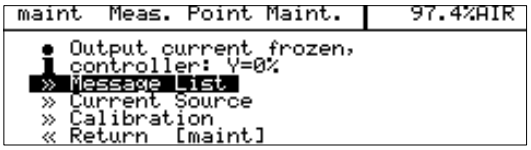
7 Maintenance menu



The Maintenance menu provides all functions for sensor maintenance and adjustment of connected instruments.
Access to the Maintenance level can be protected with a passcode.

- In the measurement point maintenance mode you can view the message list, activate the current source or start calibration.
- The sensor monitor allows to observe the sensor current.
- The current source allows manual adjustement of all active output currents for configuring and checking connected peripheral devices (such as indicators or recorders).
- Temperature probe adjustment allows individual calibration of the connected temperature probe.
- If the Transmitter is equipped with the controller function (Option 483) and the controller has been activated, you can manually enter the controller output (manipulated variable Y).
- The “Reset Sensocheck” submenu only appears when Sensocheck® has been switched on. It allows to reset a Sensocheck® signal.
  However, it is better to perform a calibration.

Measurement point maintenance

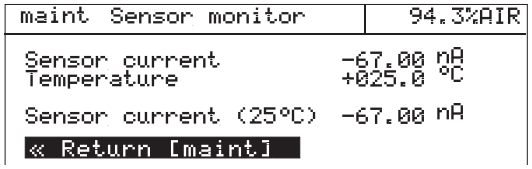


Measurement point maintenance allows you to remove the sensor. While the Transmitter is in measurement point maintenance mode, you can clean or replace the sensors. The output current is frozen at its last value, the controller output is either frozen or set to zero and the NAMUR “functional check” signal is active.

The Measurement Point Maintenance menu provides the following submenus:

- Message list
  In this submenu you can view the message list containing all active messages (without releasing the outputs) (see Pg 6-1).
- Current source
  In this submenu you can manually specify the output currents during maintenance (for current source function, see Pg 7-2).
- Calibration
  In this submenu you can start a calibration directly from the Maintenance menu without having to release the outputs (for calibration, see Pg 5-1 and the following).

Sensor monitor

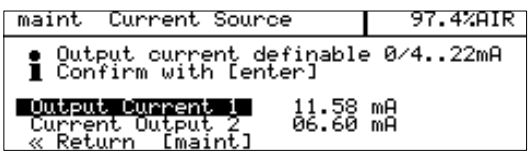


The sensor monitor allows to observe and evaluate the sensor current during maintenance.
The uncompensated sensor current and the temperature are displayed.

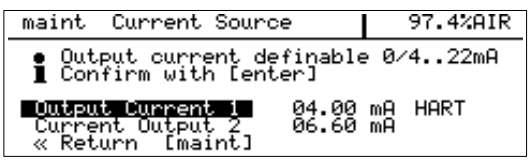
Current source function

During current source function the output currents do not follow the measured value!
The values can be entered manually.

Therefore, you must make sure that the connected devices (control room, controllers, indicators) do not interpret the current value as a measured value!



In the Current Source menu you can manually adjust the values for the output currents, for example to check connected peripheral devices.



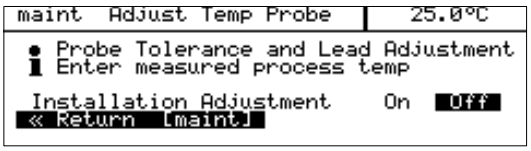
During Multidrop mode the output current 1 is permanently set to 4 mA. This is indicated by the word “HART”.

Temperature probe adjustment

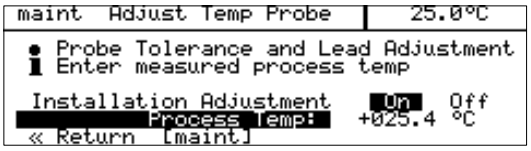
During temperature probe adjustment you compensate for the individual tolerance of the temperature probe and the influence of the lead resistances. This increases the accuracy of the temperature measurement.

Adjustment may only be carried out after the process temperature has been precisely measured using a calibrated reference thermometer!
The measurement error of the reference thermometer should be less than 0.1 °C.

To simplify the adjustment procedure, set “Measurement Display: Variable °C” (see Pg 4-3).



When the measurement display has been set accordingly, the temperature measured by the temperature probe is displayed in the upper right corner.



Switch on Installation Adjustment and enter the process temperature measured by the reference thermometer.

Now the compensated temperature from the temperature probe is displayed in the upper right corner.

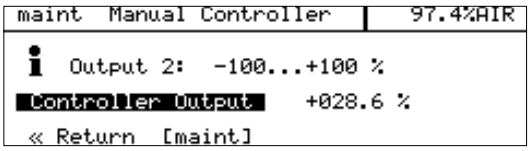
The permissible adjustment range is ±5 °C from the value measured by the temperature probe.

Manual entry of controller output

If the Transmitter is equipped with the controller function (Option 483) and the controller has been activated, you can manually adjust the controller output (manipulated variable Y) for test purposes or to start a process.

When you manually adjust the controller output, it no longer follows the controlled variable!

Therefore, you must make sure that the connected actuators and the control loop are monitored accordingly!



You can enter the controller output in the range from -100 % to +100 %, for example to check connected actuators.
When you exit manual controller entry, the Transmitter switches back to automatic controller operation.
With a PI controller (reset time ≠ 0), switchover is smooth. This allows you to rapidly start processes with large time constants or dead times.

With the definable feed time alarm, you can monitor the time during which the controller output is at +100 % or –100 %, i.e. how long the valve is fully open. If this time is exceeded, this may be due to a shortage of air flow or a defective valve, for example.

Reset Sensocheck®

It allows to reset a Sensocheck® signal. However, it is preferable to perform a calibration to determine and eliminate possible errors.

If the Sensocheck® signal appears following a successful calibration, it is possible that the adjustment of the sensor has changed during installation due to mechanical stress. Therefore, make sure when installing the sensor that it is not subjected to any mechanical stress (impact, friction, tension).

In running water and in agitated vessels free-floating solids can hit the sensor. This may cause a change in the sensor adjustment. Such a sudden change may be the reason for a Sensocheck® message.

8 Error messages

Error message	Cause
Fail Hi Zero	Sensor zero point > 200 nA or above failure limit
Warn Hi Zero	Sensor zero point above warning limit
Warn Lo Zero	Sensor zero point below warning limit
Fail Lo Zero	Sensor zero point < -200 nA or below failure limit
Fail Hi Slope	Sensor slope > –50 pA/mbar or above failure limit
Warn Hi Slope	Sensor slope above warning limit
Warn Lo Slope	Sensor slope below warning limit
Fail Lo Slope	Sensor slope < -1 µA/mbar or below failure limit
Warn Identical Media	Calibration with identical media
Warn Media Interchged	Sequence of calibration media interchanged
Fail Hi Conc Value	Concentration above failure limit
Warn Hi Conc Value	Concentration above warning limit
Warn Lo Conc Value	Concentration below warning limit
Fail Lo Conc Value	Concentration below failure limit
Warn Current Par	Current parameter error at output 1, output 2 (see Pg 4-13)
Fail Hi Temp	Temperature > 250 °C or above failure limit
Warn Hi Temp	Measured temperature above warning limit
Warn Lo Temp	Measured temperature below warning limit
Fail Lo Temp	Temperature < -50 °C or below failure limit
Fail Hi Cal Time	Cal timer interval above failure alarm limit
Warn Hi Cal Time	Cal timer interval above warning alarm limit
Warn Current1 Span	Current output 1: Start and end value too close
Warn Current1 < 4 mA	Current output 1: Output current below defined start value
Warn Current1 > 20 mA	Current output 1: Output current above defined end value
Warn Current2 Span	Current output 2: Start and end value too close
Warn Current2 < 0/4 mA	Current output 2: Output current below defined start value
Warn Current2 > 20 mA	Current output 2: Output current above defined end value
Warn Cal Temp	Calibration temperature out of range
Warn Sensor Unstable	No stable end value for calibration after 12 to 15 min
Warn Time/Date	Time had to be automatically initialized: The clock must be reset
Warn Control Para	Parameter error for controller, see Pg 4-20
Fail CRC Error par	CRC data error during parameter setting: Check all settings at the Administrator level!
Fail Hi Feed Time	Controller: Feed time above failure limit
Warn Hi Feed Time	Controller: Feed time above warning limit
Warn Write Protection	Write protection violation at “WriteProtect” (HART® communication)

Error message	Cause
Warn Device Diag Fail System Failure	Diagnostics error: Instrument self-test defective Clock failure, CRC error in factory settings
Fail Hi Saturation Warn Hi Saturation Warn Lo Saturation Fail Lo Saturation	Saturation > 600 % AIR or above failure limit Saturation above warning limit Saturation below warning limit Saturation < 0 % AIR or below failure limit
Fail Hi Part. Press. Warn Hi Part. Press. Warn Lo Part. Press. Fail Lo Part. Press.	Partial pressure > 2000 mbar or above failure limit Partial pressure above warning limit Partial pressure below warning limit Partial pressure < 0 mbar or below failure limit
Fail Hi Press. Signal Warn Hi Press. Signal Warn Lo Press. Signal Fail Lo Press. Signal	Barometric pressure > 1100 mbars or above failure limit Barometric pressure above warning limit Barometric pressure below warning limit Barometric pressure < 700 mbars or below failure limit
Warn Sensocheck	Sensocheck message
Fail Hi Impedance Fail Lo Impedance	Impedance above failure limit (open circuit) Impedance below failure limit (short circuit)
Fail Input Range Warn Temp O_2-Conc/SAT	Input overdrive, sensor current too large (see Pg 4-7) Temperature not within stored chart for water vapor pressure or concentration (Temp < –5 °C or > 60 °C) (see Pg 13-1, Concentration)

9 Product line and accessories

Devices	Ref. No.
O_2 Transmitter 4220X	O_2 4220X

Mounting accessories

Mounting plate, extruded profile AlMg3, 20 µm anodized, (not required for direct wall mounting)	ZU 0136
Bracket kit, brackets hot galvanized, screws stainless steel, wing nuts aluminum anodized, (only in conjunction with ZU 0136 mounting plate)	ZU 0125
Protective hood, aluminum AlMg1, 25 µm anodized, (only in conjunction with ZU 0136 mounting plate)	ZU 0157
Protective polyester case, IP 65, protective Macrolon panel, complete with mounting kit	ZU 0158
Bracket kit for protective case, brackets hot galvanized, screws stainless steel, wing nuts aluminum anodized, (only in conjunction with ZU 0158)	ZU 0220

Further accessories

Power supply/isolator for 24 V AC/DC	WG 20 A2
Repeater power supply for 90 to 253 V AC (optional 24 V AC/DC)	WG 21 A7
Repeater power supply with HART® transmission	WG 21 A7 Opt. 470
IS loop-powered supply with HART® transmission	WG 25 A7

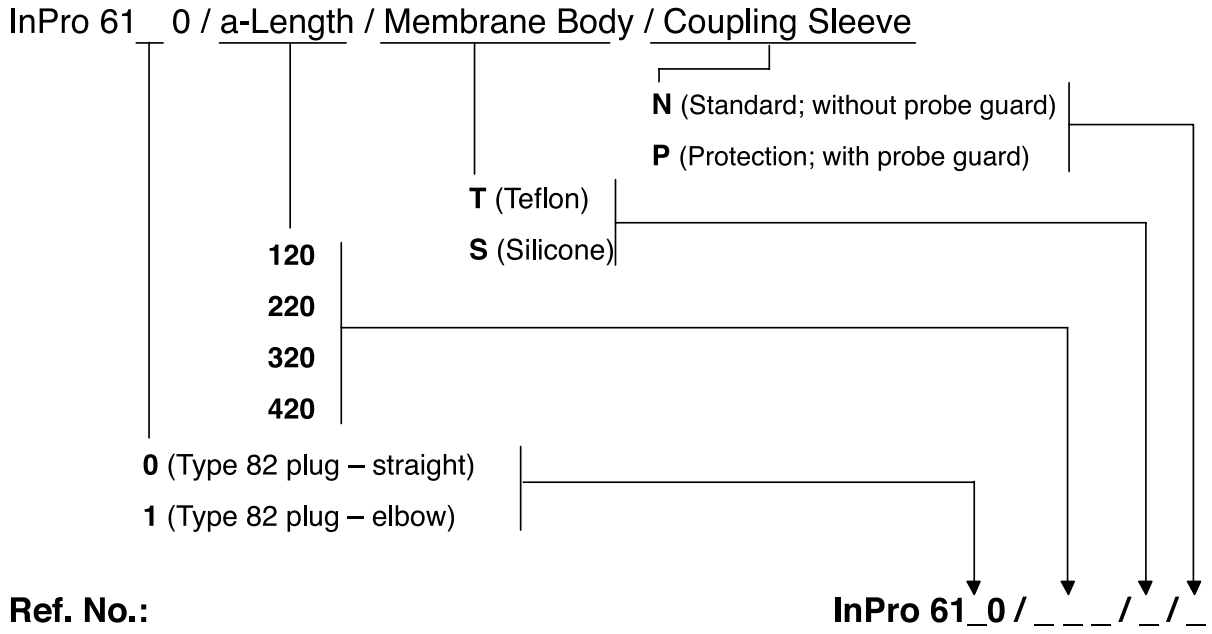
Options	TAN	Ref. No.
Logbook	x	354
Key-lockable protective panel		432
Measurement recorder	x	448
Current characteristic via enterable table	x	449
HART® communication		467
Language selection German, English, French, Italian and Swedish instead of German, English, French, Italian and Spanish		477
Analog controller (only with Opt. 487)	x	483
Second current output (passive)		487

This page has been left empty for technical reasons.

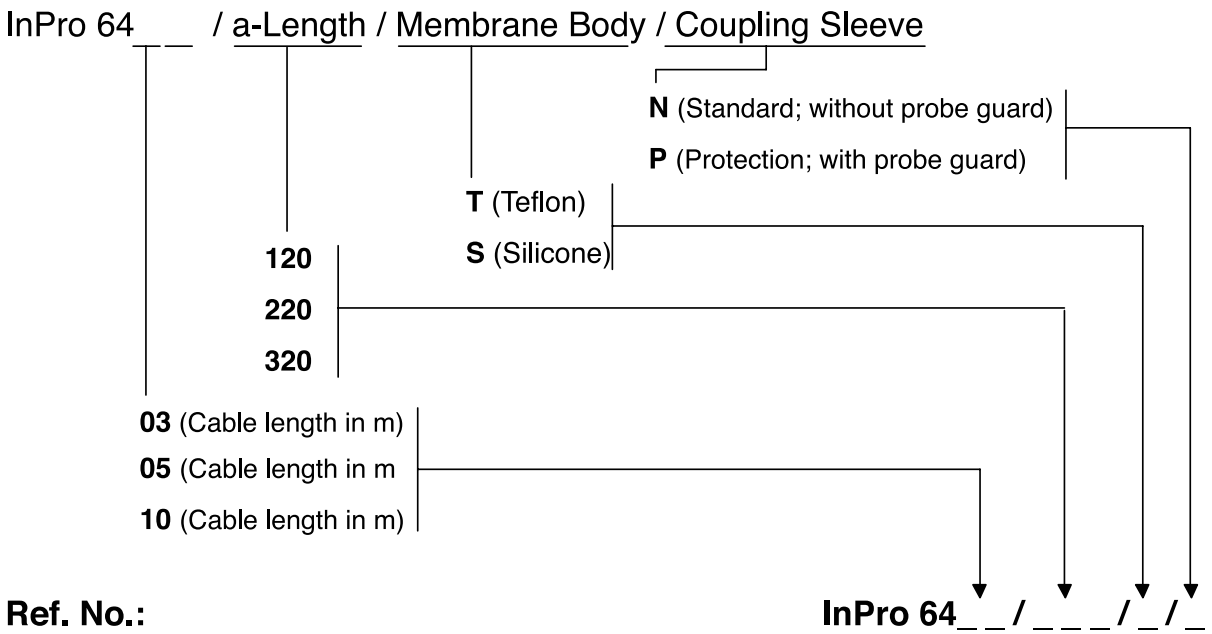
10 Sensors

Dissolved oxygen sensors of the InPro® 6000 series

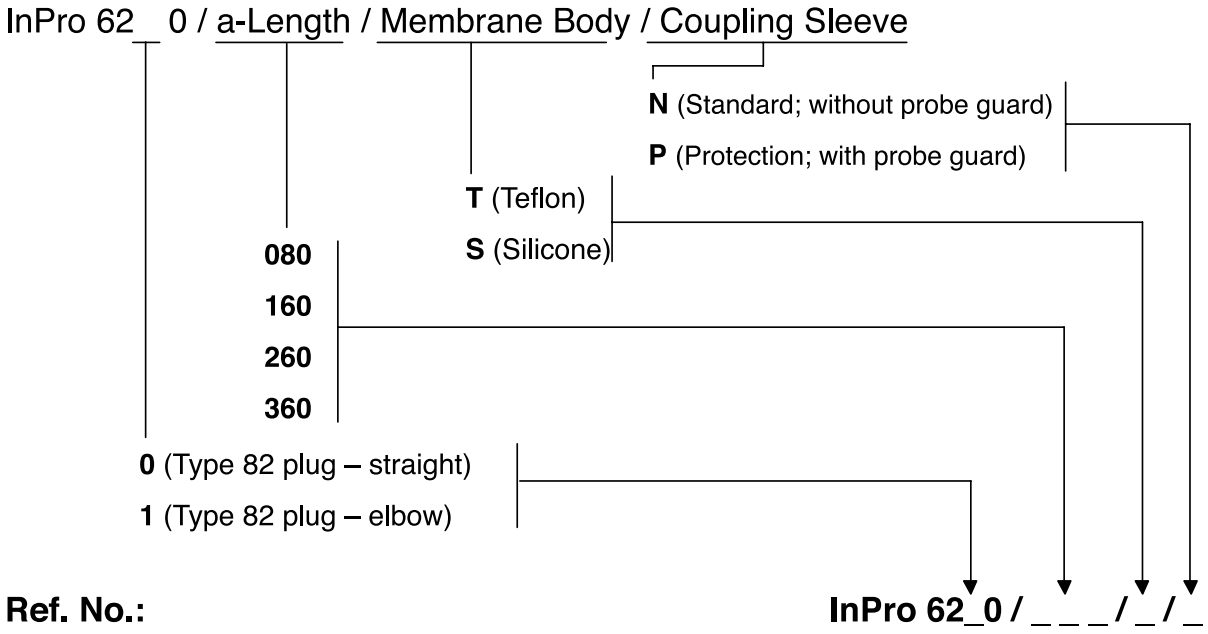
InPro®6000 12 mm sensors with screw cap



InPro®6000 12 mm sensors with fixed cable



InPro®6000 25 mm sensors with screw cap



Spare parts for dissolved oxygen sensors of the InPro® 6000 series

Designation	Order No.
Membrane module, single	
T-96	52 200 071
S-96	52 200 072
Membrane kit (4 membrane modules, replacement O rings, 25 ml electrolyte	
T-96	52 200 024
S-96	52 200 025
Coupling sleeve N (without probe guard)	52 200 037
Coupling sleeve P (with probe guard)	52 200 038

Accessories

Designation	Order No.
Electrolyte (25 ml)	34 100 2016
O_2 cable with 4-pole plug and open cable ends	
1 m	32 248 7501
3 m	32 248 7503
5 m	32 248 7505

Sensor, 12 mm dia.

Installation length	Order no. T type	Order no. S type
a = 120 mm	34 100 3045	34 100 3049
a = 220 mm	34 100 3046	34 100 3050
a = 320 mm	34 100 3047	34 100 3051
a = 420 mm	34 100 3048	34 100 3052

Spare parts for sensor, 12 mm dia.	Order no.
T membrane kit (replacement O rings, 4 membrane modules, 25 ml electrolyte)	34 100 2021
T membrane module, single	34 100 3040
S membrane kit (replacement O rings, 4 membrane modules, 25 ml electrolyte)	34 100 3041
S membrane module, single	34 100 2022
O_2 electrolyte (25 ml)	34 100 2016

Sensor, 25 mm dia.

Installation length	Order no.
a = 70 mm	32 275 6800
a = 150 mm	32 275 6801
a = 320 mm	32 275 6802

Spare parts for sensor, 25 mm dia.	Order no.
Membrane kit (replacement O rings, 4 membrane modules, 25 ml electrolyte)	32 202 5114
Membrane module, single	32 204 8617
O_2 electrolyte (25 ml)	34 100 2016

Accessories	Order no.
O_2 cable with 4-pole plug and open cable ends	
1 m	32 248 7501
3 m	32 248 7503
5 m	32 248 7505

This page has been left empty for technical reasons.

11 Specifications

DO measuring input	1 input for Mettler Toledo DO sensors	
EEx ia IIC		
Ranges	Saturation	0.0 to 600.0 % Air 0.0 to 120.0 % O_2
	Concentration	0.0 µg/l to 90.00 mg/l 0.0 ppb to 90.00 ppm
	Partial pressure	0 to 2000 mbar
	Barometric pressure	700 to 1100 mbar
	manual	0 to 9999 mbar
	Salt correction	0.0 to 45.0 g/kg
Measuring current	0 to 600 nA, resolution 10 pA **	
Meas. error	Measuring current	< 0.5 % of meas. value ± 0.02 nA
Polarization voltage	–675 mV	
Calibration	Operating modes * • Automatic calibration in air-saturated water • Automatic calibration in air • Manual entry of saturation • Data entry	
Sensocheck	Monitoring of membrane and electrolyte, can be switched off	
Temp measuring input	1 input for Pt 100 / Pt 1000 / NTC 22 kΩ	
EEx ia IIC	temperature probe adjustable	
Ranges	Pt100/Pt1000	–50 to +250 °C;
	NTC 22 kΩ	–20 to +130 °C
Meas. error	Pt100/Pt1000	< 0.2 % meas. value ± 0.3 K
	NTC ***	< 0.2 % meas. value ± 0.3 K
Temperature compensation	Nonlinear, preset for Mettler Toledo DO sensors Operating modes: • Automatic with NTC 22 kΩ • Manual	
Output 1 *	4 to 20 mA (22 mA), floating, supply unit required	
(current loop)	user defined for %Air, %O_2, mg/l, µg/l, pO_2, °C	
EEx ib IIC	Current characteristic definable: linear, trilinear, function or as chart (with Option 449)	
Start/end of scale *	As desired within ranges	
Spans *	Saturation	10.0 to 600.0 %; 2.0 to 20.0 % O_2
	Concentration	≥ 20.0 µg/l, min. 10 % full scale
	Partial pressure	20 to 1200 mbar
	Temperature	10.0 to 300.0 °C
Output current error	< 0.3 % meas. value + 20 µA	
Current source function	4.00 mA to 22.00 mA	
Supply voltage EEx ib IIC	14.3 to 30 V; I_{max} = 100 mA; P_{max} = 0.8 W	

* User-defined

** Reduced accuracy at temperatures > 100 °C

Output 2, (passive) *	0(4) to 20 mA (22 mA), floating, supply unit required		
(Option 487)	user defined for %Air, %O_2, mg/l, µg/l, pO_2, °C		
EEx ib IIC	Current characteristic definable: linear, trilinear or function or as analog controller output (Option 353)		
Start/end of scale *	As desired within ranges		
Spans *	Saturation	10.0 to 600.0 %; 2.0 to 20.0 % O_2	
	Concentration	± 20.0 µg/l, min. 10 % full scale	
	Partial pressure	20 to 1200 mbar	
	Temperature	10.0 to 300.0 °C	
Output current error	< 0.3 % meas. value + 20 µA		
Current source function	0.00 mA to 22.00 mA		
Supply voltage	1.3 to 30 V; I_{max} = 100 mA; P_{max} = 0.8 W		
Defined as switching output	Switching controller, limit or alarm output		
Loadability	DC V_{max} = 30 V; I_{max} = 100 mA; P_{max} = 0.8 W, voltage drop: < 1.3 V		
Display	Graphic LCD, 240 x 64 matrix		
	Main display	character height approx. 20 mm	
	Secondary display	character height approx. 6 mm	
	Dialog display	7 lines, character height approx. 4 mm	
Display options	Main display	Secondary display	
	Saturation	Saturation	[% Air]; [% O_2]
	Concentration	Concentration	[mg/l; µg/l] [ppm; ppb]
	Partial pressure	Partial pressure	[mbar]
	Temperature	Temperature	[°C]
		Pressure	[mbar]
		Current output 1	[mA]
		Current output 2	[mA]
		Sensor current	[nA, µA]
		Cal timer	[h]
	Time	Time	[h,min]
		Date	[d,m,y]
		Man. temperature	[°C]
		Controller output1	[%]
		Controller setpoint X_w	
2-channel measurement recorder * (Option 448)	Graphic representation of two process variables in the display user-defined for %Air, %O_2, conc., pO_2, °C, pressure, output 1, output 2, Span and time base definable, Recording of: Snapshot, min, max or mean value, 500 measurement points with time and date		
Languages *****	German, English, French, Italian, Spanish Option 477: Swedish instead of Spanish		
HART® Communication	Digital communication by FSK*** modulation of loop current (output 1 only), point-to-point connection or Multidrop (bus) *		
PI controller (Option 483)	Continuous controller via output 2 (Option 487) user defined for % AIR and % O_2		
Clock	Real-time clock with date, self-contained Date format user-definable		

* User-defined

*** Frequency shift keying

Records	For quality management documentation to ISO 9000.		
Logbook (Option 354)	Recording of	function activations, appearance and disappearance of warning and failure messages, with date and time	
	Storage capacity	200 entries available	
Device self-test	Test of RAM, EPROM, EEPROM, display and keypad		
Calibration record	All relevant data of the last calibration for documentation to GMP		
Data retention in case of power failure	Parameters and factory settings		>10 years (EEPROM)
	Logbook, cal record		> 1 year (lithium battery)
	Clock (reserve power)		> 1 year (lithium battery)
	No battery replacement required according to NAMUR NE 32		
Explosion protection	II 2 (1) G EEx ib [ia] IIC T6 , PTB 00 ATEX 2190		
EMC	EN 61326/	VDE 0843 Part 20:	1998-01
	EN 61326 /A1	VDE 0843 Part 20/A1:	1999-05
	Interference immunity to NAMUR EMC recommendation for process and laboratory control equipment		
Ambient temperature	Operation ****		-20 to +50 °C
	Transport and storage		-20 to +70 °C
Enclosure	Case with separate terminal compartment, suitable for outdoor mounting Material: acrylonitrile butadiene styrene, Front: polyester Ingress protection: IP 65		
Cable glands	Metric cable glands		
Dimensions	See dimension drawing		
Weight	Approx. 1.5 kg		

**** At ambient temperatures below 0 °C the readability of the display may be reduced.
This does not impair the instrument functions.

This page has been left empty for technical reasons.

12 Oxygen solubility table

c_S (p_N) Oxygen saturation concentration at normal pressure (p_N = 1013.25 mbars)

t °C	c mg/l	t °C	c mg/l	t °C	c mg/l
–5	16.98	17	**9.66**	39	6.51
–4	16.46	18	**9.47**	40	**6.41**
–3	15.97	19	**9.28**	41	6.32
–2	15.50	20	**9.09**	42	6.23
–1	15.05	21	**8.91**	43	6.14
0	**14.62**	22	**8.74**	44	6.05
1	**14.22**	23	**8.58**	45	5.96
2	**13.83**	24	**8.42**	46	5.88
3	**13.46**	25	**8.26**	47	5.79
4	**13.11**	26	**8.11**	48	5.71
5	**12.77**	27	**7.97**	49	5.63
6	**12.45**	28	**7.83**	50	5.55
7	**12.14**	29	**7.69**	51	5.47
8	**11.84**	30	**7.56**	52	5.39
9	**11.56**	31	7.43	53	5.31
10	**11.29**	32	7.30	54	5.24
11	**11.03**	33	7.18	55	5.16
12	**10.78**	34	7.06	56	5.08
13	**10.54**	35	6.95	57	5.00
14	**10.31**	36	6.83	58	4.91
15	**10.08**	37	6.72	59	4.83
16	**9.87**	38	6.61	60	4.74

Bold: EN 25 814: 1992
Not bold: interpolated and extrapolated values

This page has been left empty for technical reasons.

13 Glossary

3-wire connection
Connection of the temperature probe with a (third) sense line for compensating for the supply lead resistances. Required for exact temperature measurement with long wires.

Administrator level
“adm”, menu level of the Parameter Setting menu. All device settings and the passcodes can be defined.

Administrator passcode
Protects access to the Administrator level. Can be set at the Administrator level.

Alarm limit
For each process variable, you can define high and low warning and failure limits. The alarm can be activated individually for each variable. If an alarm limit is exceeded, an error message appears.

Alarm processing
In the alarm processing function, delay times can be set for the NAMUR Failure, Warning and Functional Check signals. The delay times are treated separately. Alarms can be output as 22 mA signals via outputs 1 and 2 (see Alarm processing, Pg 4-22)

cal
Menu key for the Calibration menu

Calibration menu
Menu for calibrating the Transmitter

Calibration passcode
Protects access to calibration. Can be set or disabled at the Administrator level.

Calibration record
The calibration record shows all relevant data of the last calibration for documentation to GMP.

Calibration sequence
Four different methods are available for calibration: Automatic calibration in air-saturated water, automatic calibration in air, manual entry of saturation and data entry.

Cal timer
Counts the time passed since the last calibration. The cal timer count can be monitored with alarm limits.

Concentration
With Henry’s Law, the oxygen concentration can be calculated from the oxygen partial pressure via a solubility coefficient.

Controlled variable
User-defined variable that acts on the controller.

Cursor keys — ◀ and ▶, serve to select entry positions or digits during number entry.

Delay — User-defined time until the NAMUR signals “Warning” and “Failure” react to an alarm message and an off-delay of the NAMUR signal “Functional check”.

diag — Menu key for the Diagnostics menu

Diagnostics menu — Display of all relevant information on the device status.

DO sensor — Dissolved oxygen sensor – O_2-sensitive sensor

enter — Key for confirming entries

Failure — Failure is a NAMUR signal. The limits are set in the Alarm Settings menu.
Failure means that the equipment no longer operates properly or that a process parameter has reached a critical value.

Feed time alarm — Monitors the time during which the controller output is at 100 %.

First calibration — During First Calibration, the sensor data are stored as reference values for sensor statistics.

Functional check — Functional check is a NAMUR signal. This signal is active during parameter setting, calibration and maintenance (see Alarm processing, Pg 4-22).

GMP — Good Manufacturing Practice: Rules for performance and documentation of measurements.

HART® — Digital communication by superimposing digital signals on the loop current.

Information display — Information text for operator guidance or indication of device status. Marked with **i** .

Interval — Time from the start of one device test to the start of the next device test, user defined.

Language selection — In the Parameter Setting menu, you can select the user interface language: The language can be selected without entering a passcode.

Limit contact — Is controlled by a user-defiable process variable. The limit contact is activated if the measured value falls below or exceeds an alarm limit, depending on the user-defined effective direction.

Logbook

The logbook shows the last 200 events with date and time, e.g. calibrations, warning and failure messages, power failure etc. This permits quality management documentation to ISO 9000.

Main display

Large measured-value display in the measuring mode. The displayed process variable can be defined. The process variable of the main display is shown in the menus in the upper right corner.

maint

Menu key for the Maintenance menu

Maintenance menu

The Maintenance menu provides all functions for sensor maintenance and adjustment of connected devices.

Maintenance passcode

Protects access to Maintenance. Can be set or disabled at the Administrator level.

Manipulated variable

Output variable of the controller, controls output 2.

meas

Menu key. Pressing **meas** allows return to measuring mode from all other menus.

Measurement recorder

Two-channel recorder for optical display of the process development on the system display. One process variable can be assigned to each channel.

Measuring mode

When no menu function is activated, the Transmitter is in measuring mode. The selected measured value is displayed. You can always return to the measuring mode by pressing **meas** .

Menu

Pressing a menu key (**cal**, **diag** , **maint** or **par**), gives access to a menu from which you can select the corresponding functions.

Menu level

The menu is divided into several menu levels.

You can switch between the different levels by pressing the corresponding menu key or a cursor key ◀ or ▶).

Message list

The message list shows the number of currently activated messages and the individual warning or failure messages in plain text.

NAMUR

German committee for measurement and control standards in the chemical industry

NAMUR signals

Failure, warning and functional check are NAMUR signals. They can be assigned to outputs 1 and 2 as 22 mA signals. The limits for failure and warning are set in the Alarm Settings menu.

Operator level — "opl", menu level of the Parameter Setting menu. You can edit the device settings that have been enabled at the Administrator level.

Operator passcode — Protects access to the Operator level. Can be set or disabled at the Administrator level.

Oxygen concentration — See Concentration

Oxygen partial pressure — See Partial pressure

Oxygen saturation — See Percent saturation

par — Menu key for the Parameter Setting menu

Parameter Setting menu — The Parameter Setting menu is divided into three submenus: Viewing level (view), Operator level (opl) and Administrator level (adm)

Partial pressure — Share of a gas to the total pressure of the gas mixture

Passcode protection — Access to the Calibration, Maintenance, Operator and Administrator levels is protected by passcodes. The passcodes can be defined or disabled at the Administrator level.

Percent saturation — Ratio (in percent) of the measured quantity of O_2 to the highest possible quantity (saturation)

Polarization time — Time after power-on of the Transmitter until the sensor delivers stable measured values (also see operating instructions of sensor)

Pulse suppression — To increase immunity to interference, a disconnectable input filter suppresses transient interference pulses while slow changes of the measured value are detected immediately.

Recorder — See Measurement recorder

Scrolling key — ▲ and ▼: Keys for selecting menu lines or entering numbers.

Secondary display — Two small displays located below the main display in measuring mode. The process variables to be displayed can be selected using ▲ / ▼ and ◀ / ▶.

Sensor slope — Specified in pA/mbar

Sensor statistics	The sensor statistics provide the sensor data of the last three calibrations and the first calibration.
Slope	See Sensor slope.
Tag number	Can be defined to identify the Transmitter and can be displayed in the diag menu. For HART® transmission, the first 8 characters are used as “TAG”.
TAN	Transaction number for later installation of software options.
Temperature compensation	Correction of temperature dependence of membrane diffusion
Viewing level	“view”, menu level of the Parameter Setting menu. Display of all device settings, however no editing possible.
Warning (maintenance required)	Alarm message, means that the equipment is still operating properly but should be serviced, or that process parameters have reached a value requiring intervention.
Zero point	Sensor signal which is output when measuring in an oxygen-free medium.

This page has been left empty for technical reasons.

14 Index

N

O

P