Instruction manual

O_2 Transmitter 4100e FF

Order number: 52 121 252

METTLER TOLEDO

Warranty

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

Subject to change without notice.

Return of products under waranty

Please contact METTLER TOLEDO's Customer Service Dept. before returning a defective device. Ship the cleaned device to the address you have been given. If the device has been in contact with process fluids, it must be decontaminated/disinfected before shipment. In that case, please attach a corresponding certificate, for the health and safety of our service personnel.

Disposal (Directive 2002/96/EC of January 27, 2003)
Please observe the applicable local or national regulations concerning the disposal of "waste electrical and electronic equipment".

CE

Mettler-Toledo GmbH, Process Analytics, Industrie Nord,
CH-8902 Urdorf, Tel. +41 (01) 736 22 11 Fax +41 (01) 736 26 36
Subject to technical changes. Mettler-Toledo GmbH, 09/04.
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Safety information

Be sure to read and observe the following instructions!
The device has been manufactured using state of the art technology and it complies with applicable safety regulations. When operating the device, certain conditions may nevertheless lead to danger for the operator or damage to the device.

Caution!
Commissioning may only be carried out by trained experts. Whenever it is likely that protection has been impaired, the device shall be made inoperative and secured against unintended operation.

The protection is likely to be impaired if, for example:
- the device shows visible damage
- the device fails to perform the intended measurements
- after prolonged storage at temperatures above 70 °C
- after severe transport stresses

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

Caution!
Before commissioning it must be proved that the device may be connected with other equipment, such as coupling elements and cables.

Safety precautions for installation

- The stipulations of EN 60079-10 / EN 60079-14 must be observed during commissioning.
- The **O_2 Transmitter 4100e FF** is approved for operation in hazardous locations.

Connection to supply and coupling elements

- The **O_2 Transmitter 4100e FF** may only be connected to explosion-proof power supply and coupling elements (for input ratings refer to annex of Type Examination Certificate). Before commissioning it must be proved that the intrinsic safety is maintained when connecting the device to other equipment, such as supply elements and cables.

Terminals:
suitable for single wires / flexible leads up to 2.5 mm^2 (AWG 14)

Cleaning in a hazardous location

In hazardous locations the device may only be cleaned with a damp cloth to prevent electrostatic discharge.

Intended use / Short description

The O_2 Transmitter 4100e FF is an analyzing device with digital communication via Foundation Fieldbus (FF). It is used for measurement of dissolved and gaseous oxygen (O_2 saturation, O_2 concentration, and temperature) in biotechnology, chemical and pharmaceutical industry, as well as in the field of industry, environment, food processing, and waste-water treatment.
3 measured values can be cyclically transmitted at the same time (O_2 saturation (%), O_2 concentration (Conc), temperature, zero, slope, volume concentration).
The bus address is automatically assigned by the control system, but can also be adjusted on the device.
The rugged molded enclosure can be fixed into a control panel or mounted on a wall or at a post.
The protective hood provides additional protection against direct weather exposure and mechanical damage.
The transmitter has been designed for application with amperometric METTLER TOLEDO sensors of the InPro 6800 and InPro 6900 series.

- The **O_2 Transmitter 4100e FF** is an intrinsically safe equipment for operation in hazardous locations.
  Power is supplied (intrinsically safe) via the fieldbus.

Trademarks

The following names are registered trademarks. For practical reasons they are shown without trademark symbol in this manual.
Sensocheck, Sensoface, Calimatic, GainCheck
InPro® is a registered trademark of Mettler Toledo.

EC Declaration of Conformity

Mettler-Toledo GmbH
Process Analytics

Adresse | Im Hackacker 15 (Industrie Nord), CH-8902 Urdorf, Schweiz
Briefadresse | Postfach, CH-8902 Urdorf
Telefon | 01-736 22 11
Telefax | 01-736 26 36
Internet | www.mt.com
Bank | Credit Suisse First Boston, Zürich (Acc. 0835-370501-21-90)

Declaration of conformity
Konformitätserklärung
Déclaration de conformité

CE 0820

Wer/ 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

02 4100e FF
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).

EMC Directive/ EMV-Richtlinie/ Directive concernant la CEM

89/336/EWG

Low voltage directive/ Niederspannungsrichtlinie/ Directive basse tension

73/23/EWG

Explosion protection/ Explosionsschutzrichtlinie/ Prot. contre les explosions

94/9/EG
Prüf- und Zertifizierungsstelle ZELM
ZELM 02 ATEX 0073
D-38124 Braunschweig, ZELM 0820

Place and Date of issue/ Ausstellungsort/ - Datum Lieu et date d'émission

Urdorf, September 1st, 2004

Mettler-Toledo GmbH, Process Analytics

Waldemar Rauch
General Manager PO Urdorf

Christian Zwicky
Head of Marketing

Norm/ Standard/ Standard

EN 50014 EN 50020
EN 61326/ VDE 0843 Teil 20
EN 61010/ VDE 0411 Teil 1

METTLER TOLEDO

KF 02#100e FF Int.doc

EC-Type-Examination Certificate

Prüf- und Zertifizierungsstelle

ZELM Ex

(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:

ZELM 02 ATEX 0073

(4) Equipment: **O_2 - Transmitter Typ 4100 PA**

(5) Manufacturer: **Mettler Toledo GmbH**

(6) Address: **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 Prüf- und Zertifizierungsstelle ZELM Ex, notified body No. 0820 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 ZELM Ex 03701 12102.

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

EN 50 014: 1997+A1+A2 **EN 50 020: 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 ia IIC T4

Zertifizierungsstelle **ZELM Ex**

Dipl.-Ing. Harald Zelm

Braunschweig, Januar, 08. 2002

Sheet 1/3

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In case of dispute, the German text shall prevail.

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Prüf- und Zertifizierungsstelle

ZELM Ex

(13) # SCHEDULE

(14) **EC-TYPE-EXAMINATION CERTIFICATE ZELM 02 ATEX 0073**

(15) Description of equipment

The O2 - Transmitter Typ 4100 PA with Profibus – PA – communication interface is preferably used for the recognition and processing of electrochemical quantities and is equipped with an input for measurements of the oxygen partial pressure and a temperature measuring input.

The maximum permissable ambient temperature is 55 °C.

Electrical data

BUS- / Supply loop (terminals 11 and 10)

type of protection Intrinsic Safety EEx ia IIC/IIB
resp. EEx ib IIC/IIB

for the connection to a certified intrinsically safe circuit only (for example FISCO – supply unit) with the following maximum values:

	FISCO- supply unit	linear barrier
$U_{o/max}$	17.5 V	24 V
$I_{o/max}$	280 mA	200 mA
$P_{o/max}$	4.9 W	1.2 W

effective internal capacitance: $C_i \leq 1$ nF
effective internal inductance: $L_i \leq 10$ µH

Oxygen measuring loop (terminals 1/2, 4 and 5)

type of protection Intrinsic Safety EEx ia IIC/IIB
resp. EEx ib IIC/IIB

maximum values: $U_o = 10$ V
$I_o = 11$ mA
$P_o = 14$ mW
$R = 475$ Ω
(linear characteristics)

	IIC	resp.	IIB
max. permissible external inductance	1 mH		5 mH
max. permissible external capacitance	925 nF		4 µF

effective internal capacitance: $C_i \leq 25$ nF
The effective internal inductance is negligibly small.

Prüf- und Zertifizierungsstelle

ZELM Ex

Anlage zur EG-Baumusterprüfbescheinigung ZELM 02 ATEX 0073

Temperatur-Meßstromkreis (Klemmen 7, 8)	In Zündschutzart Eigensicherheit bzw	EEx ia IIC/IIB EEx ib IIC/IIB	
	Höchstwerte	U_o = 5 V I_o = 1 mA P_o = 2 mW R = 7,88 kΩ (lineare Kennlinie)	
		IIC	**bzw. IIB**
	höchstzulässige äußere Induktivität	1 mH	5 mH
	höchstzulässige äußere Kapazität	4 µF	10 µF
	wirksame innere Kapazität:	C_i ≤ 120 nF	
	Die wirksame innere Induktivität ist vernachlässigbar klein.		
PA (Klemme 9)	Zum Anschluß an den Potentialausgleich		

Hinweise:

Der Anschluß an den Potentialausgleich ist zur Sicherstellung der elektrostatischen Ableitung unbedingt erforderlich.

Der BUS- / Speisestromkreis ist von allen übrigen Stromkreisen bis zu einem Scheitelwert der Nennspannung von 60 V sicher galvanisch getrennt.

Die Betriebsanleitung ist zu beachten.

(16) Prüfbericht Nr. ZELM Ex 0370112102

(17) Besondere Bedingungen

nicht zutreffend

(18) Grundlegende Sicherheits- und Gesundheitsanforderungen

durch Normen erfüllt

Zertifizierungsstelle **ZELM** Ex

Dipl.-Ing. Harald Zelm

Braunschweig, 08.01.2002

Seite 3/3

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1.Supplement

(Supplement according to EC-Directive 94/9 Annex III letter 6)

to EC-type-examination Certificate

ZELM 02 ATEX 0073

Equipment:	**O_2 Transmitter Type O_2 4100e FF**
Manufacturer:	**Mettler-Toledo GmbH**
Address:	**Im Hackacker 15, CH – 8902 Urdorf**

Description of supplement

The O_2 Transmitter Type O_2 4100 PA was extended by the O_2 Transmitter Type O_2 4100e FF with Foundation Fieldbus communication interface

The type of protection, the electrical and all further data of the device remain unchanged.

The Foundation Fieldbus version of the Transmitter may be manufactured in future in consideration of this supplement.

References:

The Operating Instructions has to be considered

Report No. ZELM Ex 1040417317

Special conditions for safe use

not applicable

Essential Health and Safety Requirements

met by adherence to the standards

EN 50 014: 1997+A1+A2 **EN 50 020: 1994**

Zertifizierungsstelle **ZELM Ex**

Dipl.-Ing. Harald Zelm

Braunschweig, October 04. 2004

Sheet 1 / 1

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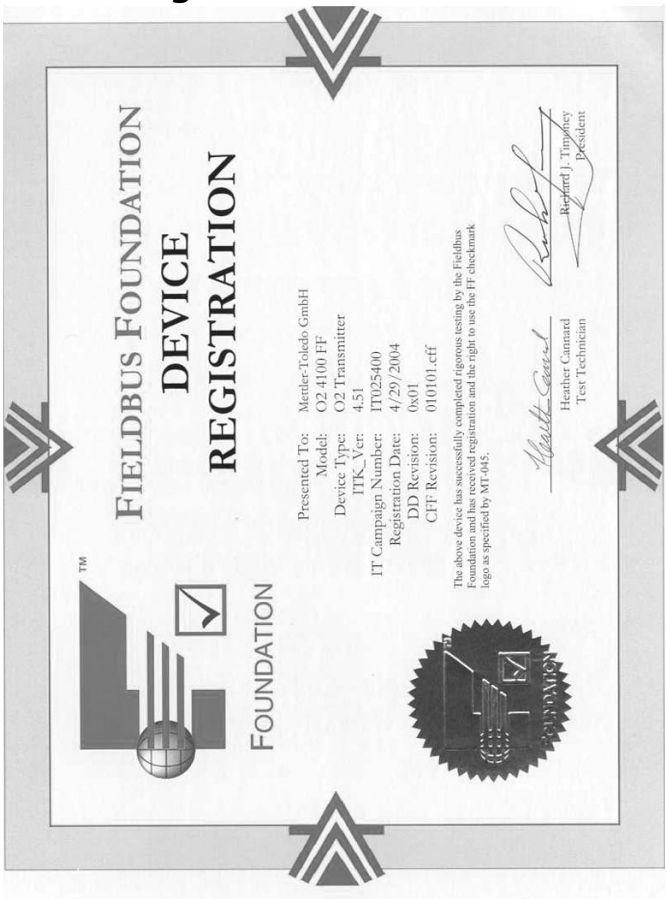
Fieldbus Foundation: Device Registration



Foundation Fieldbus (FF) technology

General

Foundation Fieldbus (FF) is a digital communication system that connects different field devices over a common cable and integrates them into a control system.
Its application range covers manufacturing, process, and building automation.
As fieldbus standard according to EN 61158-2 (IEC 1158-2) the Foundation Fieldbus ensures the communication of different devices over one bus line.

Basic properties

The "Data Link Layer" of the Fieldbus Foundation protocol defines 3 device types:

The **Active Link Master** plans all activities as "Link Active Scheduler" (LAS). It controls the complete data traffic on the bus. Several Link Masters on one bus increase safety, but only one is active at a time.

Basic devices are peripheral devices such as valves, drives, transmitters, or analyzers. They can react acyclically to servicing, configuration and diagnostic tasks of the master. The Link Master cyclically reads the measurement data with status.

Bridges: can connect a network from different bus systems.

Bus communication

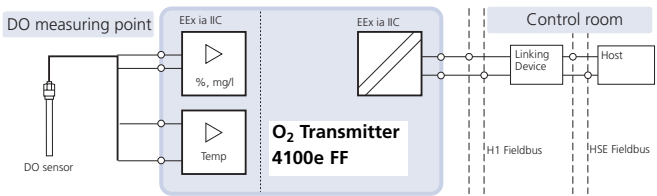
Foundation Fieldbus (FF) permits cyclic and acyclic services:

Cyclic Services - Scheduled Communication
are used to transmit measurement data with status information.
The Link Active Scheduler maintains a list of transmission times for all data in all devices that need to be cyclically transmitted. When it is time to transmit data, the LAS issues a "Compel Data (CD)" start signal to the respective device. Upon receipt of the "Compel Data" signal, the device broadcasts the data to all devices on the fieldbus.

Acyclic Services - Unscheduled Communication
are used for device configuration, remote maintenance, and diagnostics during operation.
All devices are given the chance to send acyclic (unscheduled) messages between transmissions of cyclic (scheduled) data. The LAS grants permission to a device to broadcast acyclic messages by issuing a "Pass Token (PT)" message. Upon receipt of the "Pass Token", the device starts data transmission.

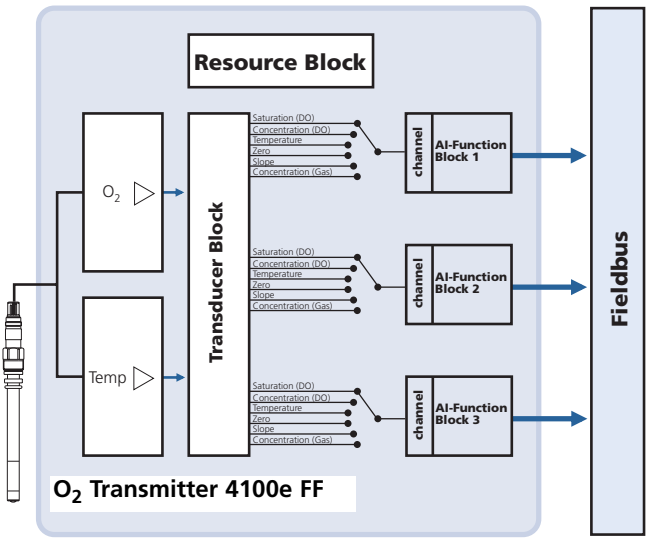
Technical features of O_2 Transmitter 4100e FF

Communication between the field devices and control room is effected by Foundation Fieldbus FF. Data exchange is cyclic and acyclic.



Communication model

The device performance is described by function blocks according to the "Fieldbus Specification" for process control devices.



Function blocks

All variables and parameters of the transmitter are assigned to blocks. The O_2 Transmitter 4100e FF is equipped with the following blocks:

Standard Resource Block (RB)
describes the transmitter characteristics (manufacturer, device name, operating status, global status).

Standard Analog Input Block (AI)
Three Analog Input Function Blocks provide for cyclic transmission of measured values (currently measured value with status, alarm limits, freely selectable process variable).

Transducer Block (TB) with calibration possibility
provides for acyclic data transmission.
Calibration, configuration, and maintenance commands coming from the control station are processed in the Transducer Block.
The sensor signal is first preprocessed in the Transducer Block. From here, the measured value is sent to the Analog Input Blocks where it can be further processed (limit values, scaling).

Commissioning and configuration via Foundation Fieldbus

Commissioning on the Foundation Fieldbus

Different configuration tools from different manufacturers are available. They can be used to configure the device and the Foundation Bus.

Note:
Be sure to observe the operating instructions and the menu guidance of the control system or the configuration tool during installation and configuration via the control system.

Installing the DD (Device Description):

During initial installation the device description (*.sym, *.ffo) must be installed in the control system.
For network projecting, you require the CFF file (Common File Format).

These files can be obtained from:

- the included CD
- www.mtpro.com/transmitters
- Foundation Fieldbus: www.fieldbus.org.

Identifying the transmitter

There are several possibilities to identify a FF transmitter in the network. The most important one is the "Device Identifier" or DEV_ID. It consists of the manufacturer ID, device ID, and serial number XXXXXXX.

The DEVICE_ID is: 4652551004 V2_01__XXXXXXX00

Manufacturer ID Mettler: MANUFAC_ID = 0x465255

Device ID O_2 Transmitter 4100e FF: DEV_ID = 4100

Initial commissioning

1. Supply the device with power (see "Installation and wiring", Pg 32).
2. Open the configuration program of the control system.
3. Load DD and CFF file.
   After the first connection establishment, the device answers as follows:

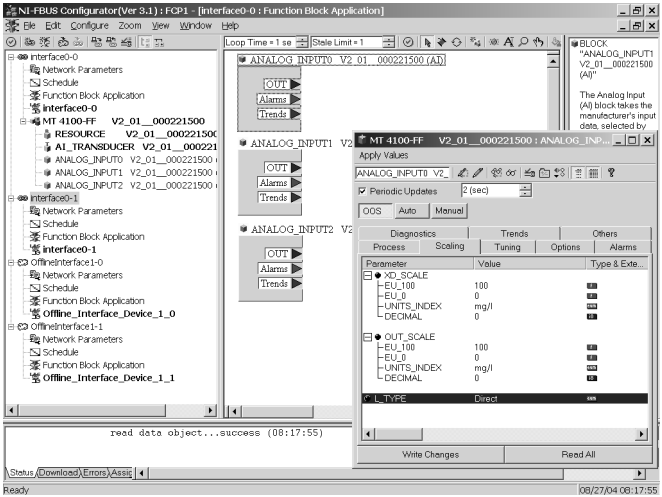
MT 4100-FF V2_01__XXXXXXX00- ID= 4652551004 V2_01__XXXXXXX00

4. Assign the desired name to the field device. (PD_TAG)

Setting the Resource Block (RB) parameters

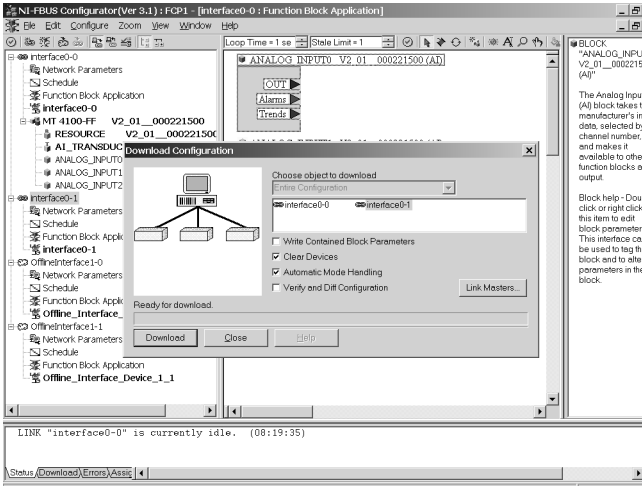
5. Make sure that the WRITE_LOCK parameter is set to "NOT LOCKED".
6. Set the MODE_BLK. TARGET to Auto.

Setting the Analog Input Block (AI) parameters



7. Set MODE_BLK. TARGET to OOS (Out Of Service).
8. Select the desired process variable from the CHANNEL parameter. See table on Page 102.
9. Select the unit belonging to the process variable from the XD_SCALE parameter.
10. Select the unit belonging to the process variable from the OUT_SCALE parameter.
11. Set the LIN_TYPE linearization type to Direct
12. If these steps are not properly executed, the "Block Configuration Error" is generated when the block is set to "Auto".

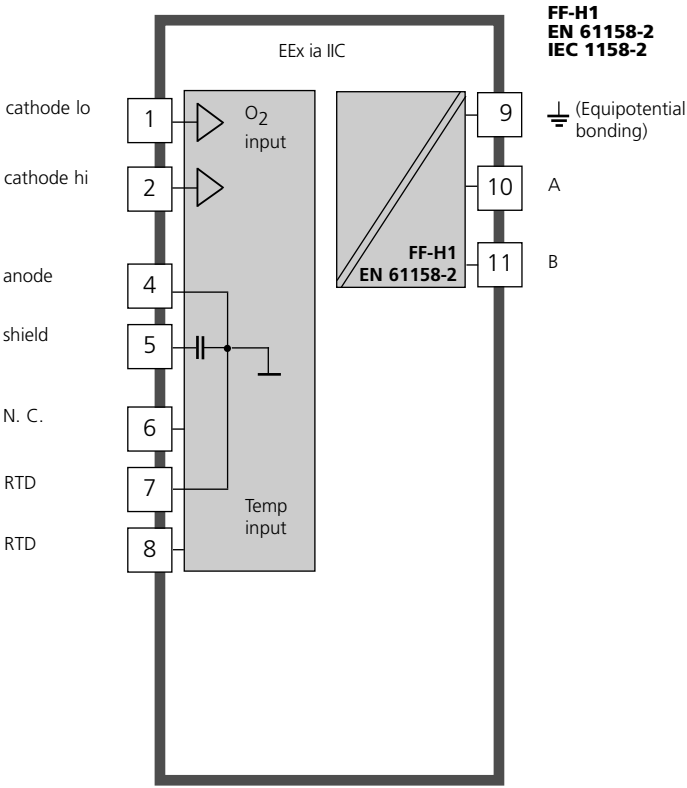
System configuration



This step is mandatory since otherwise the target mode of the Analog Input Block cannot be set to "Auto".
Using the NI-FBUS Configurator from National Instruments, for example, you can graphically connect the function blocks and then load the system configuration in the device.

13. Download all data and parameters to the field device.
14. Set the target modes of all Analog Input Blocks to "Auto".

Overview of the transmitter

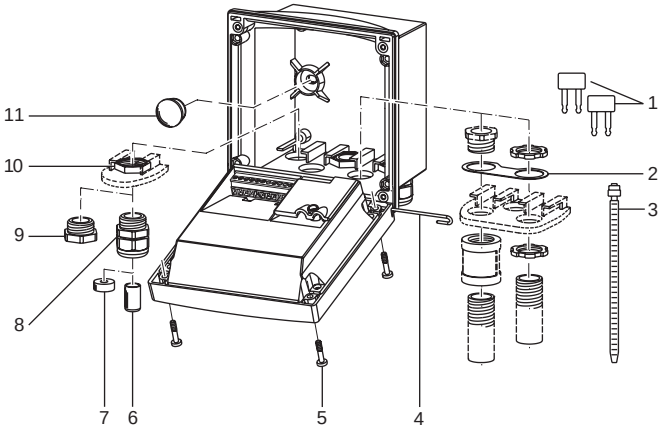


Assembly

Packing list

Check the shipment for transport damage and completeness.
The package should contain:

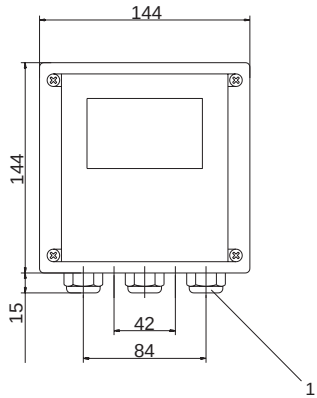
- Front unit
- Lower case
- Bag containing small parts
- Instruction manual
- Specific test report
- CD with Device Description
  * .sym, * .ffo
  Common File Format
  CFF-File

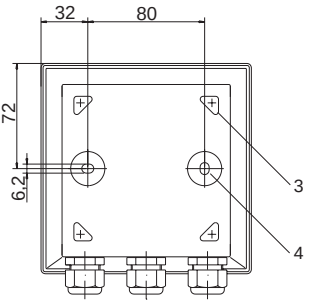


1 Jumper (2 piece)
2 Washer (1 piece), for conduit mounting: place washer between enclosure and nut
3 Cable ties (3 pieces)
4 Hinge pin (1 piece), insertable from either side
5 Enclosure screws (4 pieces)
6 Sealing inserts (1 piece)
7 Rubber reducer (1 piece)
8 Cable glands (3 pieces)
9 Filler plugs (3 pieces)
10 Hexagon nuts (5 pieces)
11 Sealing plugs (2 pieces): for sealing in case of wall mounting

Fig.: Assembling the enclosure

Mounting plan

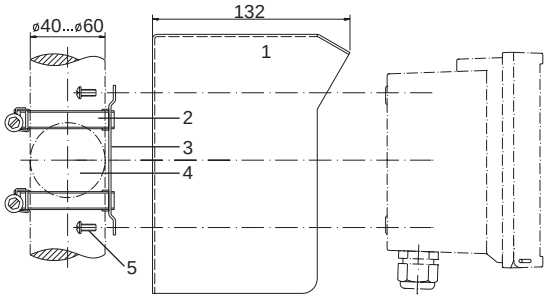




1 Cable gland (3 pieces)
2 Breakthroughs for cable gland or conduit 1/2", ø 21.5 mm (2 breakthroughs)
Conduits not included!
3 Breakthroughs for pipe mounting (4 breakthroughs)
4 Breakthroughs for wall mounting (2 breakthroughs)

Fig.: Mounting plan

Pipe mounting, panel mounting



1 Protective hood (if required)
2 Hose clamps with worm gear drive to DIN 3017 (2 pieces)
3 Pipe-mount plate (1 piece)
4 For vertical or horizontal posts or pipes
5 Self-tapping screws (4 pieces)

Fig.: Pipe-mount kit

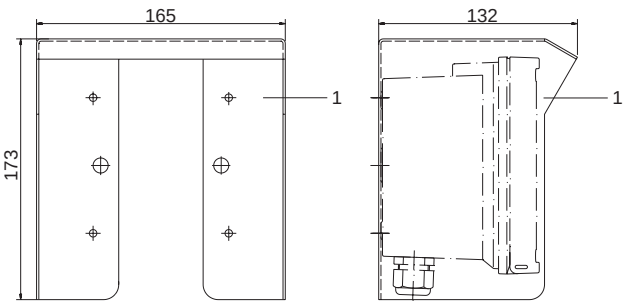


Fig.: Protective hood for wall and pipe mounting

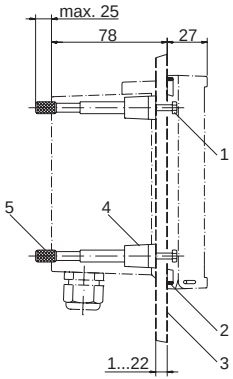


Fig.: Panel-mount kit

1 Screws (4 pieces)
2 Gasket (1 piece)
3 Panel
4 Span pieces (4 pieces)
5 Threaded sleeves (4 pieces)

Panel cutout 138 x 138 mm
(DIN 43700)

Installation and connection

Information on installation

- Installation 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.
- Be sure to observe the IEC 60079-27 "Fieldbus Intrinsically Safe Concept (FISCO)" and the "Fieldbus Non-Incendive Concept (FNICO)"
- Be sure not to notch the conductor when stripping the insulation.
- All parameters must be set by a system administrator prior to commissioning.

For connection to supply and coupling elements, see Pg 8.

Terminals:
Suitable for single wires / flexible leads up to 2.5 mm² (AWG 14)
A special twisted and shielded two-wire cable (e.g. Siemens) is used as bus cable.

Terminal assignments

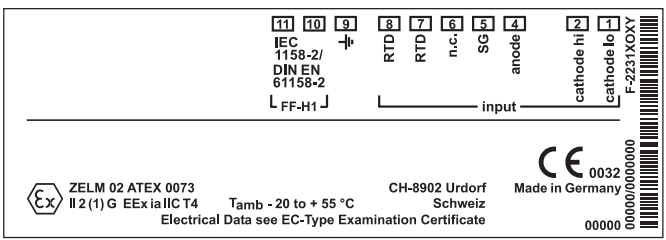
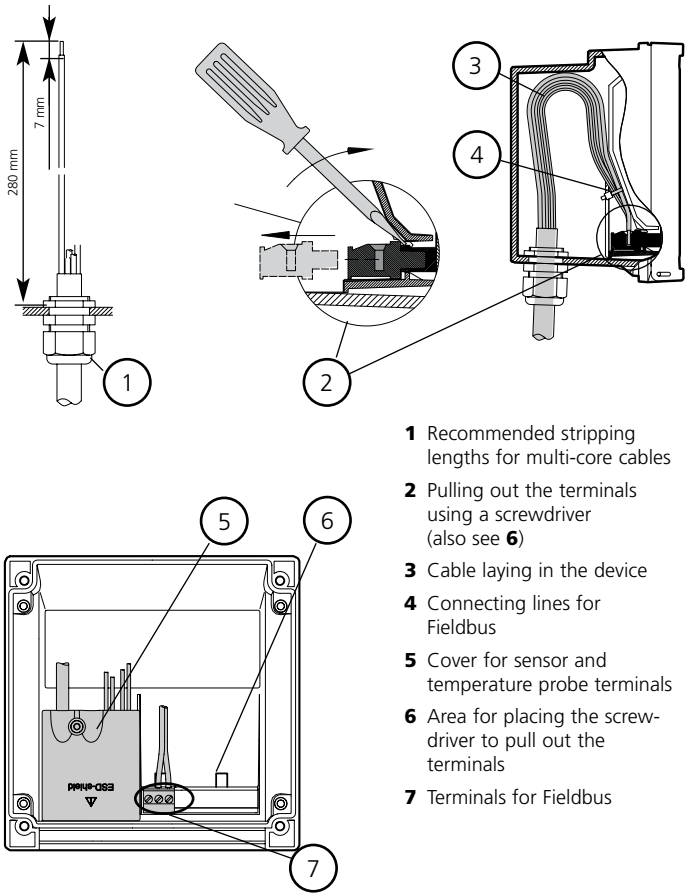


Fig.: Terminal assignments O_2 Transmitter 4100e FF



1 Recommended stripping lengths for multi-core cables

2 Pulling out the terminals using a screwdriver (also see **6**)

3 Cable laying in the device

4 Connecting lines for Fieldbus

5 Cover for sensor and temperature probe terminals

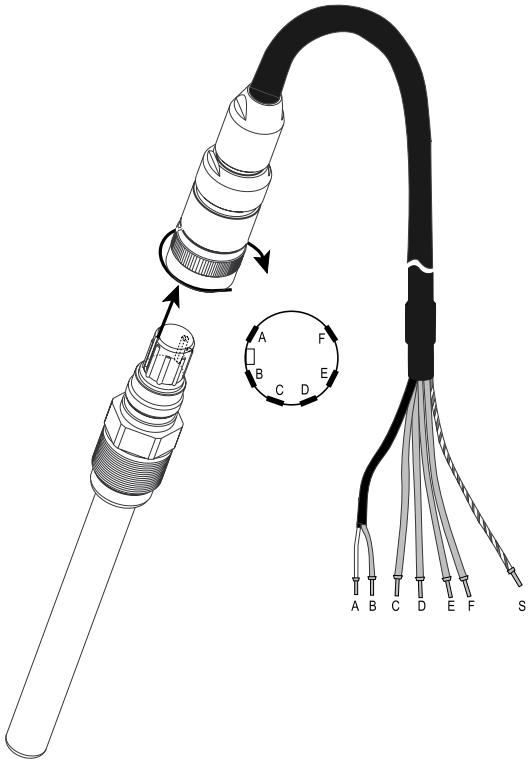
6 Area for placing the screwdriver to pull out the terminals

7 Terminals for Fieldbus

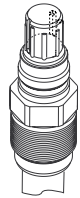
Fig.: Information on installation, rear side of device

Connecting the VP cable

Connecting the sensor to the VP cable



VP cable assignment



A transparent — Cathode

B red — Anode

C gray — Guard

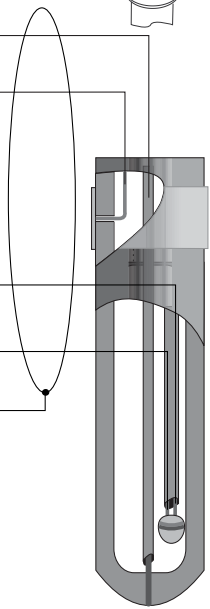
D blue — Not connected

E white — (RTD)

F green — (RTD)

S green/yellow — Outer shield

C = 220 nF

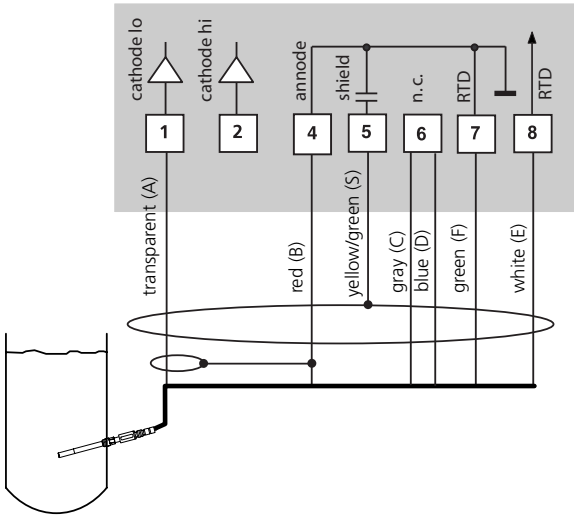


RTD = temperature probe

Wiring examples

Example 1:

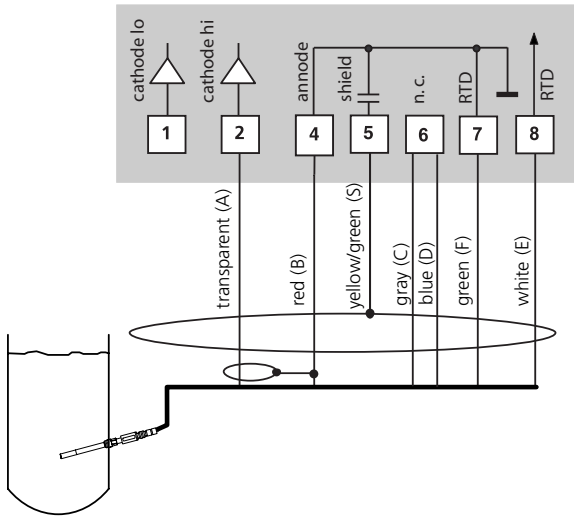
- Oxygen measurement with InPro 6900 trace sensor for low-level range (see Pg 117) (VP cable connection)



Connection	Terminal	InPro 6900 sensor VP cable
cathode lo	1	transparent (coax core)
cathode hi	2	not connected
anode	4	red (coax shield)
shield	5	yellow/green (external shield)
n. c.	6	gray, blue
RTD	7	green
RTD	8	white

Example 2:

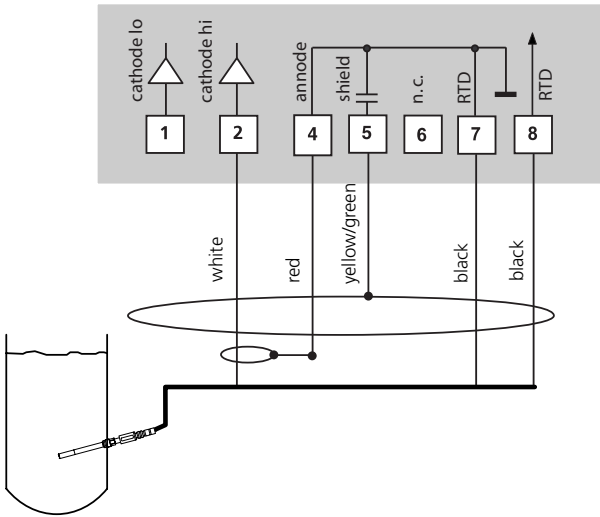
- Dissolved oxygen measurement with InPro 6800 for high-level range (see Pg 118) (VP cable connection)



Connection	Terminal	InPro 6800 sensor VP cable
cathode lo	1	not connected
cathode hi	2	transparent (coax core)
anode	4	red (coax shield)
shield	5	yellow/green (external shield)
n. c.	6	gray, blue
RTD	7	green
RTD	8	white

Example 3:

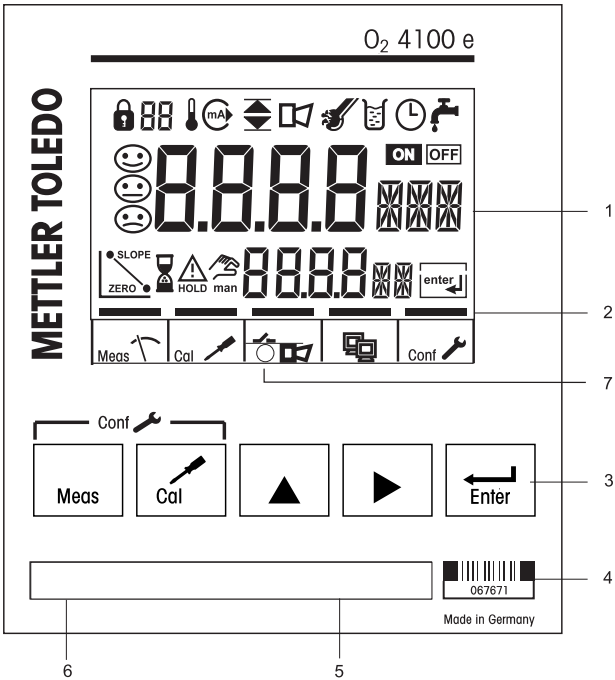
- Oxygen measurement with InPro 6800 for high-level range, also see Pg 118 (connection via T82)



Connection	Terminal	InPro 6800 sensor
cathode lo	1	not connected
cathode hi	2	white (coax core)
anode	4	red (coax shield)
shield	5	yellow/green (external shield)
n. c.	6	not connected
RTD	7	black
RTD	8	black

User interface and display

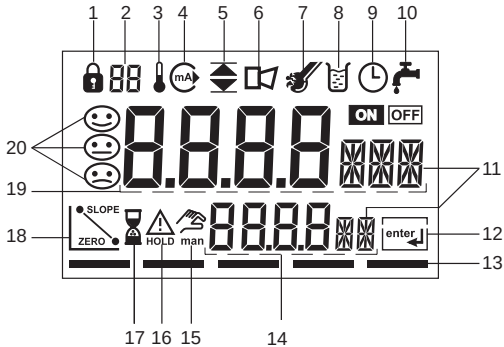
User interface



1 Display
2 Mode indicators (no keys), from left to right:
- Measuring mode
- Calibration mode
- Alarm
- Foundation Fieldbus communication
- Configuration mode

3 Keypad
4 Coding
5 Rating plate
6 Model designation
7 Alarm LED

Display

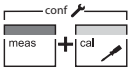


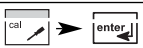
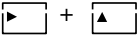
1 Mode code entry
2 Display of measured variable*
3 Temperature
4 Current output±
5 Limit values
6 Alarm
7 Sensocheck
8 Calibration
9 Interval/response time
10 Wash contact*
11 Measurement symbols
12 Proceed with **enter**
13 Bar for identifying the device status, above mode indicators from left to right:
- Measuring mode
- Calibration mode
- Alarm
- Foundation Fieldbus communication
- Configuration mode

14 Lower display
15 Manual temp specification
16 Hold mode active
17 Waiting time running
18 Sensor data
19 Main display
20 Sensoface

* Not in use

Operation: Keypad

	Start, end calibration
	Start configuration
	Abort configuration, calibration, then Hold mode is activated.
	Select digit position (selected position flashes)
	Edit digit
	• Calibration: Continue in program sequence • Configuration: Confirm entries, next configuration step • End the Hold mode

	Cal Info, display of asymmetry potential and slope
	Error Info: Display of last error message
	Start GainCheck device self-test

Hold mode

Display: ⚠ HOLD

The Hold mode is a safety state during configuration and calibration. In Hold mode the last valid value (last usable value) is transmitted.
Measured value status = uncertain : Last_usable_value
If the calibration or configuration mode is exited, the device remains in the Hold mode for safety reasons. This prevents undesirable reactions of the connected peripherals due to incorrect configuration or calibration. The measured value and "HOLD" are displayed alternately. The device only returns to measuring mode after **enter** is pressed and 20 seconds have passed.

Configuration mode is also exited automatically 20 minutes after the last keystroke (timeout). The device returns to measuring mode.

Timeout is not active during calibration.

Alarm on the device

During an error message the alarm LED flashes.
The alarm response time is permanently set to 10 sec.
(see Configuration on the device, Pg 65)
The alarm LED on the front panel can be configured as follows:

HOLD off:	Alarm: LED flashing
HOLD on:	Alarm: LED on. HOLD: LED flashing.

For alarm handling via Foundation Fieldbus, see Pg 104.

Safety functions

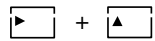
Sensocheck, Sensoface sensor monitoring

Sensocheck continuously monitors the sensor and lines. Sensocheck can be switched off (Configuration, Pg 65).

Sensoface provides information on the sensor condition.
The slope, response time and Sensocheck are evaluated. The three Sensoface indicators provide the user with information about wear and required maintenance of the sensor.

GainCheck device self test

A display test is carried out, the software version is displayed and the memory and measured value transfer are checked.

Start GainCheck device self-test: 

Automatic device self-test

The automatic device self-test checks the memory and measured-value transfer. It runs automatically in the background at fixed intervals.

Mode codes

Mode codes allow fast access to the functions

Calibration

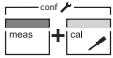
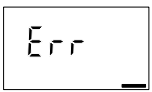
Key + Code	Description	Page
cal 0000	**Cal Info**	83
cal 1001	**Zero calibration**	78
cal 1100	**Slope calibration: for saturation**	70
	for concentration	72
	Volume concentration (GAS)	74
cal 1105	**Product calibration** Adjusting the zero / slope (product)	76
cal 1015	**Temp probe adjustment**	80

Configuration

Keys + Code	Description	Page
conf meas + cal 0000	**Error Info** Display last error and erase	83
conf meas + cal 1200	**Configuration**	46
conf meas + cal 2222	**Sensor monitor** Display sensor current and temp	83

Configuration on the device

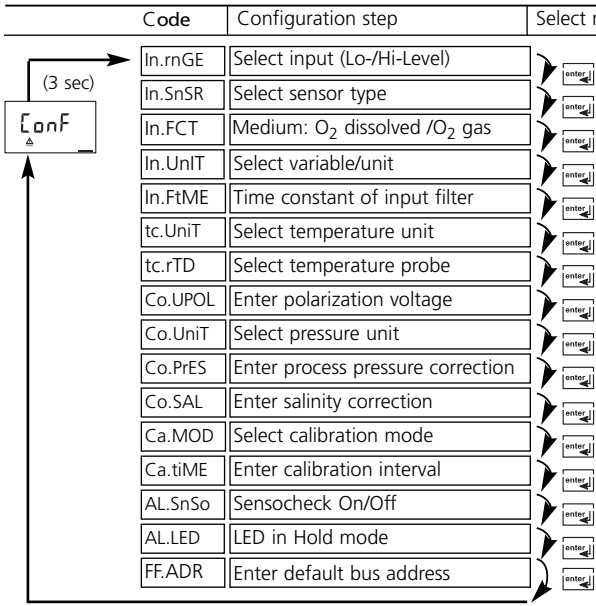
In the configuration mode on the device you primarily set parameters for the display.

Activate		Activate with **meas + cal**
		Enter mode code "1200". Edit parameter with ▸ and ▴, confirm/continue with **enter**. (End with **meas**, then **enter**.)
Hold During configuration the device remains in the Hold mode.	 HOLD icon	The last valid value (last usable value) is transmitted. Measured value status = uncertain: Last_usable_value. Sensoface is off, "Configuration" mode indicator is on. Red LED flashes when "HOLD ON" has been set.
Input errors		The configuration parameters are checked during the input. In the case of an incorrect input "Err" is displayed for approx. 3 sec. The incorrect parameters cannot be stored. Input must be repeated.
End		End with **meas**. The measured value and Hold are displayed alternately, "enter" flashes. Sensoface is active.
		Press **enter** to end the Hold mode. The measured value is displayed. Hold remains on for 20 sec (measured value status = uncertain: Last_usable_value). (HOLD icon is on, "hour glass" flashes).

The configuration steps are optically organized in menu groups:

- Select: Input signal level, sensor, process variable, process medium, input filter (code: In.)
- Temperature measurement (code: tc.)
- Correction (code: Co.)
- Calibration mode (code: CA.)
- Alarm settings (code: AL.)
- Input of bus address (code: FF.)

Pressing the **enter** key accesses the next configuration step. The values are edited using the arrow keys. Pressing **enter** confirms/stores the settings and opens the next configuration step. After the last configuration step the menu starts once more with the welcome text and the first step is opened again. Return to measurement: Press **meas**.



Overview of configuration steps

Code	Menu	Selection / Default (Factory setting bold print)	BUS access
In.	**Select meas. procedure / sensor, input filter**		
In.rnGE	Select input level	Lo / **Hi**	X
In.SnSR	Select sensor type	Standard **Type A** / Traces Type B	X
In.FCT	Select process medium: O_2 dissolved (DO) / gas	**DO** / GAS	X
In.UnIT	For DO: unit in display	**%**, mg/l, µg/l, ppm, ppb	X
In.UnIT	For GAS: unit in display	**ppm**, %	X
In.FtME	Time constant of input filter	0000 SEC (0000 ...0120 SEC)	X
tc.	**Temp compensation**		
tc.UnIT	Temperature unit	**°C** / °F	X
tc.rTD	Select temperature probe	**22 NTC** / 30 NTC	X
Co.	**Correction**		
Co.UPOL	Polarization voltage	**-0675 mV** (-1000 mV ... 0)	X
Co.UnIT	Select pressure unit	**BAR** / kPa / PSI	X
Co.PrES	Enter process pressure correction	**1.013 BAR** (0.000...9.999 BAR /999.9 kPa/ 145.0 psi)	X
Co.SAL	Enter salinity correction	**00.00 mg/l** (00.00...45.00 mg/l)	X
CA.	**Calibration mode**		
Ca.MOD	Select calibration mode	**SAt** / Conc	X
CA.tiME	Calibration interval	0000 ... 9999 h **(0000 h)**	X
AL.	**Alarm settings**		
AL.SnSO	Sensocheck On/Off	ON / OFF **(OFF)**	X
AL.LED	LED in HOLD mode	ON / OFF **(OFF)**	X
FF.	**Bus address**		
FF.ADR	Adjust default bus address	(0017 ... 0036) **(0026)**	X

Individual settings

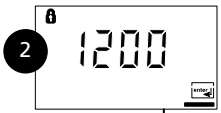
(Original for copy)

Code	Parameter	Factory settings	Individual settings
In.rnGE	Select signal level	Hi	
In.SnSR	Sensor type	Type A	
In.FCT	Process medium	DO	
In.UnIT	For DO: Unit	%	
In.UnIT	For GAS: Unit	ppm	
In.FtME	Filter time	0000 SEC	
tc.UnIT	Temp unit	°C	
tc.rTD	Temperature probe	22 NTC	
Co.UPoL	Polarization voltage	-0675 mV	
Co.UnIT	Pressure unit	BAR	
Co.PrES	Process press. corr.	1.013 BAR	
Co.SAL	Salinity correction	00.00 ppt	
CA.MoD	Calibration mode	SAt	
CA.tiME	Calibration interval	0000 h	
AL.SnSO	Sensocheck	OFF	
AL.LED	LED in Hold mode	OFF	
FF.ADR	Default bus address	0026	

Configuration on the device

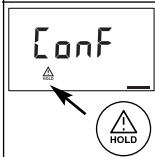
Select input: Hi-Level / Lo-Level

1. Simultaneously press **meas + cal**.
2. Enter mode code "1200", then **enter**.
   The device goes to Hold mode.
3. "ConF" is displayed for 3 sec.
   Then menu step:
   Select input: Hi-Level / Lo-Level.
   Edit with arrow keys (see Pg 51).
   Confirm (and proceed) with **enter**.
4. Pressing **enter** opens the next menu step.
5. End: Press **meas**, then **enter**



Display (3 sec)

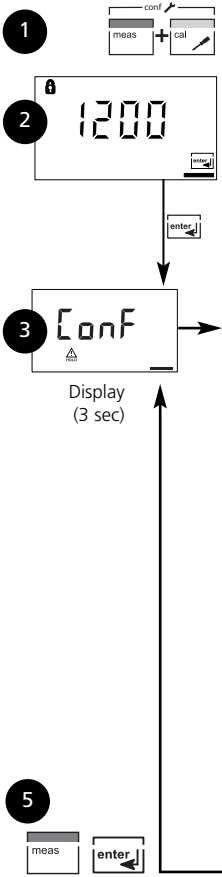
In.rnGE	Select input (Lo-/Hi-Level)
In.SnSR	Select sensor type
In.FCT	Medium: O_2 dissolved /O_2 gas
In.UnIT	Select variable/unit
In.FtME	Time constant of input filter
tc.UniT	Select temperature unit
tc.rTD	Select temperature probe
Co.UPOL	Enter polarization voltage
Co.UniT	Select pressure unit
Co.PrES	Enter process pressure correction
Co.SAL	Enter salinity correction
Ca.MOD	Select calibration mode
Ca.tiME	Enter calibration interval
AL.SnSo	Sensocheck On/Off
AL.LED	LED in Hold mode
FF.ADR	Enter default bus address

Code	Display	Action	Choices
In.		Select configuration: (Simultaneously press **meas + cal**.)	
		Enter passcode "1200" (Select position using arrow key ▸ and edit number using ▲ key. When the display reads "1200", press **enter** to confirm.) If an invalid code is entered, the device returns to measuring mode.	
		After correct input the welcome text is displayed for approx. 3 sec. The device is in HOLD mode (HOLD icon is active, red LED flashes when "HOLD ON" has been set.).	
		Select range for measuring current: Lo-level range: Measuring current -2 ... 600 nA, resolution 10 pA for measuring low oxygen concentrations Hi-level range: Measuring current -2 ... 1800 nA, resolution 30 pA	**Hi** (Lo/Hi)

Note: Characters represented in gray are flashing and can be edited.

Configuration on the device

Select sensor type.



1. Simultaneously press **meas + cal**.
2. Enter mode code "1200", then **enter**.
   The device goes to Hold mode.
3. "ConF" is displayed for 3 sec.
   Press **enter** to access **Select sensor type** menu.
   Edit with arrow keys (see Pg 53).
   Confirm (and proceed) with **enter**.
4. Pressing **enter** opens the next menu step.
5. End: Press **meas**, then **enter**

In.rnGE	Select input (Lo-/Hi-Level)
In.SnSR	**Select sensor type**
In.FCT	Medium: O_2 dissolved /O_2 gas
In.UnIT	Select variable/unit
In.FtME	Time constant of input filter
tc.UniT	Select temperature unit
tc.rTD	Select temperature probe
Co.UPOL	Enter polarization voltage
Co.UniT	Select pressure unit
Co.PrES	Enter process pressure correction
Co.SAL	Enter salinity correction
Ca.MOD	Select calibration mode
Ca.tiME	Enter calibration interval
AL.SnSo	Sensocheck On/Off
AL.LED	LED in Hold mode
FF.ADR	Enter default bus address

Code	Display	Action	Choices
In.		Select sensor type A / B (see table on left-hand side) Select with arrow key ▸ Proceed with: **enter**	**Type A** (InPro 6800) Type B (InPro 6900)

**** Type A sensor (standard applications)**

Sensor type	Screw cap	Sensor current in air (25 °C)	Detection limit
InPro 6800	4-pole (T82) VP	50 ... 110 nA typ. 60 nA	0.01 ppm 0.006 ppm

**** Type B sensor (traces)**

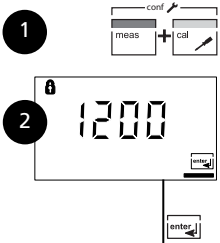
Sensor type	Screw cap	Sensor current in air (25 °C)	Detection limit
InPro 6900	VP	typ. 350 nA	0.001 ppm

Note:
After sensor replacement you must perform a new calibration.

Note: Characters represented in gray are flashing and can be edited.

Configuration on the device

Select medium / variable / unit

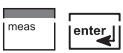


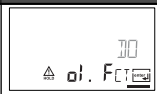
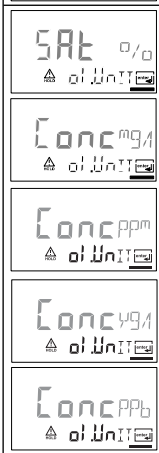
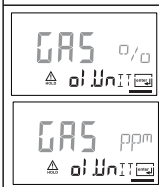
1. Simultaneously press **meas + cal**.
2. Enter mode code "1200", then **enter**.
   The device goes to Hold mode.
3. "ConF" is displayed for 3 sec.
   Press **enter** to access **Select medium** menu.
   Edit with arrow keys (see Pg 55).
   Confirm (and proceed) with **enter**.
4. Pressing **enter** opens the next menu step.
5. End: Press **meas**, then **enter**

4

In.rnGE	Select input (Lo-/Hi-Level)
In.SnSR	Select sensor type
In.FCT	**Medium: O_2 dissolved /O_2 gas**
In.UnIT	**Select variable/unit**
In.FtME	Time constant of input filter
tc.UniT	Select temperature unit
tc.rTD	Select temperature probe
Co.UPOL	Enter polarization voltage
Co.UniT	Select pressure unit
Co.PrES	Enter process pressure correction
Co.SAL	Enter salinity correction
Ca.MOD	Select calibration mode
Ca.tiME	Enter calibration interval
AL.SnSo	Sensocheck On/Off
AL.LED	LED in Hold mode
FF.ADR	Enter default bus address

5

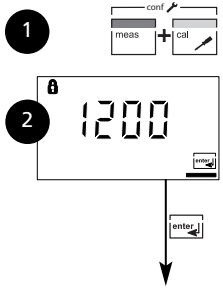


Code	Display	Action	Choices
In.		Select medium: • Dissolved oxygen (DO) / • Gas (GAS) Select with ▸ arrow key Proceed with **enter**	**DO** (GAS)
		Select variable / unit (valid for all following settings): Select with ▸ arrow key. Proceed: **enter** For input = Hi level: • **SAt:** Percent saturation: 0.0 ... 500 % • **Conc:** Concentration 0.00 ... 50.00 mg/l 0.00 ... 50.00 ppm For input = Lo level: **SAt:** Percent saturation: 0.0 ... 120 % • **Conc:** Concentration 0000 ... 9999 µg/l 0.000 ... 9.999 mg/l 0000 ... 9999 ppb 0.000 ... 9.999 ppm	**%** (µg/l mg/l ppb ppm)
		<u>Only with Measurement in gas selected (Select: GAS):</u> Select variable (valid for all following settings): Select with ▸ arrow key. Proceed with: **enter** For ranges, see Pg 117 et seq.	**%** (ppm)

Note: Characters represented in gray are flashing and can be edited.

Configuration on the device

Input filter / Time constant



1. Simultaneously press **meas + cal**.
2. Enter passcode "1200", then **enter**.
   The device goes to Hold mode.
3. "ConF" is displayed for 3 sec.
   Press **enter** to access **Time constant of input filter** menu.
   Edit with arrow keys (see Pg 57).
   Confirm (and proceed) with **enter**.
4. Pressing **enter** opens the next menu step.
5. End: Press **meas**, then **enter**

Display (3 sec)

4

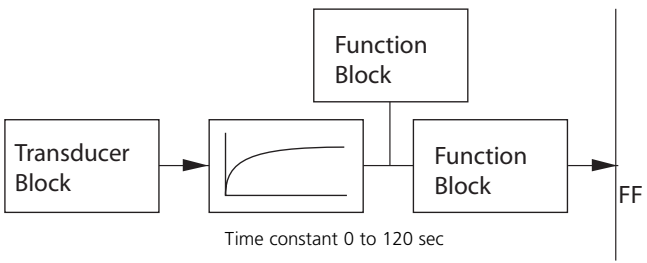
In.rnGE	Select input (Lo-/Hi-Level)
In.SnSR	Select sensor type
In.FCT	Medium: O_2 dissolved /O_2 gas
In.UnIT	Select variable/unit
In.FtME	**Time constant of input filter**
tc.UniT	Select temperature unit
tc.rTD	Select temperature probe
Co.UPOL	Enter polarization voltage
Co.UniT	Select pressure unit
Co.PrES	Enter process pressure correction
Co.SAL	Enter salinity correction
Ca.MOD	Select calibration mode
Ca.tiME	Enter calibration interval
AL.SnSo	Sensocheck On/Off
AL.LED	LED in Hold mode
FF.ADR	Enter default bus address

Code	Display	Action	Choices
In.		Time constant of input filter Default setting: 0 s (inactive). To specify a time constant: Select with ▸ key, edit number with ▲ key, proceed with **enter.**	**0000 SEC** (0000 ... 0120 SEC)

Time constant of input filter (attenuation)

To smoothen the signal input, a low-pass filter with adjustable filter time constant can be switched on. When there is a jump at the input (100 %), the output level is at 63 % after the time constant has been reached.

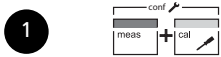
The time constant can be set from 0 to 120 sec. If the time constant is set to 0 sec, the filter is without effect.

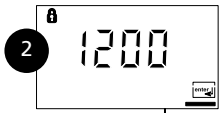


Time constant 0 to 120 sec

Configuration on the device

Temperature unit / Temperature probe



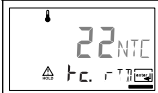


Display (3 sec)

1. Simultaneously press **meas + cal**.
2. Enter mode code "1200", then **enter**. The device goes to Hold mode.
3. "ConF" is displayed for 3 sec. Press **enter** to access **Select Temperature unit** menu. Edit with arrow keys (see Pg 59). Confirm (and proceed) with **enter**.
4. Pressing **enter** opens the next menu step.
5. End: Press **meas**, then **enter**

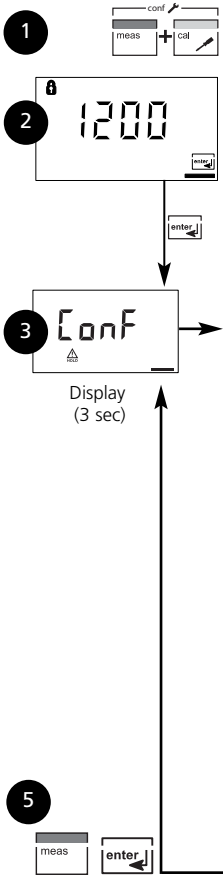
4

In.rnGE	Select input (Lo-/Hi-Level)
In.SnSR	Select sensor type
In.FCT	Medium: O_2 dissolved /O_2 gas
In.UnIT	Select variable/unit
In.FtME	Time constant of input filter
tc.UniT	**Select temperature unit**
tc.rTD	**Select temperature probe**
Co.UPOL	Enter polarization voltage
Co.UniT	Select pressure unit
Co.PrES	Enter process pressure correction
Co.SAL	Enter salinity correction
Ca.MOD	Select calibration mode
Ca.tiME	Enter calibration interval
AL.SnSo	Sensocheck On/Off
AL.LED	LED in Hold mode
FF.ADR	Enter default bus address

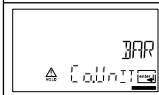
Code	Display	Action	Choices
tc.	 	Specify temperature unit Select with ▸ arrow key. Proceed with **enter**	**°C** (°F)
	 	Select temperature probe Select with ▸ arrow key. Proceed with **enter**	**22NTC** (30NTC)

Configuration on the device

Polarization voltage / Process pressure / Salinity correction



1. Simultaneously press **meas + cal**.
2. Enter mode code "1200", then **enter**.
   The device goes to Hold mode.
3. "ConF" is displayed for 3 sec.
   Press **enter** to access **Enter polarization voltage** menu.
   Edit with arrow keys (see Pg 61).
   Confirm (and proceed) with **enter.**
4. Pressing **enter** opens the next menu step.
5. End: Press **meas**, then **enter**

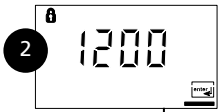
Code	Display	Action	Choices
Co.		Enter polarization voltage Select with ▸ key, edit number with ▲ key, proceed with **enter.**	**-0675 mV** (-1000 ... 0 mV)
		Select pressure unit Select with ▸ arrow key. Proceed with: **enter**	**bar** (kPa, PSI)
		Process pressure correction Enter process pressure. This value is used to correct oxygen saturation. It has no influence on concentration measurement (Conc). Select position with ▸ arrow key and edit number with ▲ key. Proceed with: **enter**	**1.013 bar** (0.000 ... 9.999 bar, 0.000 ... 999.0 kPa 0.000 ... 145.0 psi)
		Enter salinity correction (salinity) Select position with ▸ arrow key and edit number with ▲ key. Proceed with: **enter**	**00.00 ppt*** (00.00 ... 45.00 ppt)

* ppt (parts per thousand) - corresponds to g/kg

Configuration

Calibration mode / Calibration interval

1. Simultaneously press **meas + cal**.
2. Enter mode code "1200", then **enter**.
   The device goes to Hold mode.
3. "ConF" is displayed for 3 sec.
   Press **enter** to access **Select calibration mode** menu.
   Edit with arrow keys (see Pg 63).
   Confirm (and proceed) with **enter**.
4. Pressing **enter** opens the next menu step.
5. End: Press **meas**, then **enter**



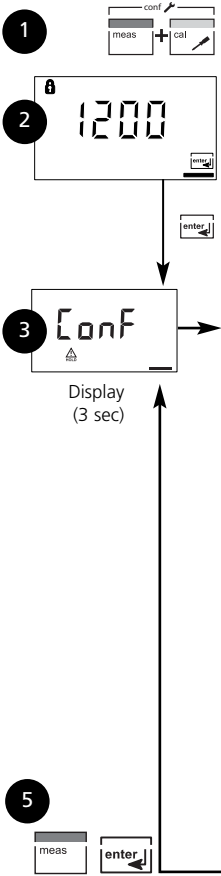
Display (3 sec)

In.rnGE	Select input (Lo-/Hi-Level)
In.SnSR	Select sensor type
In.FCT	Medium: O_2 dissolved /O_2 gas
In.UnIT	Select variable/unit
In.FtME	Time constant of input filter
tc.UniT	Select temperature unit
tc.rTD	Select temperature probe
Co.UPOL	Enter polarization voltage
Co.UniT	Select pressure unit
Co.PrES	Enter process pressure correction
Co.SAL	Enter salinity correction
Ca.MOD	**Select calibration mode**
Ca.tiME	**Enter calibration interval**
AL.SnSo	Sensocheck On/Off
AL.LED	LED in Hold mode
FF.ADR	Enter default bus address

Code	Display	Action	Choices
CA.	 	Specify calibration mode (Calibration to saturation or concentration) Select with ▸, proceed with **enter**	**SAt** (Conc)
		Calibration interval The cal timer reminds you to calibrate in time. Select with ▸ key, edit number with ▲ key, proceed with **enter.**	**0000 h** (0000 ... 9999 h)

Configuration on the device

Alarm settings



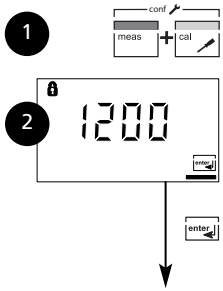
1. Simultaneously press **meas + cal**.
2. Enter mode code "1200", then **enter**.
   The device goes to Hold mode.
3. "ConF" is displayed for 3 sec.
   Press **enter** to access **Alarm settings** menu.
   Edit with arrow keys (see Pg 65).
   Confirm (and proceed) with **enter**.
4. Pressing **enter** opens the next menu step.
5. End: Press **meas**, then **enter**

<table>
<tr><th>Code</th><th>Display</th><th>Action</th><th>Choices</th></tr>
<tr><td rowspan="2">AL.</td><td> 
</td><td>Sensocheck On/Off
(continuous monitoring of sensor)
Select with ▸ key.
Proceed with enter
With sensor type B Sensocheck must be switched off.</td><td>ON / OFF</td></tr>
<tr><td> 
</td><td>LED in HOLD mode
Select with ▸ key, edit number with ▲ key, proceed with enter.

LED state:<table><tr><td>Parameter setting</td><td>Alarm</td><td>HOLD</td></tr><tr><td>ON</td><td>on</td><td>flashes</td></tr><tr><td>OFF</td><td>flashes</td><td>off</td></tr></table></td><td>ON / OFF</td></tr>
</table>

Configuration on the device

Adjustment / Default bus address



1. Simultaneously press **meas + cal**.
2. Enter mode code "1200", then **enter**.
   The device goes to Hold mode.
3. "ConF" is displayed for 3 sec.
   Press **enter** to access **Adjustment / Default bus address** menu.
   Edit with arrow keys (see Pg 67).
   Confirm (and proceed) with **enter**.
4. Pressing **enter** opens the next menu step.
5. End: Press **meas**, then **enter**

4

In.rnGE	Select input (Lo-/Hi-Level)
In.SnSR	Select sensor type
In.FCT	Medium: O_2 dissolved /O_2 gas
In.UnIT	Select variable/unit
In.FtME	Time constant of input filter
tc.UniT	Select temperature unit
tc.rTD	Select temperature probe
Co.UPOL	Enter polarization voltage
Co.UniT	Select pressure unit
Co.PrES	Enter process pressure correction
Co.SAL	Enter salinity correction
Ca.MOD	Select calibration mode
Ca.tiME	Enter calibration interval
AL.SnSo	Sensocheck On/Off
AL.LED	LED in Hold mode
FF.ADR	**Enter default bus address**

Code	Display	Action	Choices
FF.		Only when there is no bus connection: The bus address can be manually adjusted from 0017 ... 0036. Select with ▸ key, edit number with ▲ key, proceed with **enter.** When the bus address has been changed, the device automatically restarts to re-initialize the bus parameters.	**0026** (0017 ...0036)

Adjusting a new default bus address

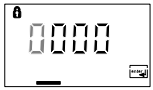
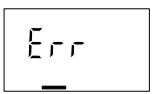
The Fieldbus Foundation automatically assigns an address. Therefore it is not required to manually adjust the bus address.
If the bus address has been changed, the bus configuration is reset to the default values during device restart. All bus parameters are set to their default values.

Note:

When the bus address has been changed, the bus configuration is automatically reset. All bus parameters are set to their default values. All individual settings have to be entered once more. The configuration must be reloaded into the device.

Calibration on the device

Calibration adjusts the device to the sensor.

Activate		Activate with **cal**
		Enter mode code: • 1001: Zero calibration • 1100: Saturation/Concentration Volume concentration (GAS) • 1105: Product calibration • 1015: Temperature probe adjustment Change parameter with ▸ and ▲, confirm/continue with **enter**. (End with **cal,** then **enter**.)
Hold During configuration the device remains in the Hold mode.	 HOLD icon	The last valid value (last usable value) is transmitted. Measured value status = uncertain: Last_usable_value. Sensoface is off, "Calibration" mode indicator is on. Red LED flashes when "HOLD ON" has been set.
Input errors		The calibration parameters are checked during the input. In the case of an incorrect input "Err" is displayed for approx. 3 sec. The incorrect parameters cannot be stored. Input must be repeated.
End	 	End with **cal**. **Safety prompt:** The measured value and Hold are displayed alternately, "**enter**" flashes. Sensoface is active. Press **enter** to end the Hold mode. The measured value is displayed. Measured value status = uncertain: Last_usable_value. (HOLD icon is on, "hourglass" flashes).

Calibration

It is always recommended to calibrate in air.
Compared to water, air is a calibration medium which is easy to handle, stable, and thus safe. In the most cases, however, the sensor must be dismounted for a calibration in air.
When dealing with biotechnological processes which require sterile conditions, the sensor cannot be removed for calibration. Here, calibration must be performed with aeration directly in the process medium (e.g. after sterilization).
In the field of biotechnology, for example, often saturation is measured and calibration is performed in the medium for reasons of sterility.
For other applications where concentration is measured (water control etc.), calibration in air has proved to be useful.

Common combination: process variable / calibration mode

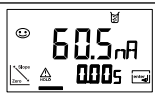
Measurement	Calibration
Saturation	Water
Concentration	Air (synthetic air)
Volume concentration	Air

The calibration procedures for these two common applications are described on the following pages. Of course, other combinations of process variable and calibration mode are possible.

Note:
When a 2-point calibration is required, the zero calibration should be performed prior to saturation or concentration calibration, resp (see Pg 78).
All calibration procedures must be performed by trained personnel.

Calibration to percent saturation (SAT)

Display	Action	Remark
	Activate calibration (Press **cal**.) Enter mode code 1100 Select with ▸ key, edit number with ▲ key, proceed with **enter**	Configuration: Select "DO", then set calibration mode to Sat. If an invalid code is entered, the device returns to measuring mode.
	Place sensor in calibration medium Start with **enter**	Welcome (3 sec) Device is in Hold mode
	Enter relative humidity Select with ▸ key, edit number with ▲ key, proceed with **enter**	Default for relative humidity in aqueous media: rH = 100 % (in air approx. 50 %)
	Enter calibration pressure Select with ▸ key, edit number with ▲ key, proceed with **enter**	Default for calibration pressure is the process pressure configured
	Automatic drift check Display of sensor current (related to 25 °C and 1013 mbars normal pressure) and measuring temperature. The drift check might take some time.	Drift check can be stopped after > 10 sec by pressing **cal** (accuracy reduced).

Display	Action	Remark
	Enter desired value for saturation Select with ▸ key, edit number with ▲ key, proceed with **enter**	Default: last value entered
	Display new slope and zero (related to 25 °C and 1013 mbars). End calibration with **enter.**	
	Place sensor in process. Safety prompt: The percent saturation is shown in the main display alternately with "Hold"; enter flashes. Sensoface is active. Stop Hold with **enter**.	After end of calibration, the outputs remain in Hold mode for approx. 20 sec.

Information on saturation calibration (SAT)

- The calibration medium must be in equilibrium with air (percent saturation for water is 100 %). Oxygen exchange between water and air is very slow. To speed up the adjustment processes, make sure that there is a steady medium flow during calibration.
- If the percent saturation is known from a simultaneous measurement, it can be entered manually.
- For 2-point calibration, perform zero calibration first (see Pg 78).

Calibration to concentration (Conc)

Display	Action	Remark
	Activate calibration (Press **cal**.) Enter mode code 1100 (Press ▸ key to select position, enter number using ▲ key, confirm with **enter**)	Configuration: Select "DO", then set calibration mode to Conc. If an invalid code is entered, the device returns to measuring mode.
	Place sensor in air Start with **enter**	Device is in Hold mode
	Enter relative humidity (Press ▸ key to select position, enter number using ▲ key, confirm with **enter**)	Default for relative humidity in air: rH = 50 %
	Enter calibration pressure (Press ▸ key to select position, enter number using ▲ key, confirm with **enter**)	Default for calibration pressure is normal pressure 1.013 bars.
	Automatic drift check Display of input current (related to 25 °C and 1013 mbars) and measuring temperature. The drift check might take some time.	Drift check can be stopped after > 10 sec by pressing **cal** (accuracy reduced).

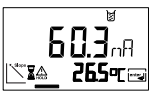
Display	Action	Remark
	Enter default for concentration (Press ▸ key to select position, enter number using ▲ key, confirm with **enter**)	Default value is calculated from rel. humidity, cal pressure, and cal temperature. (The unit of measurement, ppm or mg/l, ... is preset during configuration.)
	Display of new slope and zero (related to 25 °C and 1013 mbars) Press **enter** to end concentration calibration.	
	Place sensor in process. Safety prompt: The new value is shown in the main display alternately with "Hold"; "enter" flashes. Sensoface is active. End with **enter**.	After end of calibration, the outputs remain in Hold mode for approx. 20 sec.

Information on concentration calibration (Conc)

- Calibration in air. This calibration method is recommended when the sensor can be removed for calibration. Air has a stable oxygen content. Therefore the adjustment processes during calibration run more quickly.
- For 2-point calibration, perform zero calibration first (see Pg 78).

Calibration to volume concentration (GAS)

Cal medium: Air

Display	Action	Remark
	Activate calibration (Press **cal**.) Enter mode code 1100 (Press ▸ key to select position, enter number using ▲ key, confirm with **enter**)	Configuration: Gas is selected as medium (select "GAS") If an invalid code is entered, the device returns to measuring mode.
	Place sensor in air	Welcome (3 sec) Device is in Hold mode
	Enter relative humidity (Press ▸ key to select position, enter number using ▲ key, confirm with **enter**)	Default for relative humidity in air: rH = 50 %
	Enter calibration pressure (Press ▸ key to select position, enter number using ▲ key, confirm with **enter**)	Default for calibration pressure is normal pressure 1.013 bars.
	Automatic drift check of input current (related to 25 °C and 1013 mbars) and measuring temperature. The drift check might take some time.	Drift check can be stopped after > 10 sec by pressing **cal** (accuracy reduced).

Display	Action	Remark
	Display of new slope and zero (related to 25 °C and 1013 mbars) Press **enter** to end concentration calibration.	
	Place sensor in process. Safety prompt: The new value is shown in the main display alternately with "Hold"; "enter" flashes. Sensoface is active. Stop Hold with **enter**.	After end of calibration, the outputs remain in Hold mode for approx. 20 sec.

Information on calibration

- For 2-point calibration, perform zero calibration first (see Pg 78).

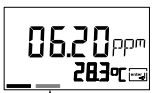
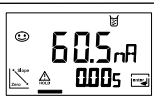
Product calibration

Calibration with sampling

1. The type of product calibration (SAT, Conc, Volume concentration) is selected during configuration.
2. For product calibration via Foundation Fieldbus, see Pg 90.

During product calibration the sensor remains in the process. The measurement process is only interrupted briefly.
Procedure: During sampling the currently measured value is stored in the transmitter. The device immediately returns to measuring mode. The calibration mode indicator flashes and reminds you that calibration has not been terminated. The comparison value is measured on the site, e.g. using a portable DO meter in a bypass. This value is then entered in the transmitter. The new value for slope or zero is calculated from the stored value and the comparison value. From the measured value, the device automatically recognizes whether a new slope or zero must be calculated (above approx. 5 % saturation: slope, below: zero).
If the sample is invalid, you can take over the measured value stored during sampling instead of the comparison value. In that case the old calibration values remain stored. Afterwards, you can start a new product calibration.
The following describes a product calibration with slope correction – a product calibration with zero correction is performed correspondingly.

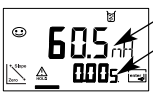
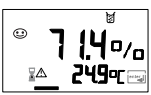
Display	Action	Remark
	Product calibration step 1: Activate calibration (Press **cal** key). Enter mode code 1105 Select with ▸ key, edit number with ▲ key. Proceed with **enter**)	The type of product calibration (SAT, Conc, Volume conc) is selected during configuration.

Display	Action	Remark
	Welcome text	Display for approx. 3 sec
	Take sample and store the currently measured value. Proceed with **enter**	Now the comparison value must be determined. The device goes to measuring mode.
	Measuring mode	From the flashing CAL mode indicator you see that product calibration has not been terminated.
	Product calibration 2nd step: When a comparison value has been determined, call up the product calibration once more (**cal** key, mode code 1105).	Display (approx. 3 sec)
	Enter the comparison value. Confirm with **enter**.	New calibration: Press **cal** key.
	Display of new slope and zero point (related to 25 °C at 1013 mbars) End calibration with **enter**	
	The measured value is shown in the main display alternately with "Hold". "enter" flashes, Sensoface is active. Stop Hold with **enter**.	Safety prompt After end of calibration, the outputs remain in Hold mode for approx. 20 sec.

Zero calibration

Zero calibration

The Series InPro 6800/InPro 6900 sensors have a very low zero point current. Therefore, a zero point calibration is only recommended for measurement of oxygen traces. If a zero calibration is performed, the sensor should remain for at least 10 to 30 minutes (InPro 6900 at least 60 minutes) in the calibration medium in order to obtain stable, non-drifting values.
During zero point calibration, a drift check is not performed.
Zero point current of a properly functioning sensor is notably less than 0.5 % of air current. The display (secondary: measured value, main: entered value) does not change until an input current is entered for the zero point.
When measuring in an oxygen-free medium, the displayed current can be taken directly.

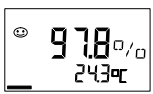
Display	Action	Remark
	Activate calibration (Press **cal** key). Enter mode code 1001 Select with ▸ key, edit number with ▲ key, proceed with **enter**	Device is in the Hold mode. If an invalid code is entered, the device returns to measuring mode.
	Place sensor in oxygen-free medium	Welcome (3 sec)
	Main display: Zero point current; store with **enter** or correct with arrow keys and then store with **enter**. Lower display: Sensor current measured	
	Display of slope Display of new zero point current End calibration with **enter** key, place sensor in process	
	The oxygen value is shown in the main display alternately with "Hold", "hourglass" and "enter" are flashing. Sensoface is active. Stop Hold with **enter**.	Safety prompt The outputs remain in Hold mode for approx. 20 sec.

Temp probe adjustment

Display	Action	Remark
	Activate calibration (Press **cal** key). Enter mode code 1015 Select with ▸ key, edit number with ▲ key, proceed with **enter**	Wrong settings change the measurement properties! If an invalid code is entered, the device returns to measuring mode.
	Ready for calibration	Device is in the Hold mode. Display for approx. 3 sec
	Measure the temperature of the process medium using an external thermometer. Enter measured temperature value: Select with ▸, edit number with ▲, proceed with **enter**. End adjustment with **enter**. HOLD will be deactivated after 20 sec.	Default: Current value of secondary display

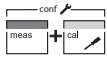
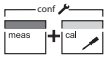
Symbol flashes:	Problem, possible cause
	**Slope out of range** • Wrong calibration values specified (relative humidity, pressure, saturation, concentration) • Wrong calibration medium
 In addition "CAL Err" flashes. is flashing	**Calibration aborted after 12 minutes** • Sensor defective or dirty • No electrolyte in the sensor • Sensor cable insufficiently shielded or defective • Strong electric fields influence the measurement • Temperature fluctuation of calibration solution

Measurement

Display	Remark
	In the measuring mode the main display shows the configured process variable (%, mg/l, or ppm) and the lower display the temperature. During calibration you can return to measuring mode by pressing the **cal**, then the **enter** key, during configuration by pressing **meas**, then **enter**. (Waiting time for measured value stabilization approx. 20 sec).

Cleaning

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

Display	Remark
 Code: 0000 	**Cal info** **Display of calibration data** Press **cal** while in measuring mode and enter mode code "0000". The slope is shown in the main display, the zero current in the secondary display. After 20 sec the device returns to measuring mode (immediate return at pressing **enter**).
 Code: 2222 	**Sensor monitor** **Display of sensor current** (Sensor monitoring for validation of sensor and complete measured-value processing) Press **meas + cal** while in measuring mode and enter mode code "2222". The (uncompensated) sensor current is shown in the main display, the measuring temperature in the secondary display. Press **enter** to return to measurement.
 Code: 0000 	**Error Info** **Display of last error message** Press **meas + cal** while in measuring mode and enter mode code "0000". The last error message is displayed for approx. 20 sec. After that the message will be deleted (immediate return to measurement at pressing **enter**).

Sensoface

(Sensocheck must have been activated during configuration.)

The smiley in the display (Sensoface) alerts to sensor problems (defective cable, maintenance request).
The permitted calibration ranges and the conditions for a friendly, neutral, or sad Sensoface are summarized in the following chart. Additional icons refer to the error cause.
Replace membrane module or filling solution, if required.

Type A sensor (InPro 6800)

	Slope	Zero point	Response time	Cal timer
Adm. range	25 .... 130 nA	-2 ... +2 nA	max. 720 s	
☺	> 35 ... < 90 nA	> - 0.3 ... < 0.3 nA	≤ 300 s	≤ 80 % expired
😐	 30 ... 35 nA or 90 ... 110 nA	 -0.6 ... -0.3 nA or +0.3 ... +0.6 nA	 300 ... 600 sec	 80 ... ≤ 100 % expired
☹	 < 30 nA or > 110 nA	 < -0.6 nA or > +0.6 nA	 > 600 s	 Timer expired

Note

The worsening of a Sensoface criterion leads to the devaluation of the Sensoface indicator (Smiley becomes "sad"). An improvement of the Sensoface indicator can only take place after calibration or removal of a sensor defect.

Type B sensor (InPro 6900)

	Slope	Zero point	Response time	Cal timer
Adm. range	200 ... 550 nA	-2 ... +2 nA	max. 720 s	
😐	> 250 ... < 500 nA	> - 0,5 ... < 0.5 nA	< 300 s	< 80 % expired
😐	 220 ... 250 nA or 460 ... 525 nA	 -1.0 to -0.5 nA or +0.5 ... +1.0 nA	300 ... 600 sec	80 ... ≤ 100 % expired
😕	 < 220 nA or > 525 nA	 < -1.0 nA or > +1.0 nA	> 600 s	Timer expired

🌡 😕	Thermometer and Sensoface: Temperature out of concentration or saturation range

Sensocheck

Continuously monitors the sensor and leads for short circuits or open circuits. Critical values make the Sensoface "sad" and the corresponding icon flashes:

The Sensocheck message is also output as error message Err 33.

Sensocheck can be switched off during configuration (then Sensoface is also disabled). Exception: After a calibration a Smiley is always displayed for confirmation.

Communication
Fieldbus / Device
Resource block (RB)

Block status
The RS_STATE parameter indicates the operating status of the resource block:

- Standby — The resource block is in OOS mode. The other blocks cannot be executed.
- Online — The resource block is in Auto mode, that is normal state.

Write protection
With the WRITE_LOCK parameter, you can set a write protection for the device.
- UNLOCKED — Device can be written to (default)
- LOCKED — Device is locked.

Key lock
With the DEVICE_LOCK parameter, you can set a key lock.
- UNLOCKED — Device can be operated via keypad.
- LOCKED — Key lock is active.

Alarms
The BLOCK_ALM parameter sends the status of the process alarms to the control system. This parameter specifies whether an alarm must be acknowledged via the control system.

For bus parameters of resource block, see Pg 88.

Communication Fieldbus / Device

Bus Parameters Resource block (RB)

Index	Parameter	Description	Default	R/W
1	ST_REV	Static revision	0	R
2	TAG_DESC	TAG description	'	R/W
3	STRATEGY	Strategy	0	R/W
4	ALERT_KEY	Alert key	0	R/W
5	MODE_BLK	Target	OOS	R/W
		Actual	-	
		Permitted	OOS, Auto	
		Normal	Auto	
6	BLOCK_ERR	Block error		R
7	RS_STATE	Resource state	1	R
8	TEST_RW	Test		R/W
9	DD_RESOURCE	DD resource	'	R
10	MANUFAC_ID	Manufacturer ID	0x465255 for Mettler	R
11	DEV_TYPE	Device type	4100e	R
12	DEV_REV	Device revision	1	R
13	DD_REV	DD revision	1	R
14	GRANT_DENY	Grant	0	R/W
		Deny	0	R/W
15	HARD_TYPES	Hardware type	1	R
16	RESTART	Restart		R/W
17	FEATURES	Feature supported	Reports/ Soft W Lock	R
18	FEATURES	Feature selected	Reports/ Soft W Lock	R/W
19	CYCLE_TYPE	Cycle type	Scheduled/ Block Execution	R
20	CYCLES_SEL	Cycle selected	Scheduled/ Block Execution	R/W
21	MIN_CYCLE_T	Min cycle time	1600 1/32 msec (50ms)	R
22	MEMORY_SIZE	Memory size		R
23	NV_CYCLE_T	Non-volatile cycle time		R

Index	Parameter	Description	
42	DEVICE_LOCK	Locks the device for local access.	

Index	Parameter	Description	Default	R/W
24	FREE_SPACE	Free space		R
25	FREE_TIME	Free time		R
26	SHED_RCAS			R/W
27	SHED_ROUT			R/W
28	FAULT_STATE	Fault state		R
29	SET_FSTATE	Set fault state	1	R/W
30	CLR_FSTATE	Clear fault state	1	R/W
31	MAX_NOTIFY	Max notifications	20	R
32	LIM_NOTIFY	Limit of notification	8	R/W
33	CONFIRM_TIME	Confirmation time	640000 1/32ms	R/W
34	WRITE_LOCK	Write locking	1 (Unlocked)	R/W
35	UPDATE_EVT	Unacknowledged	0	R/W
		Update state	0	R
		Time stamp	0	R
		Static revision	0	R
		Relative index	0	R/W
36	BLOCK_ALM	Unacknowledged		R/W
		Alarm state		R
		Time stamp		R
		Sub-code		R
		Value		R
37	ALARM_SUM	Current		R
		Unacknowledged		R
		Unreported		R
		Disabled		R/W
38	ACK_OPTION	Automatic acknowledge option	0 (Disabled)	R/W
39	WRITE_PRI	Write priority	0	R/W
40	WRITE_ALM	Unacknowledged		R/W
		Alarm state		R
		Time stamp		R
		Sub-code		R
		Value		R
41	ITK_VER	ITK_version	4	R

	Default Value	R/W	Bytes	Data type	Range
	0 = Unlocked	R/W	1	uns8	0 = Unlocked 1 = Locked

Communication Fieldbus / Device

Transducer Block (TB)

Configuration

In the Transducer Block you can configure the device via Fieldbus. The required parameters are listed in the table on Pg 92.

Calibration

Depending on the configuration the product calibration for SAT, CONC, or volume concentration can be performed via Fieldbus using 3 parameters.

Product calibration CONC/ SAT of dissolved oxygen

Configuration for CONC:
PRIMARY_VALUE_TYPE = DO_mg/l, DO_µg/l, DO_ppm, DO_ppb
APPLICATION = "Dissolved oxygen"
CALIBRATION_MODE = Conc

Configuration for SAT:
PRIMARY_VALUE_TYPE = DO_%
APPLICATION = "Dissolved oxygen"
CALIBRATION_MODE = Sat

1. Set CAL_SAMPLE_PRD parameter to Sample.
   The device stores the conc value of the sample.
   After the writing, the parameter is automatically reset to NOP (= no operation).

2. Read out CAL_SAMPLE_PRD_STORED_VAL parameter.
   It contains the stored value.

3. Write lab value of the sample in the CAL_PRODUCT parameter. The CAL_SAMPLE_PRD_STORED_VAL parameter is reset to zero. Now the device is calibrated.

Note:
When step 1 has been performed directly on the site on the device, the operation on the Fieldbus as described in point 1 is omitted.

Product calibration of gaseous oxygen via Fieldbus
Configuration for CONC/SAT:
PRIMARY_VALUE_TYPE = GAS_ppm or GAS_%
APPLICATION= "measurement in gases"

Procedure as with dissolved oxygen steps 1 to 3.

The calibration values can also be entered directly in the CAL_HIGH, CAL_ZERO parameters.

Error messages
The LAST_ERROR parameter always indicates the last error:

01	Measurement range violation
02	Measurement range violation
03	Temperature probe
33	Membrane defective
98	System error
99	Factory settings

If now a "bad" status occurs for the OUT_Value in the Analog Input, the user can take this parameter to draw conclusions about the problem.
For bus parameters of transducer block, see Pg 92.

Communication Fieldbus / Device

Bus Parameters of Standard Transducer Block (TB)

Index	Parameter	Description	
1	ST_REV	The revision of the static data associated with the function block. Used by the host to determine when to re-read the static data.	
2	TAG-DESC	The user description of the intended application of the block.	
3	STRATEGY	The strategy field can be used to identify a grouping of blocks. Can be used for any purpose by the user.	
4	ALERT_KEY	Identification number that may be used by the host system to sort alarms and other device information.	
5	MODE_BLK	Allows the user to set the Target, Permitted, and Normal device mode. Displays the Actual mode. Target Actual Permitted Normal	
6	BLOCK_ERR	Reflects the error status associated with the hardware or software of the block. It is a bit string so multiple errors may be shown.	
7	UPDATE_EVENT	Unacknowledged Update State Time Stamp Static Rev Relative Index	
8	BLOCK_ALM	Unacknowledged Alarm State Time Stamp Subcode Value	
9	TRANSDUCER_DIRECTORY	Directory that specifies the number and the starting indices of the transducers in the transducer block.	

	Default Value	R/W	Bytes	Data type	Range
	The revision value is incremented every time a static parameter in the block is changed.	R	2		
	Text	R/W	32		
	0	R/W	2		
	0	R/W	1		
	Available Modes: Automatic, Out Of Service (OOS), Manual	R/W R R/W R/W	1 1 1 1		
		R	2		
	0 0 0 0 0	R	1 1 8 2 2		
	0 0 0 0 0	R	1 1 8 2 1		
		R	4		

Communication Fieldbus / Device

Bus Parameters of Standard Transducer Block (TB)

Index	Parameter	Description	
10	TRANSDUCER_TYPE	Identifies the transducer type.	
11	XD_ERROR	A transducer block sub-code. XD_ERROR contains the highest priority alarm that has been activated in the TB_DETAILED_STATUS parameter.	
12	COLLECTION_DIRECTORY	A directory that specifies the number, starting indices, and DD item of ID's of the data collection in each transducer within a transducer block. Used by the host for efficient transfer of information.	
	Mettler-Specific Parameters – Output		
13	INPUT_RANGE.	Selects the connection of the sensor	
14	POLARIZATION_VOLTAGE	Sets the polarization voltage	
15	SENSOR_TYPE	Selects the used sensor type.	
16	APPLICATION	Selects the measurement method (DO/ GAS)	
17	PRIMARY_VALUE	Shows the primary value and status Value Status	
18	PRIMARY_VALUE_TYPE	Selects the displayed primary value depending on the selected measuring method in APPLICATION parameter	
19	FILTER_TIME	Sets the filter time of the input filter	

	Default Value	R/W	Bytes	Data type	Range
	65535 = other	R	2		
	0	R	1		
		R	36		
	1 = HI_LEVEL	R/W	2	uns 16	0 = LO_LEVEL 1 = HI_LEVEL
	-675mV	R/W	4	float	-1000 ... 0
	0 = Standard	R/W	2	uns 16	0 = Standard 1 = Traces
	0 = Dissolved oxygen	R/W	2	uns16	0 = Dissolved oxygen 1 = Measurement in gases
		R	4 1	DS-65	
	DO : DO_% GAS : GAS_ppm	R/W	2	uns16	0 = DO_% 1 = DO_mg/l 2 = DO_µg/l 3 = DO_ppm 4 = DO_ppb 5 = GAS_ppm 6 = GAS_%
	0s	R/W	2	uns16	0...120

Communication Fieldbus / Device

Bus Parameters of Standard Transducer Block (TB)

Index	Parameter	Description	
20	IMPEDANCE	Shows the impedance of the sensor	
21	SENSOR_CURRENT	Shows the momentary current of the sensor	
	Mettler-Specific Parameters – Temperature		
22	SECONDARY_VALUE_2	Process temperature value and status Value Status	
23	SECONDARY_VALUE_UNIT_2	Degree C or degree F. Changes the unit of temperature being displayed and transmitted.	
24	TEMP_SENSOR_TYPE	Type of temperature sensor. The value entered must correspond to the temp. sensor being used.	
25	TEMP_WIRE_IMPEDANCE	Sets the wire impedance of the temp sensor. Typically 0 unless the wire of the sensor gets too long	
26	TEMP_SENSOR_CAL	Desired temperature reading, used for temperature measurement calibration.	
	Mettler-Specific Parameters – Concentration/Saturation		
27	PROCESS_PRESSURE_UNIT	Selects the process pressure measurement unit	
28	PROCESS_PRESSURE	Sets the process pressure	
29	SALINITY	Sets the salinity value	

	Default Value	R/W	Bytes	Data type	Range
		R	4	float	
		R	4	float	
		R R	4 1	DS- 65	
	1001 = °C	R/W	2	uns16	1001 = °C 1002 = °F
	1000 = NTC30	R/W	2	uns16	1000 = NTC30 1002 = NTC22
	0 Ohm	R/W	4	float	
	0	R/W	4	float	-10 ... +10K
	1137 = BAR	R/W	2	uns16	1133 = kPA 1137 = BAR 1141 = PSI
	1.013 BAR	R/W	4	float	0...9.999 BAR 0...999.9 kPa 0...145 PSI
	0 g/kg	R/W	4	float	0...45g/kg

Communication Fieldbus / Device

Bus Parameters of Standard Transducer Block (TB)

Index	Parameter	Description	
	Mettler-Specific Parameters – Calibration		
30	CALIBRATION_MODE	Sets the calibration mode	
31	CAL_HIGH	The slope of the Oxy electrode in Ampere	
32	CAL_ZERO	The zero offset resulting from a calibration in Ampere	
33	CAL_SETTLINGTIME	Shows the settling time in seconds	
34	CAL_RH	Shows the relative humidity in %	
35	CAL_PRESSURE	Shows the pressure	
36	CAL_TEMP	Shows the temperature which was used during calibration	
37	CAL_VALUE_SAT	Shows the value of saturation calibration	
38	CAL_VALUE_CONC	Shows the value of concentration calibration	
39	CALIBRATION_TIMER	Sets the calibration timer (time in which the device should be calibrated).	
40	CAL_SAMPLE_PRD	Starts the 1st part of Oxy product calibration.	
41	CAL_SAMPLE_PRD_STORED_VAL	Shows the stored value of the first step of Oxy product calibration	
42	CAL_PRODUCT	Sets the value for the 2nd part of Oxy product calibration.	

	Default Value	R/W	Bytes	Data type	Range
	0 = Sat	R/W	1	uns8	0 = Sat 1 = Conc
	60 E-9A	R/W	4	float	30 ... 110 Sensor A 220 ... 525 Sensor B
	0 E-9A	R/W	4	float	-2 ... +2
	0 s	R	4	float	
		R	4	float	
		R	4	float	
		R	4	float	
		R	4	float	
		R	4	float	
	0000 h = disable	R/W	4	float	000...9999h
	0 = Nop	R/W	1	uns8	0 = Nop 1 = Sample
	0 if step 1 of product calibration was not started	R	4	float	
		R/W	4	float	

Communication Fieldbus / Device
Bus Parameters of Standard Transducer Block (TB)

Index	Parameter	Description	
	Mettler-Specific Parameters – Alert		
43	HOLD	Sets the device to HOLD mode	
44	SENSOCHECK	Enables or disables Sensocheck.	
45	ALARM_LED_MODE	Sets the LED to HOLD mode.	
46	LAST_ERROR	Shows the last error.	
47	SENSOFACE_STATUS	Shows the current status of the Sensoface.	
	Mettler-Specific Parameters – Identification and Local Parameter Setting		
48	SW_REV_LEVEL	Software revision number	
49	HW_REV_LEVEL	Hardware revision number	

	Default Value	R/W	Bytes	Data type	Range
	0 = Off	R/W	1	uns8	0 = Off 1 = On
	0 = Off	R/W	1	uns8	0 = Off 1 = On
	0 = Off	R/W	1	uns8	0 = Off 1 = On
	0 = None	R	2	uns16	0...100
	0 = Good	R	1	uns8	0 = Good 1 = Neutral 2 = Bad
		R	2	uns16	
		R	1	uns8	

Setting the operating mode

The following operating modes can be set in the MODE_BLK parameter:

- OOS
- MAN
- Auto

When there is no write protection, the OOS mode allows unlimited access to all parameters.

Selecting the process variables and units

The O_2 Transmitter 4100e FF provides 3 Analog Input blocks. The respective process variable can be selected in the CHANNEL parameter.

The corresponding measurement unit is selected in the UNITS subparameter of the XD_SCALE parameter.

The following variables are available:

CHANNEL	Function	Unit	Unit_Value
1	Saturation	% percent	1342
2	Concentration	mg/l µg/l ppm ppb	2001 2002 1423 1424
3	Temperature	°C °F	1001 1002
4	Zero	A	1209
5	Slope	A	1209
6	Volume concentration	% percent ppm	1342 1423

Linearization types
The input value can be linearized in the AI with the LIN_TYPE parameter:

• Direct:
The measured value is directly led from the Transducer block to the Analog Input block, avoiding the linearization function. Here, you must make sure that the units in the XD_SCALE and OUT_SCALE parameters are identical.

• Indirect
Here, the measured value of the TB is linearly scaled over the input scale (XD_SCALE) to the output scale (OUT_SCALE).

• Indirect Square Root
The input value is rescaled over the XD_SCALE parameter and recalculated using a root function. Then the value is further scaled to OUT_SCALE.

Diagnostics
The BLOCK_ERR parameter indicates the current block status.

Alarm handling

The process control system receives the alarm status via the BLOCK_ALM parameter. In the ACK_OPTION parameter you specify whether an alarm must be acknowledged via the control system.

Block alarms

An AI can generate the following block alarms via the BLOCK_ERR parameter:

- Simulate Active
- Input Failure
- Block Configuration Error
- Out Of Service

Limit alarms

If an OUT measured value falls below or exceeds the defined limit, the control system is alerted.
The following limit parameters are defined:

- HI_HI_LIM
- HI_LIM
- LO_LIM
- LO_LO_LIM

The behavior is defined by the respective priorities.

Examples of alarm handling in the O_2 Transmitter 4100e FF

Example 1: Device failure ERR 99
During measurement a device failure occurs.
The measured value is given the BAD_DEVICE_FAILURE status.
The BLOCK_ERROR parameter (Diagnostics parameter of AI) changes to INPUT_FAILURE. The Analog Input Block generates the "Input Failure" block alarm.
When the LAST_ERROR parameter is read out in the Transducer Block, the Err99 error is detected.
Measure: Replace device.

Example 2: Calibration timer expired
(Prerequisite: The CALIBRATION_TIMER parameter has been set to a value > 0 or the cal timer interval has been preset on the device to a time > 0 s.) If the calibration timer has expired, the measured-value status changes to UNCERTAIN_SENSOR_CONVERSION_NOT_ACCURATE (see Pg 114). To see how far the calibration timer has expired, the SENSOFACE_STATUS parameter can be read out in the TB (Good, Neutral = 80% expired, Bad = 100% expired).
Measure: Calibration

Example 3: Slope error
After a product calibration the measured value is given the UNCERTAIN_SENSOR_CONVERSION_NOT_ACCURATE status (Zero and/or slope and/or response of the sensor are not okay (see Pg 114).
Measure: Replace sensor.

Alarm diagnostics / Bus parameters
In the case of an alarm the following bus parameters must be evaluated:
- AI block OUT parameter (currently measured value)
- TB LAST_ERROR parameter (error indication 1 ... 100)
- TB SENSOFACE_STATUS parameter
  (0 = Good, 1 = Neutral, 2 = Bad)

Communication Fieldbus / Device
Bus Parameters / Analog Input Blocks (AI)

Index	Parameter	Description	Default	R/W
1	ST_REV	Static Revision	0	R
2	TAG_DESC	TAG Description		R/W
3	STRATEGY	Strategy	0	R/W
4	ALERT_KEY	Alert Key	0	R/W
5	MODE_BLK	Target	OOS	R/W
		Actual	-	
		Permitted	OOS, Auto	
		Normal	Auto	
6	BLOCK_ERR	Block Error		R
7	PV	Process Value		R
		Status		R
8	OUT	Measured Value		R
		Status		R
9	SIMULATE	Simulate Status		R/W
		Simulate Value		R/W
		Transducer Status		R
		Transducer Value		R
		Simulate Enable/ Disable		R/W
10	XD_SCALE	High Range	100	R/W
		Low Range	0	R/W
		Units Index	0	R/W
		Decimal Point	0	R/W
11	OUT_SCALE	High Range	100	R/W
		Low Range	0	R/W
		Units Index	0	R/W
		Decimal Point	0	R/W
12	GRANT_DENY	Grant	0	R/W
		Deny	0	R/W
13	IO_OPTS	IO Block Options	0	R/W
14	STATUS_OPTS	Status Options		
15	CHANNEL	Channel	1	R/W
16	L_TYPE	Linearization Type	0	R/W
17	LOW_CUT	Low Cut Off	0	R/W
18	PV_TIME	Filter Time	0	R/W
19	FIELD_VAL	Percent Value		R
		Status		R
20	UPDATE_EVT	Unacknowledged	0	R/W
		Update State	0	R
		Time Stamp	0	R
		Static Revision	0	R
		Relative Index	0	R

Index	Parameter	Description	Default	R/W
21	BLOCK_ALM	Unacknowledged	0	R/W
		Alarm State	0	R
		Time Stamp	0	R
		Subcode	0	R
22	ALARM_SUM	Current	0	R
		Unacknowledged	0	R
		Unreported	0	R
		Disabled	0	R/W
23	ACK_OPTION	Automatic Acknowledge Option	0	R/W
24	AlARM_HYS	Alarm Hysteresis	0.50%	R/W
25	HI_HI_PRI	High High Priority	0	R/W
26	HI_HI_LIM	High High Limit	INF	R/W
27	HI_PRI	High Priority	0	R/W
28	HI_LIM	High Limit	INF	R/W
29	LO_PRI	Low Priority	0	R/W
30	LO_LIM	Low Limit	- INF	R/W
31	LO_LO_PRI	Low Low Priority	0	R/W
32	LO_LO_LIM	Low Low Limit	- INF	R/W
33	HI_HI_ALM	Unacknowledged	0	R/W
		Alarm State	0	R
		Time Stamp	0	R
		Subcode	0	R
		Value	0	R
34	HI_ALM	Unacknowledged	0	R/W
		Alarm State	0	R
		Time Stamp	0	R
		Subcode	0	R
		Value	0	R
35	LO_ALM	Unacknowledged	0	R/W
		Alarm State	0	R
		Time Stamp	0	R
		Subcode	0	R
		Value	0	R
36	LO_LO_ALM	Unacknowledged	0	R/W
		Alarm State	0	R
		Time Stamp	0	R
		Subcode	0	R
		Value	0	R

Cyclic measured value status

Priority	Quality	Sub-status	Bin-coding without limit bits	Hex-coding
Low	Good	Good Non-Specific	10 00 00 00	0 x 80
		Good Active Advisory Alarm	10 00 10 xx	0 x 88
		Good Active Critical Alarm	10 00 11 xx	0 x 8C
	Uncer-tain	Uncertain Non-Specific	01 00 00 xx	0 x 40
		Last Usable Value (LUV)	01 00 01 xx	0 x 44
		Substitute Set	01 00 10 xx	0 x 48
		Initial Value	01 00 11 xx	0 x 4C
		Sensor Conversion Not Accurate	01 01 00 xx	0 x 50
		Engineering Unit Violation	01 01 01 xx	0 x 54
		Sub-Normal	01 01 10 xx	0 x 58
	Bad	Non-Specific	00 00 00 xx	0 x 00
		Sensor Failure	00 01 00 xx	0 x 10
		Device Value	00 00 11 xx	0 x 0C
High		Out of Service	00 01 11 xx	0 x 1C

The respective status bit is set when the condition occurs. It is reset as soon as the condition does not exist any more.

Measured-value limits: Limit bits

Bin-coding of limit bits	Meaning of limit bits
00	ok
01	Low limited
10	High limited
11	constant

When the measured-value status is “BAD”, the AI block BLOCK_ERR parameter indicates an “Input Failure”.

Operating states / Measured value status

Operating state (Activation)	Red LED	Time out	Status AI 1	
Measuring	live	-	**good**	
Cal Info (**cal**) 0000	live	20 sec	**good**	
Error Info (**meas + cal**) 0000	live	20 sec	**good**	
Configuration (**meas + cal**) 1200	Hold[1)]	20 min	**uncertain** last usable value	
Calibration (**cal**) 1001	Hold[1)]	-	**uncertain** last usable value	
Calibration (**cal**) 1100	Hold[1)]	-	**uncertain** last usable value	
Temp probe adjustment (**cal**) 1015	Hold[1)]	-	**uncertain** last usable value	
Product calibration (SAT + Conc) Step 1(**cal**) 1105	live	-	**good**	
Step 2 (**cal**) 1105	Hold[1)]	-	**uncertain** last usable value	
Sensor monitor (**meas + cal**) 2222	live	20 min	**good**	

1) LED flashes when "HOLD ON" has been set (see Pg 65).

	Status AI 2	Status AI 3
	good	**good**
	good	**good**
	good	**good**
	uncertain last usable value	**uncertain** last usable value
	uncertain last usable value	**uncertain** last usable value
	uncertain last usable value	**uncertain** last usable value
	uncertain last usable value	**uncertain** last usable value
	good	**good**
	uncertain last usable value	**uncertain** last usable value
	good	**good**

Error messages / Measured value status

Error	Display	Problem Possible causes	Sensoface	Red LED	
ERR 99	"FAIL" flashes	**Factory settings** EEPROM or RAM defective This error message only occurs in the case of a total defect. The device must be repaired and recalibrated at the factory.		x	
ERR 98	"Conf" flashing	**System error** Configuration or calibration data defective; completely reconfigure and recalibrate the device. Memory error in device program		x	
ERR 01	Measured value flashes	Sensor defective, wrong sensor connected, measurement range exceeded With "DO" selected: **SAT range** Lo level: < 0; > 120 % Hi level: < 0; > 500 %		x	
		With "GAS" selected: **Volume conc range** Lo level: < 0; > 9999 ppm < 0; > 120% Hi level: < 0; > 9999 ppm < 0; > 120%		x	
ERR 02	Measured value flashes	Sensor defective, wrong sensor, measurement range exceeded Only with "D0" selected: **Conc range** Lo level: < 0; > 9999 ppb / µg/l < 0; > 9.999 ppm / mg/l Hi level: < 0; > 50 ppm / mg/l		x	

	Status AI Sat	Status AI Conc	Status AI Temp	Status Volume Concentration	Status AI Zero	Status AI Slope
	bad device_ failure	**bad** device_ failure	**bad** device_ failure	**bad** device_ failure	**bad** device_ failure	**bad** device_ failure
	bad device_ failure	**bad** device_ failure	**bad** device_ failure	**bad** device_ failure	**bad** device_ failure	**bad** device_ failure
	bad sensor_ failure	**good**	**good**	**-**	**good**	**good**
			good	**bad** sensor_ failure	**good**	**good**
	good	**bad** sensor_ failure	**good**	**-**	**good**	**good**

Error messages / Measured value status

Error	Display	Problem Possible causes	Sensoface	Red LED	
ERR 03	 flashes	Temperature range Open or short circuit Temperature range exceeded: Temperature input: < -20 ... > +150.0°C < -4 ... > +302°F		x	
ERR 33	 flashes	Sensocheck Sensor: Connecting cable defective see Pg 84	x	x	
	 flashes	Zero point error see Pg 84		x	
	 flashes	Slope error see Pg 84		x	
	 flashes	Cal timer exceeded see Pg 84		x	

	Status AI Sat	Status AI Conc	Status AI Temp	Status Volume Concen-tration	Status AI Zero	Status AI Slope
	bad Sensor_ failure	**bad** Sensor_ failure	**bad** Sensor_ failure	**bad** Sensor_ failure	**good**	**good**
	bad 1) Sensor_ failure	**bad** 1) Sensor_ failure	**bad** 1) Sensor_ failure	**bad** 1) Sensor_ failure	**good**	**good**
	uncertain Sensor_ conversion_ not _accurate	**uncertain** Sensor_ conversion_ not _accurate	**uncertain** Sensor_ conversion_ not _accurate	**uncertain** Sensor_ conversion_ not _accurate	**bad** Sensor_ failure	**good**
	uncertain Sensor_ conversion_ not _accurate	**uncertain** Sensor_ conversion_ not _accurate	**uncertain** Sensor_ conversion_ not _accurate	**uncertain** Sensor_ conversion_ not _accurate	**good**	**bad** Sensor_ failure
	2) uncertain Sensor_ conversion_ not _accurate	**2) uncertain** Sensor_ conversion_ not _accurate	**2) uncertain** Sensor_ conversion_ not _accurate	**2) uncertain** Sensor_ conversion_ not _accurate	**2) uncertain** Sensor_ conversion_ not _accurate	**2) uncertain** Sensor_ conversion_ not _accurate

1) When Sensocheck has been set to "ON"
2) When cal timer ≠ 0000 h

Appendix

Product line and accessories

Devices	Order no.
O_2 Transmitter 4100e FF	52 121 246
Mounting accessories	
Pipe-mount kit	52 120 741
Panel-mount kit	52 120 740
Protective hood	52 120 739

Sensors

Mettler-Toledo GmbH, Process Analytics offers a wide range of sensors for the following fields of applications:
- Chemical process industry
- Pharmaceutical industry
- Food and beverage industry
- Water/waste-water

For more information concerning our sensors and housings program, please refer to our website.

The Device Description (DD file) and the Common File Format (CFF file) for network project are included in the shipment. They can also be downloaded at:

http://www.mtpro.com/transmitters

O_2 input	Sensor Type A:	InPro 6800
	Sensor Type B:	InPro 6900
Lo-level range		
Measuring current	-2 ... 600 nA,	Resolution: 10 pA
	Saturation (-10 ... 80 °C):	0.0 ... 120 %
	Measurement error[1,2,3]	0.5 % meas.val. +0.1 %
	Concentration (-10 ... 80 °C)	
		0000 ... 9999 µg/l 0.000 ... 9.999 mg/l 0000 ... 9999 ppb 0.000 ... 9.999 ppm
	Measurement error[1,2,3]	0.5 % meas.val. +5 µg/l or 5 ppb
	Volume concentration in gas	(-10...80 °C)
		0000 ... 9999 ppm 0.00 % ... 120,0 % (0.00 % ... 29,99 % 30.0 % ... 120.0 %)
	Measurement error[1,2,3]	0.5 % meas.val. +0.02 % or 200 ppm
Hi-level range		
Measuring current	-2 ... 1800 nA,	Resolution: 30 pA
	Saturation (-10 ... 80 °C):	0.0 ... 500 %
	Measurement error[1,2,3]	0.5 % meas.val. + 0.5 %
	Concentration (-10 ... 80 °C):	0.0 ... 50.0 mg/l 0.0 ... 50.0 ppm
	Measurement error[1,2,3]	0.5% meas.val.+ 0.05mg/l or 0.05 ppm

Specifications

Measuring range 2 (high level)

	Volume concentration in gas:	(-10...80 °C)
		0000 ... 9999 ppm 0.00 % ... 120.0 %
		(0.00 % ... 29,99 % 30.0 % ... 120.0 %)
	Measurement error[1,2,3]	0.5 % meas.val.+0.1 % or 1000 ppm

Polarization voltage*	-1000 ... 0 mV	
Process pressure*	0.000 ... 9.999 bars (... 999.9 kPa / ... 145.0 psi)	
Salinity correction*	00.00 ... 45.00 g/kg	

Sensor standardization

Operating modes*	• O_2 saturation (automatic calibration) • O_2 concentration (automatic calibration) • Volume concentration (gas) • Product calibration • Zero calibration	
Calibration range Sensor type A	Zero point Slope	± 2 nA 25 ... 130 nA (at 25°C, 1013 mbars)
Calibration range Sensor type B	Zero point Slope	± 2 nA 200 ... 550 nA (at 25°C, 1013 mbars)
Cal timer*	0000 ... 9999 h	
Pressure correction*	0.000 ... 9.999 bars (... 999.9 kPa / ... 145.0 psi)	

Sensocheck	Monitoring for short circuits / open circuits (can be disabled), delay: 30 sec
Sensoface	Provides information on the sensor condition evaluation of zero point/slope, response time, calibration interval, Sensocheck
Sensor monitor	Direct display of measured values from sensor for validation (uncompensated sensor current, measuring temp)
Temperature probe *	NTC 22 kOhm / NTC 30 kOhm 2-wire connection, adjustable
Range	-20.0 ... +150.0 °C / -4 ... +302 °F
Adjustment range	10 K
Resolution	0.1 °C / 1 °F
Measurement error [1,2,3]	< 0.5 K (<1 K at > 100°C)
FF communication	FF_H1 (Foundation Fieldbus)
Physical interface	To EN 61 158-2 (IEC 1158-2)
Address range	017 ... 246, Factory setting: 026
Mode of operation	Bus-powered device with constant current consumption
Supply voltage	FISCO ≤ 17.5 V (trapezoidal or rectangular characteristic) ≤ 24 V (linear characteristic)
Current consumption	< 13.2 mA
Max. current in case of fault (FDE)	< 17.6 mA
FF communication model	Certified to ITK 4.51
1 resource block 1 transducer block 3 AI function blocks	Selectable: O_2 saturation, O_2 concentration, temperature, zero, slope, volume concentration Execution time 50 ms

Specifications

Display	LC display, 7-segment with icons
Main display	Character height 17 mm, unit symbols 10 mm
Secondary display	Character height 10 mm, unit symbols 7 mm
Sensoface	3 status indicators (friendly, neutral, sad)
Mode indicators	5 mode indicators "meas", "cal", "alarm", "FF communication", "config" 18 further icons for configuration and messages
Alarm indication	Red LED in case of alarm or HOLD, user defined
Keypad	5 keys: [cal] [conf] [▸] [▲] [enter]

Service functions

Device self-test	Automatic memory test (RAM, FLASH, EEPROM)
Display test	Display of all segments
Last Error	Display of last error occurred
Sensor monitor	Display of direct, uncorrected sensor signal (sensor current / temperature)

* User-defined
1) To IEC 746 Part 1, at nominal operating conditions
2) ± 1 count
3) Plus sensor error

Data retention		Parameters and calibration data > 10 years (EEPROM)
EMC		EN 61326
Emitted interference:		Class B (residential area)
Immunity to interference:		Industry
	FCC:	FCC rules part 15/B class A
Lightning protection		EN 61000-4-5, Installation Class 2
Explosion protection	ATEX:	II 2(1)G EEx ia IIC T4
	FM:	IS, Class I Div1, Group A, B, C, D NI, Class I Div2, Group A, B, C, D

Nominal operating conditions

Ambient temperature	–20 ... +55 °C
Transport/Storage temp	–20 ... +70 °C

Enclosure	Molded enclosure made of PBT (polybutylene terephtalate)
Color	Bluish gray RAL 7031
Mounting	• Wall mounting • Pipe mounting: Ø 40 ... 60 mm, 30 to 45 mm • Panel mounting, □ cutout to DIN 43 700 Sealed against panel
Dimensions	H 144 mm, W 144 mm, D 105 mm
Protection	IP 65/NEMA 4X (USA, Canada: indoor use only)
Cable glands	3 breakthroughs for M20x1.5 cable glands 2 breakthroughs for NPT 1/2" or Rigid Metallic Conduit
Weight	Approx. 1 kg

Patents / Intellectual Property Rights

Patent/Application	Title
U.S. 6,424,872	Block Oriented Control System
U.S. 6,594,530	Block Oriented Control System, Cont'd.
U.S. App. 09/598,697	Block Oriented Control System on High Speed Ethernet
European Patent App.* 941594.4	Block Oriented Control System on High Speed Ethernet
China Patent App.* 00809263.X	Block Oriented Control System on High Speed Ethernet
Hong Kong Patent App.* 2107127.9	Block Oriented Control System on High Speed Ethernet
U.S. App. 10/453596	Flexible Function Blocks
U.S. App. 10/826,576	System and Method for Implementing Safety Instrumented Systems in a Fieldbus Architecture
PCT App. US/04/11616	System and Method for Implementing Safety Instrumented Systems in a Fieldbus Architecture
U.S. 5,909,368	Process Control System Using a Process Control Strategy Distributed among Multiple Control Elements
U.S. 5,333,114	Field Mounted Control Unit
U.S. 5,485,400	Field Mounted Control Unit
U.S. 5,825,664	Field Mounted Control Unit
Japan Patent # 3137643 Australian Patent # 638507 Canadian Patent # 2,066,743 European Patent # 0495001 Validated in: UK Patent # 0495001 France Patent # 0495001 Germany Patent # 69032954T Netherlands Patent # 0495001	
U.S. 6,055,633	Method of Reprogramming Memories in Field Devices Over a Multidrop Network
European Patent App.* Publication No. EP1029406A2	

U.S. 6,104,875 Method for Field Programming an Industrial Process Transmitter

Australian Patent App.*
Publication No. AU9680998A1

The Foundation may acquire or hold patent rights in addition to those listed.

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