Operating Instructions
TRANSIC121LP

Laser Oxygen Transmitter

FM
C   US
APPROVED

Endress+Hauser [EH]

People for Process Automation

Described product

Product name: TRANSIC121LP
Variants: TRANSIC121LP-A (In-situ measurement)
                   TRANSIC121LP-B (Ambient gas measurement)
                   TRANSIC121LP-C (Extractive measurement)
                   TRANSIC121LP-F (In-situ measurement)
                   TRANSIC121LP-G (In-situ measurement)
                   TRANSIC121LP-H (In-situ measurement)

Manufacturer

Endress+Hauser SICK GmbH+Co. KG
Bergener Ring 27
01458 Ottendorf-Okrilla
Germany

Production location

Endress+Hauser SICK GmbH+Co. KG
Poppenbütteler Bogen 9b
22399 Hamburg
Germany

Legal information

Original document

This document is an original document of Endress+Hauser SICK GmbH+Co. KG.

Warning symbols

Hazard (general)
Please consult the documentation.

EX   Note on explosion protection (general)

Hazard through electric voltage

Hazard through explosive substances/mixtures

Hazard through oxidizing substances

Hazard through toxic substances

Hazards through noxious substances

Hazard through laser radiation

Hazards through high temperature or hot surfaces

Hazard for the environment/nature/organic life

Warning levels / signal words

DANGER
Risk or hazardous situation which *will* result in severe personal injury or death.

WARNING
Risk or hazardous situation which *could* result in severe personal injury or death.

CAUTION
Hazard or unsafe practice which *could* result in less severe or minor injuries.

NOTICE
Hazard which *could* result in property damage.

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1   Important information

1.1   Main operating information

Observe the following safety precautions:

CAUTION: TRANSIC121LP is a protection class 1 laser product (IEC 60825-1:2014-05).

Normal handling and operation of the TRANSIC121LP is eye-safe, because laser radiation is collimated and maintained inside the probe, as is schematically shown in "Probe design and laser beam guidance within the probe", page 12.
!▶ Do not place objects with reflecting surfaces (tools, etc.) directly onto the probe when the TRANSIC121LP is in operation to prevent the laser beam being reflected out of the probe.

NOTICE: Protection against electrostatic discharges

The products are adequately protected against ESD when used as intended.
▶ Observe the generally valid ESD regulations to avoid damaging the TRANSIC121LP through electrostatic discharges when touching parts within the enclosure.

WARNING: Hazard through TRANSIC121LP modifications.

Do not remove, add or change any components in or on the device unless such changes are officially allowed and specified by the manufacturer. Failure to observe these precautions could result in
– The manufacturer's warranty becomes void.
– The device could become dangerous.

WARNING: Hazard through device failure

Safe operation of the TRANSIC121LP is questionable when
– The device shows visible damage.
– Moisture has penetrated the device.
– The device has been stored or operated in unallowed ambient conditions.
If safe operation is no longer possible:
▶ Put the TRANSIC121LP out of operation.
▶ Disconnect all connections to the power supply.
▶ Make sure an unauthorized startup is not possible.

1.1.1 Installation location

The TRANSIC121LP can be used indoors and outdoors.

Altitude: Up to 2000 m above sea level

Max. air humidity: 100% r.h., non-condensing

> **WARNING: Risk of fire through strong oxidation processes**
> High O_2 concentrations have strong oxidizing properties. These increase the risk of combustion and can trigger violent reactions with inflammable substances.
> ▶ Before installation, check the TRANSIC121LP is suitable for your application with regard to all ambient conditions.

1.2 Intended use

1.2.1 Purpose of the TRANSIC121LP

The TRANSIC121LP is a stationary oxygen transmitter and serves continuous measurement of oxygen in the industrial sector.

There are 3 variants of the TRANSIC121LP:

1. In-situ measurement

2. Extractive measurement

3. Measurement in ambient air

- The TRANSIC121LP is certified for a process-side operating range from 800 mbar(a) to 1400 mbar(a). Usage with deviating pressures can void the Ex certification.
- The TRANSIC121LP must be operated within the specifications described in the Section Technical Data (see "Technical Data", page 94). The Ex certification becomes void when the TRANSIC121LP is operated outside the specifications.
- The TRANSIC121LP has not been evaluated regarding the safety function as laid out in 2014/34/EU, Annex II, Section 1.5.

Operation in potentially explosive atmospheres

- FM approval: Class I, Division 2, Gas groups A,B,C and D.
  FM approval sensor: Class I Division 1 and 2.
- Approved for installation indoors and outdoors with enclosure classification IP66.
- Temperature class: T4.

> **EX**
> **CAUTION: Risk of explosion through nonobservance of the Technical Data**
> To ensure safe operation, all Technical Data must be observed and complied with during installation.
> ▶ Observe the specifications in the control drawing, see "Control drawing", page 102.

1.3   Responsibility of user

Designated users

The TRANSIC121LP should only be operated, maintained and inspected by skilled technicians who, based on their technical training and knowledge as well as knowledge of the relevant regulations, especially in potentially explosive atmospheres, can assess the tasks given and recognize the hazards involved.

Correct use

> **!** ● This Manual presumes that the TRANSIC121LP has been delivered as specified during project planning and the relevant delivery state of the TRANSIC121LP.
>   ▶ Contact Endress+Hauser Customer Service if you are not sure whether the TRANSIC121LP corresponds to the state defined during project planning or to the delivered system documentation.

▶ Use the device only as described in these Operating Instructions.
The manufacturer bears no responsibility for any other use.
▶ Read the Operating Instructions before putting the device into operation.
▶ Observe all safety instructions.
▶ If you do not understand something described in the Operating Instructions, contact Endress+Hauser Customer Service.
▶ Carry out the specified maintenance work.
▶ Do not remove, add or change any components in or on the device unless such changes are officially allowed and specified by the manufacturer. Failure to observe these precautions could result in
  – voiding the manufacturer's warranty
  – causing the device to become dangerous

Special operating conditions

● A PELV power supply unit (11 … 36 V DC, 24 V DC recommended) is required.
● The service interface with the Endress+Hauser service interface cable (Part No. 2059595) may only be used outside the Ex area.

Special local conditions

▶ Follow all local laws, regulations and company policies applicable at the respective installation location.

Retention of documents

These Operating Instructions:

▶ Must be available for reference.
▶ Must be conveyed to new owners.
▶ Keep passwords in a separate, safe place and secure against unauthorized use.

2 Product description

2.1 Product identification

Product name:	TRANSIC121LP
Manufacturer:	Endress+Hauser SICK GmbH+Co. KG Bergener Ring 27 · D-01458 Ottendorf-Okrilla · Germany

Type plates

The type plate is located on the outer left hand side of the enclosure.

The type plate contains the type code.

+**i**   The complete type code Table can be found in the Annex,

2.2 Functional principle/measuring principle

The TRANSIC121LP functions using light absorption of a tunable diode laser (Tunable Diode Laser Absorption Spectroscopy TDLAS). The gas concentration is measured using the damping of a laser beam sent from a tunable diode laser source in the gas sample. For oxygen measuring, the laser beam wavelength is set to match one of the characteristic absorption lines of oxygen in the wavelength range of around 760 nm in the near infrared range (NIR) of the electromagnetic spectrum. During measurement, the diode laser beam wavelength is continuously modulated to scan across one of the oxygen absorption lines. This generates a periodic signal in a photodetector, the amplitude of which is proportional to the amount of oxygen in the laser beam path.

+**i**   The dust load in the process does not falsify the measured O_2 value. The TRANSIC121LP outputs a maintenance signal when the dust load is too high.

2.2.1 TRANSIC121LP probe design

The sensor is designed as a probe for direct fitting at the measuring location. The diode laser light source, and the photodetector that measures the light, are located in a transmitter behind a protective window. The light is directed onto the photodetector using a focusing mirror at the far end of the probe.

Fig. 1: Probe design and laser beam guidance within the probe
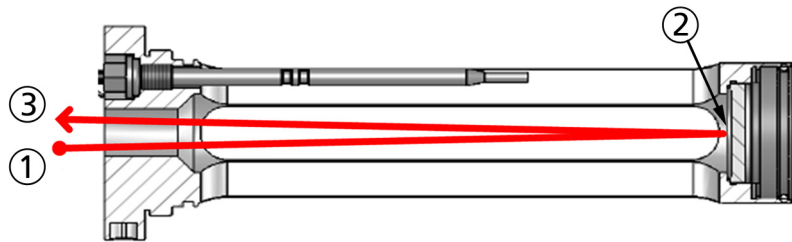
1 = Light source

2 = Mirror

3 = Photodetector
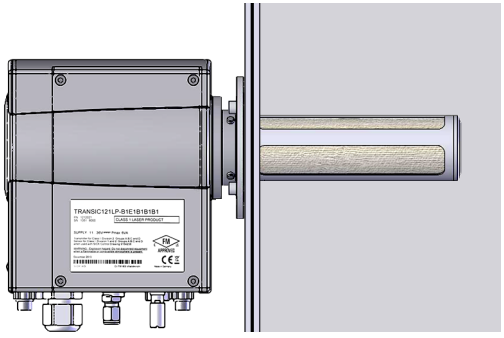
Further information on components having contact with the sample gas probe,

2.3   TRANSIC121LP variants

2.3.1   Variant for in-situ-measurement

Fig. 2: Flange mounted TRANSIC121LP-A, -F, -G, -H
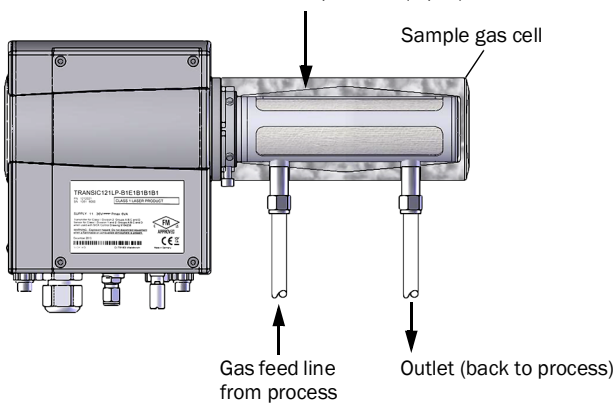
Environment
Class I, Division 2

O_2: Atmospheric oxygen concentration
(21% O_2)

T: −20 ... +60 °C (−4 ... 140 °F)

P: Atmospheric pressure variations

Measuring environment (process side)
Class I, Division 1, 2

O_2: 0 ... 25% O_2

T: −20 ... +80 °C (−4 ...176 °F)

p: 0.8 ... 1.4 bar(a) (11.6 ... 20.3 psi)

PS: 10 bar (150 psi)

DN: 50/65 mm (2"/3")

2.3.2   Variant for extractive measurement

Fig. 3: TRANSIC121LP-C with sample gas cell and wall bracket

Environment
Class I, Division 2

O_2: Atmospheric oxygen
concentration (21% O_2)

T: -20 ... +60 °C (-4 ... 140 °F)

P: Atmospheric pressure variations

Measuring environment (in sample gas cell)
Class I, Division 1, 2

O_2: 0 ... 25% O_2

T: -20 ... +80 °C (-4 ...176 °F)

p: 0.8 ... 1.4 bar(a) (11.6 ... 20.3 psi)

PS: 10 bar (150 psi)

V: 0.28 L

DN: 50/65 mm (2"/3")

Sample gas cell

Gas feed line
from process

Outlet (back to process)

2.3.3   Variant for ambient gas measurement

Fig. 4: TRANSIC121LP-B for ambient gas measurement and wall bracket

Measuring environment
Class I, Division 2

Measuring device complete in differing O_2 concentrations

O_2: 2 ... 21% O_2

T: -20 ... +60 °C (-4 ... 140 °F)

p: 0.8 ... 1.4 bar(a) (11.6 ... 20.3 psi)
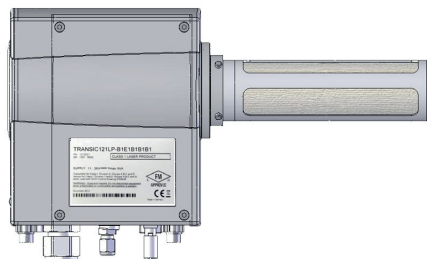
> **NOTICE:** The O_2 concentration in the transmitter is part of the O_2 measurement
> When configuring ambient gas measurements, the complete TRANSIC121LP must be exposed to the O_2 concentration to be measured.
> The TRANSIC121LP variant for ambient measurements measures oxygen concentrations from 2 ... 21 vol% O_2. The measuring function is lost for oxygen concentrations under 2 vol%.

2.4   Explosion protection

| EX | **Transmitter:**
● Transmitter
  – Gas
     outside process: Class I, Division 2
     within process: Class I, Divisions 1, 2
▶ Do not remove, add or change any components in or on the device unless such changes are officially allowed and specified by the manufacturer. Otherwise the approval for use in potentially explosive atmospheres becomes void.
▶ Adhere to the prescribed maintenance intervals (see "Safety information for assembly and maintenance work", page 83).
▶ The TRANSIC121LP may only be used in zones corresponding to the Ex identification (see type plate) of the transmitter. Check the requirements of the installation location with the Ex certification of the device.
▶ The TRANSIC121LP may only be installed by persons trained in the applicable standards.
▶ The TRANSIC121LP may not be modified. Any modification to the device voids the Ex certification. |

● The TRANSIC121LP is certified for a process-side operating range from 800 mbar(a) to 1400 mbar(a).
● The TRANSIC121LP must be operated within the specifications described in the Section Technical Data (see "Technical Data", page 94).
● The TRANSIC121LP has not been evaluated regarding the safety function as laid out in 2014/34/EU, Annex II, Section 1.5.

Operation in potentially explosive atmospheres

The TRANSIC121LP has an FM approval for Class I, Division 2, Gas groups A,B,C and D.

The sensor has an approval for Class I, Division 1 and 2. It is approved for installation indoors and outdoors with enclosure classification IP66. The temperature class is T4.

| EX | **CAUTION:** Risk of explosion through nonobservance of the Technical Data
To ensure safe operation, all Technical Data must be observed and complied with during installation.
▶ Observe the specifications in the control drawing, see "Control drawing", page 102 |

3 Installation

3.1 Project planning

3.1.1 Chemical tolerance

Materials in contact with the sample gas and the process include:

Measuring probe:	Stainless steel AISI 316 L (1.4404)
O-rings:	FKM or Kalrez® Spectrum 6375
Lense, mirror:	SiN, MgF$_2$, quartz
Filter:	Stainless steel AISI 316L (1.4404), PTFE

> **NOTICE:** Specify suitable seals when ordering
> ► Changing the seals later is work intensive and can only be done by Endress+Hauser.

> **EX** **WARNING:** Hazard through incorrect sealing material
> Incorrect sealing material can revoke division separation.

> **WARNING:** Toxic gases escaping
> Incorrect sealing material leads to leaks.
> ► Ensure the seal used is compatible with the temperature of the process gas in your application.

3.1.2 Temperature conditions

The TRANSIC121LP probe contains a temperature sensor. This measures the sample gas temperature. Changes are compensated metrologically.

Observe the temperature conditions in the various variants.

The temperature probe and the enclosure are connected heat-conductive. Thus, the ambient temperature affects the measured value of the temperature probe. This causes measurement errors because the measured temperature value used in compensation deviates slightly from the actual process gas temperature. Avoid heat build-up through direct sunlight: Use the weatherproof cover when appropriate (see "Spare parts", page 88).

Further information on the operating temperature range can be found in "Ambient conditions", page 99.

3.1.3   Strong light sources near the oxygen measuring probe

> **!** **NOTICE**: Strong light sources interfere with TRANSIC121LP operation
> ▶ Prevent strong light sources reaching the measuring probe.

The interfering effect is influenced by:

● Filter used
● Light incidence angle into the measuring probe

▶ Use a stainless steel filter for ambient light, e.g., normal interior or laboratory light.
▶ Use a PTFE filter for especially strong light sources, e.g. outdoors with direct sunlight.

3.1.4   Pressure

Observe the specifications on pressure conditions, see "Flange mounted TRANSIC121LP-A, -F, -G, -H", page 13, see "TRANSIC121LP-C with sample gas cell and wall bracket", page 13, see "TRANSIC121LP-B for ambient gas measurement and wall bracket", page 14 and see "Dimensions and mechanics", page 100.

3.2   Information on installation in potentially explosive atmospheres

> **EX** When using the device in potentially explosive atmospheres:
> ▶ Installation, start-up, maintenance and inspection should only be performed by experienced technicians with knowledge of the relevant rules and regulations for potentially explosive atmospheres.
> ▶ Observe the specifications in the control drawing, see "Control drawing", page 102.

3.3 Installation

3.3.1 Safety information

⚠ **WARNING**: Toxic gases escaping
▶ Ensure the seals have been fitted and the installation is gas-tight.

⚠ **WARNING**: Acids and alkalis escaping
▶ Ensure the installation is completely sealed.

+i Installation information: Only use Endress+Hauser original accessories and spare parts, .see "Spare parts and accessories", page 88.

⚠ **WARNING**: Risk of injury through device components under pressure
▶ Only install and remove the TRANSIC121LP when free from pressure.

+i When necessary, provide separating elements to ensure safe installation and removal.

⚠ **WARNING**: Risk of injury through components unsuitable for pressure
▶ Only use components designed for the process pressure in the application.

[!] **WARNING**: Start-up only by technicians
The TRANSIC121LP may be installed and put into operation only by technicians with appropriate training, who, based on their training and knowledge of relevant regulations concerning the gases used can assess and detect hazards.

[!] **NOTICE:** Check the TRANSIC121LP for completeness and damage
Check the TRANSIC121LP for completeness and damage (e.g. through transport) before start-up.

3.3.2 Prerequisites for assembly

An effective gas exchange is required in the optical path to ensure adequate response times and avoid condensation.

Place the TRANSIC121LP probe as far as possible in the process. The recommended minimum depth is 5 cm.

In case of an axial installation in a tube or flange piece, the tube diameter must be wide enough to allow gas exchange. Here, the recommended diameter is minimum 60 mm.

The dewpoint can be underflown when the probe is only inserted a little into the process or the temperature difference between environment and process is too high (>30 °C). In these cases, the flange area must be insulated or heated.

3.3.3   Installation angle

Install the TRANSIC121LP at a self-draining angle. When the process is very wet, ensure no liquid can reach the beam path.

● Installation angle
● The probe can be tilted freely when the process gas is dry (the process temperature is much higher than the dew point of the gas) so that there is no risk of condensation.
● When using the sample gas cell: It is possible that measured values for high O_2 concentrations can depend on the flow rate when the probe and sample gas cell are installed in vertical direction.
  ▶ Do *not* install the measuring probe vertical.

Fig. 5: Installation angle in high humidity
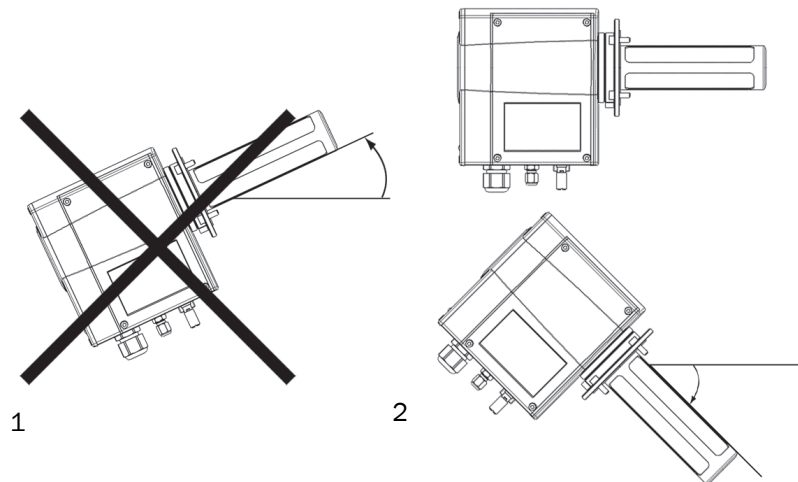
1 = The probe must not point upwards when there is a risk of condensation.

2 = Install the probe aligned horizontally or at a maximum downward angle of 45° in high humidity (5° downwards is recommended).

3.4 Installation options

3.4.1 Process conditions for installation options

The basic TRANSIC121LP variant provides the following installation options.

1 In-situ measurement (flange installation)
2 Extractive measurement (installation with sample gas cell)

Information on process conditions for the various installation options can be found in the Technical Data Section, see "Ambient conditions", page 99..

> **!** NOTICE: Installation of the TRANSIC121LP special variant for ambient gas measurement, see "Installing the TRANSIC121LP - ambient gas measurement", page 25

3.4.2 TRANSIC121LP installation - in-situ with flange

Filter recommendation

● Stainless steel filter: Protection against coarse dirt and incident light
● PTFE filter: Reduces the effects on oxygen measurements resulting from water, dust, other contamination and extremely strong ambient light. Gases and vapors are not filtered.

> **!** NOTICE: Filters influence the response time
> ● For short response times: Remove the filter.
>   The optical components are then more susceptible to contamination and must therefore be cleaned more often, see "Safety information for assembly and maintenance work", page 83.
>   Do not remove the filter when humidity or dirt can reach the optical components. Read see "Strong light sources near the oxygen measuring probe", page 17 before taking the filter out.
> ● Do not use a PTFE filter for measurements near the dew point.
> ● Short response times not required: Endress+Hauser recommends using PTFE filters and stainless steel filters.

Fig. 6: TRANSIC121LP with flange adapter
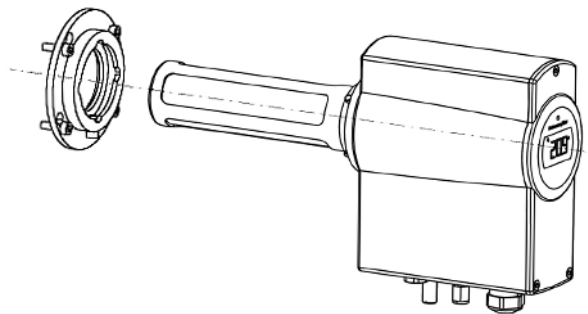
Suitable process flanges

Information on the diameter of the TRANSIC121LP flange adapter and flanges can be found in the Data Table, see "Dimensions and mechanics", page 100.

The smallest DIN flange suited for the flange adapter of TRANSIC121LP is a DIN/ISO 1092 DN50 (fitted with M16 hex bolts) or ANSI flange 2'' 150 lbs. All flange adapters (see "Type code", page 103) are fitted at the factory and are fastened to the probe with a screw.

Installation with clamping flange

A suitable counterflange must be present on the plant side in order to install the TRANSIC121LP with clamping flange 3"/ DN65 in accordance with DIN 32767. The scope of delivery does not include a seal. The customer must select the seal. The pressure, the chemical and thermal requirements must be considered when selecting the seal. Dimension drawing, see "Adapter flange, clamping flange DIN32676 3"/DN65, suitable for PS= 10 bar (150 psi)", page 96.

> +i↵   Information on use of the clamping flange in Canada, see "Approval in Canada", page 93.

Installation with welding adapter

The welding adapter must be welded on in accordance with valid, regional regulations.

> ⚠   **WARNING:** Risk of toxic gases escaping
> ▶ Carry out a leakage test after installation to exclude the risk of process gas escaping.

Installation with flange adapter:

1 Drill the threads in the process flange. Flange adapter and drilling dimensions, see "Dimensions, fitting the flange with M5 screws suitable up to 0.5 bar (7.25 psi)", page 95 and see "Dimensions, fitting the flange with M8 screws suitable for PS=10 bar (150 psi)", page 95.

2 Flange adapter with M5 screws:
   a) Screw the four M5 flange adapter fastening screws provided more or less halfway into the prepared threads.
   b) Push the TRANSIC121LP through the process flange. Check the correct position of the flange adapter seal to ensure a gas-tight connection between flange adapter and process flange.
   c) Turn the TRANSIC121LP clockwise so that the screws fit through the larger recesses of the flange adapter. Then turn the TRANSIC121LP counterclockwise to the stop.

3 Flange adapter with M8 screws:
   d) Push the TRANSIC121LP through the process flange.
   e) Check the correct position of the flange adapter seal to ensure a gas-tight connection between flange adapter and process flange.
   a) Screw the four M8 fastening screws provided for the flange adapter in the threads.
   b) Tighten the screws to finish installation.

> +i   The TRANSIC121LP can be removed from the process by loosening the screws holding the flange adapter in place. However, this is not recommended because fitting the TRANSIC121LP measuring device back on again is difficult.

3.4.3   Installation TRANSIC121LP - extractive

Filter recommendation

> ⚠️ **CAUTION:** Risk of burns through hot gas
> ▶ Attach the enclosed warning label clearly visible to the sample gas cell surface when process temperatures are >65 °C (>149 °F).

- Stainless steel filter: Minimum protection against dirt particles
- PTFE filter: For gas with humidity and/or fine dirt particles

> **!** **NOTICE:** Preparing the gas sample for dirty and wet gas
> ▶ Filter and dry the gas sample before pumping it into the sample gas cell.
> ▶ Use a hydrophobic dust filter before the inlet opening of the sample gas cell to protect the optical components against particle and water.
> ▶ Replace the dust filter regularly to ensure sufficient throughflow.
> ▶ Dry the gas through cooling and reheating to guard against condensation in the sample gas cell.

Fig. 7: TRANSIC121LP with sample gas cell
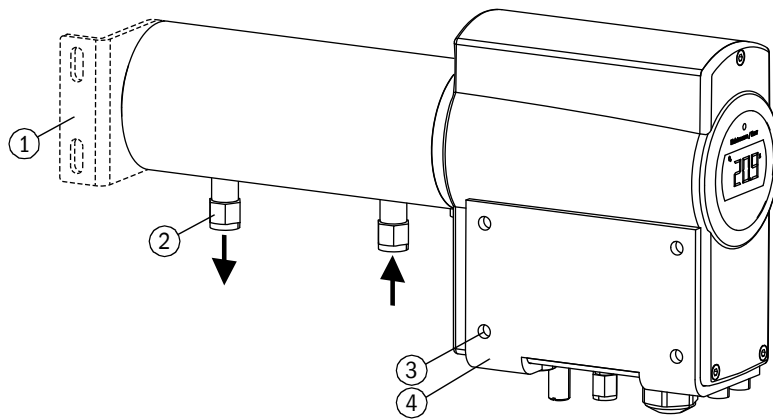
1 = Optionally available assembly bracket

2 = Swagelok connections for Ø 6 mm gas tubes (in scope of delivery: Adapter for 1/4")

3 = Max. screw size M6

4 = Wall bracket

Installing the wall bracket

1 Fasten the wall bracket.
   Wall bracket dimensions, see "TRANSIC121LP with wall bracket and sample gas cell, suitable for PS=10 bar (150 psi)", page 97.
2 Fasten the TRANSIC121LP .
   1 Fit the TRANSIC121LP on the wall bracket using the four M6 screws provided.
   2 First fix both outer screws in the threads at the bottom of the TRANSIC121LP. This simplifies fastening the two inner screws when positioning the TRANSIC121LP on the wall bracket.
   3 Tighten all four screws.

Drying the gases

In humid ambient conditions, condensation in the sample gas cell must be prevented. To do this, dry the gas sample through cooling and reheating. Use a cooling coil and a water trap. Switch a reheating system after the cooling process.

The humidity contained in the sample gas condenses on the walls of the stainless steel pipe; the water is collected. The relative humidity of the sample gas is reduced by reheating. If the temperature in the sample gas cell is significantly above the ambient temperature, the cooling coil and the water trap can be simply positioned outside the sample gas cell. For reheating, the heat generated by a pump system can sometimes be sufficient so that no additional heating is required. A simplified scheme of a sample gas treatment system for the removal of dirt and humidity is shown on .

Fig. 8: System for sample gas treatment
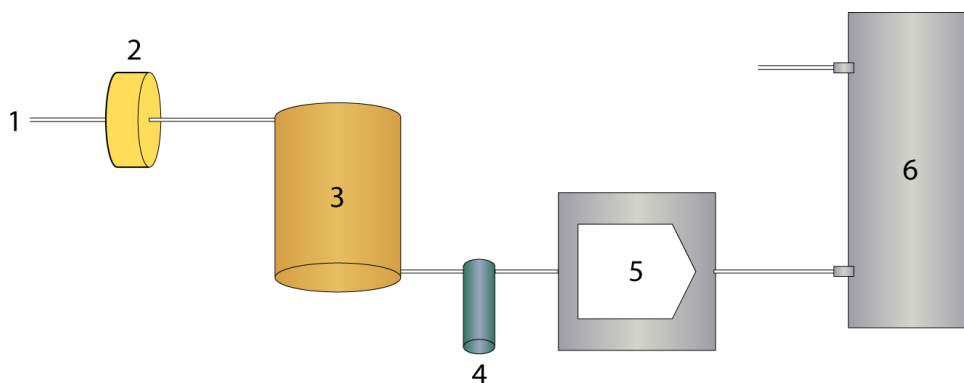
1 = Gas inlet

2 = Hydrophobic filter

3 = Stainless steel spiral tube

4 = Water trap

5 = Sample gas pump

6 = Oxygen sensor

Installing the sample gas line

1 Provide adequate support for the tubing, for example by attaching it to the wall. The tube must not put any traction on the connection.
2 The sample gas cell has two gas connections:
   – Use the gas connection closest to the measuring device as gas inlet. This provides a better gas exchange and shorter response times.
   – *When the sample gas contains condensable substances:* Lay the exhaust gas line in a way that condensing liquid can not block the exhaust gas line and protect the exhaust gas line from icing.

Installing the sample gas cell

Dimensions for TRANSIC121LP with sample gas cell, see "TRANSIC121LP with wall bracket and sample gas cell, suitable for PS=10 bar (150 psi)", page 97.

When a TRANSIC121LP with sample gas cell is ordered, it is delivered with the cell fixed at the factory and prepared for wall fitting.

▶ Take the sample gas cell off to check and replace the filter.
   1 Loosen the bayonet tube screw fitting and remove the sample gas cell by turning it and pulling it off the TRANSIC121LP, see Fig. 9.
   2 Refit the bayonet screw fitting in the reverse sequence.
      Ensure the seal is located between the sample gas cell and measuring device enclosure. The Swagelok connections must point directly downwards.

Fig. 9: Removing the sample gas cell
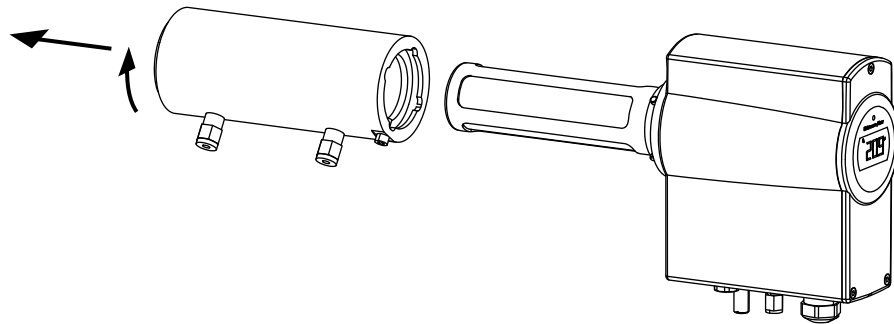
3.4.4   Installing the TRANSIC121LP - ambient gas measurement

Installation Instructions

Fig. 10: TRANSIC121LP, wall-mounted
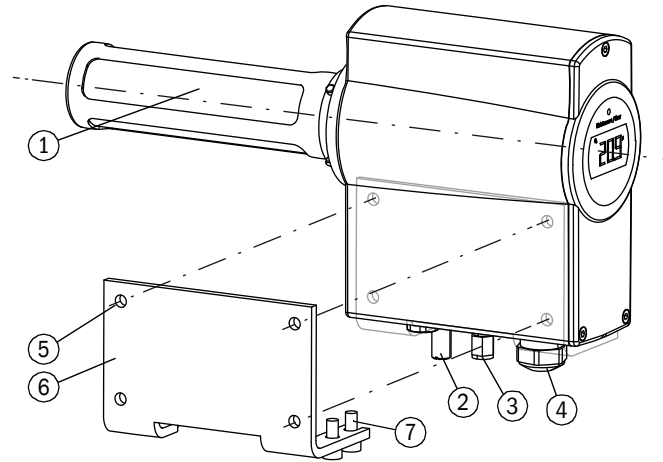
1 = Stainless steel filter
2 = External grounding connection
3 = Calibration gas inlet with a Ø 6 mm Swagelok connection (optional)
4 = M20 × 1.5 cable gland for supply and signal lines
5 = Max. screw size M6
6 = Wall bracket
7 = Device screws

1 Fit the wall bracket to the 4 drill holes.
2 Fasten the TRANSIC121LP to the wall bracket with the four M6 screws.

> First fix both outer screws in the threads at the bottom of the TRANSIC121LP. This simplifies fastening the two inner screws when positioning the TRANSIC121LP on the wall bracket.

3 Tighten the four screws.

> **+i** Dimensions and drill holes for the wall bracket, see "Dimensions and drill holes, wall bracket in mm (inches)", page 94.

> **+i** Ensure the TRANSIC121LP is installed in a representative gas mixture.

3.5   Connections

3.5.1   Cabling of signal and voltage supply lines

WARNING: Risk of explosion through incorrect installation
The signal and voltage supply lines of the TRANSIC121LP may be installed only by technicians.
▶ Observe all specifications in the control drawing, see "Control drawing", page 102.

WARNING: Risk of explosion when working on live parts
Always make sure the voltage supply lines are disconnected before starting any electrical work.

WARNING: Risk of explosion through sparks
In potentially explosive atmospheres, sparking occurring when using the RS-232 interface or activating the on/off switch can lead to an explosion.
▶ Never use the RS-232 interface or the on/off switch in a potentially explosive atmosphere.

WARNING: Damage to cabling through heat
▶ Only use cables specified for temperatures >70°C.

NOTICE: Damage to cables through dust or moisture
▶ Only open the device in a dry environment free from dust.

WARNING: Caution: Risk of fire caused by excessive energy input in error case
A PELV power supply unit (11 … 36 V DC, 24 V DC recommended) is required.
The installer/operating company is responsible for correct selection.
The installer of a system is responsible for the safety of a system in which the device is integrated.

WARNING: Endangerment of electrical safety
A disconnecting device must be provided to disconnect the TRANSIC121LP from the power supply and potential-free. Fit the disconnecting device as close as possible to the measuring device and easily accessible.

Voltage supply

● The supply voltage is 11 … 36 V DC.
● The TRANSIC121LP does not operate with AC voltage.

Fig. 11: *Connections at the integrated interface*
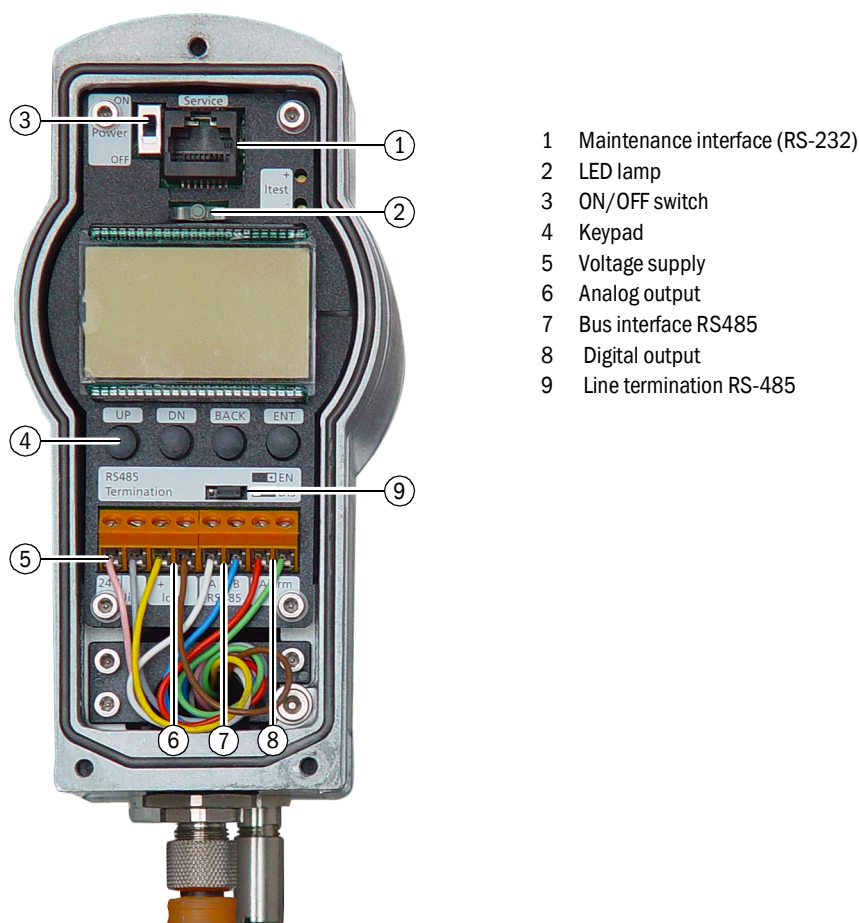
1	Maintenance interface (RS-232)
2	LED lamp
3	ON/OFF switch
4	Keypad
5	Voltage supply
6	Analog output
7	Bus interface RS485
8	Digital output
9	Line termination RS-485

WARNING: Risk of explosion when activating the ON/OFF switch
Do not activate the switch in potentially explosive atmospheres due to the risk of sparking.
▶ *Always set the ON/OFF switch to ON outside the potentially explosive atmosphere.*

1 Remove the cover.
2 The ON/OFF switch is located under a yellow protective cap. This must be switched to ON outside the potentially explosive atmosphere.
3 Push the cable through the cable gland.
4 Connect power supply terminals *(24 V)* and *(0)*.
5 Connect current output: The current output is between terminals *Iout (+)* and *(−)*. The output can be checked with an amperemeter.
6 A two-wire RS-485 line is available between terminals *RS 485 (A)* and (B).
   Line termination can be enabled by changing the *RS-485 termination* jumper position to *EN*.
7 A potential-free relay contact is available between the two *Alarm* terminals. See Page 53 for further information.
8 Close the cable gland. Tightening torque: 10 Nm
9 Ensure the cable gland seals the cable.
10 Switch the power supply on outside the potentially explosive atmosphere.
11 The TRANSIC121LP performs a self-test. PASS is displayed after termination of the self-test. Shortly after the self-test, the device is ready for measurement and starts displaying measured oxygen values. A green LED lights when the transmitter has found the absorption line and can output valid measured values.
12 Close the device front panel.

13 Ensure the enclosure is closed tight.

14 The transmitter is now ready for use.

Grounding the TRANSIC121LP

▶ Use suitable leads.
▶ Make sure the device is connected to the local ground.
▶ Lay the grounding as functional grounding.

| ! | **NOTICE:** No potential differences may occur. |

| ! | **NOTICE:** Check the grounding regularly. |

| EX | **WARNING:** FM approval becomes void
Enclosure degree of protection IP66 must *not* be degraded by using conduit cabling.
▶ Use a strain relief.
▶ Observe regional standards and regulations. |

3.5.2 Connecting the 24V PELV power supply unit

| ⚡ | **CAUTION:** Electrical voltages
▶ Always ensure the lines are disconnected before starting any electrical work. |

| +i | The 24V PELV power supply unit must have an overvoltage protection device. |

| +i | A disconnecting device must be provided in the Ex-free zone to switch the TRANSIC121LP disconnected from the main power supply and potential-free. Fit the disconnecting device as close as possible to the measuring device and easily accessible. |

| ⚠ | **WARNING:** Caution: Risk of fire caused by excessive energy input in error case
A PELV power supply unit (11 … 36 V DC, 24 V DC recommended) is required.
The installer/operating company is responsible for correct selection.
The installer of a system is responsible for the safety of a system in which the device is integrated. |

3.5.3   Gas connection (optional)

The optional test gas inlet is specified when ordering.

Fig. 12: Test gas inlet (optional)

1   Test gas inlet (optional)
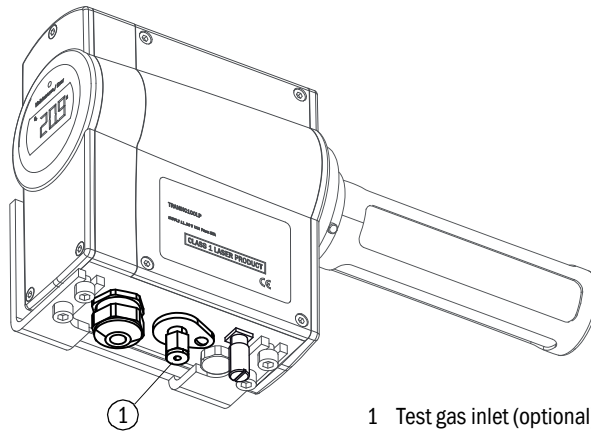
> **+i** The test gas inlet has a 6 mm Swagelok for tube or hose.
> ▶ Observe the suitability for:
>   – Pressure
>   – Gases
>   – Temperatures
>   – Oxygen
> The test gas connection has a non-return valve with opening pressure of 1.7 bar (see "Connections and systems", page 67).

4 Operation

4.1 Safety instructions for operation

NOTICE: Read the instructions through carefully before making any settings or parameter changes. Endress+Hauser accepts no responsibility for parameter or setting changes nor adjustments made by the user. Contact Endress+Hauser Customer Service when you require technical support.

+**i** The password can be found in the Annex,

DANGER: Hazard through incorrect parameter settings
Incorrect settings for parameters can have severe consequences. This is why the password is only available for authorized technicians.
▶ Note the password in the Manual and keep it safe somewhere else.

4.2 Device interfaces

There are 3 control interfaces.

- Keypad (on the device front panel)
- Maintenance interface (RS-232)
- RS-485 interface

+**i** The basic commands in the maintenance and RS-485 interface are available for all users.
Changes to parameters are password protected. The password allows access for 30 minutes after entry.

4.2.1 Control via keypad

A display and four pushbuttons are located on the front enclosure panel. The measured oxygen value is shown on the display. LEDs signal the operating mode of the measuring device. A green LED indicates normal operation.

4.2.2 Characteristics

The main purpose of the integrated interface (keypad/display) is field calibration.

The following values can be set to attain higher measuring precision:

- Process pressure
- Humidity
- Carbon dioxide content

Fig. 13: Display and keypad

1   LED (red/green)
2   Seven-part display
3   *Up* - Upwards button
4   *Dn* - Downwards button
5   *Back* - Back button
6   *Ent* - Input button

Display modes

The display is in one of the following modes when no input is made:

Display modes	Display / LED	Process
Start (duration: 2.5 minutes)	Software version Self test PASS	Self-test starts. Information: Self-test running. Warming up phase starts.
Normal operation	Green LED remains on Oxygen measured value	Oxygen measured value is displayed continuously.
Error state	Red LED remains on Error state number	Analog output in error status.
Warning	Green LED blinks slowly Oxygen measured value is displayed	Select function *Err* in the menu or use serial interface commands to display the error message (see "Error Table", page 90).

Table 1: Display modes

4.2.3   Maintenance interface

The RS-232 interface is located on the connector block above the display. It serves:

– Maintenance
– Calibration
– Changing parameters.

All adjustable parameters can be accessed with a PC terminal program (e.g., Hyperterminal) via the serial RS-232 interface.

A serial RS-232 interface cable serves to connect the TRANSIC121LP and the PC.

The maintenance interface provides more configuration options for alarm threshold(s) or other settings than the keypad and display.

> **WARNING:** Risk of explosion through sparks
> In potentially explosive atmospheres, sparking occurring when using the RS-232 interface can lead to an explosion.
> ▶ Only use the RS-232 interface outside the Ex area.

4.2.4   RS-485 interface

The TRANSIC121LP has a two-wire, serial RS-485 port without electric isolation. There are also line termination resistors which can be switched on and off with a jumper.

Up to 32 measuring devices can be connected over a 1 km distance with a pair of twisted wires. The system can request oxygen data from the addressed measuring devices.

Three separate operating modes exist:

1 *POLL*: Standard operating mode

POLL mode for bus coupling:

Ensure that every device has a unique address:

 a) To this purpose, the device must be opened with the *OPEN* command, the address assigned and closed again with the *CLOSE* command.
 b) The devices connected to the RS-485 bus can then be addressed individually.
 c) Address the desired device by using the device address as a command parameter.

2 *RUN*: Mode for continuous output of measured data. (The parameters to be output and the output interval are adjustable). Command *S* stops RUN mode. The device switches to STOP mode.

3 *STOP*: No output of measured values.

> **+i** The RS-485 interface supports the Endress+Hauser standard command set with additional, device-specific commands.

4.2.5   Analog output

The TRANSIC121LP has a non-insulated current output. The configuration of the analog outputs (0 or 4 ... 20 mA) and the switching behavior in error states are determined at order time. These parameters can be changed via the maintenance interface.

4.2.6   Digital output relay

The contact relay can be configured at order time so that it signals limit value overflows or underflows, maintenance requests or device errors. These settings can be changed via the maintenance interface.

> **+i** The contact relay is momentary.

4.3   Settings using the keypad

4.3.1   Short description: Input of settings using the keypad

▶ Buttons *Up* or *Dn* serve to open and scroll through the menu.
▶ Button *Enter* activates the functions.
▶ Button *Back* cancels a process.
▶ Use the buttons *Up/Dn* to enter numeric values unless a different method is specified: Press *Up* to increment a digit by one. Press *Dn* to toggle through the digits in the display.

> **+i**   The menu items are shown in the following Sections "Menu navigation without password authorization" and "Menu navigation with password authorization" as they appear in the menu navigation.

Fig. 14: Blinking display
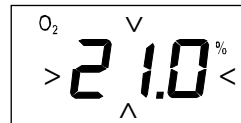
4.3.2   Safety information on using the password:

> ⚠️ **DANGER: Fatal consequences when parameters are changed without authorization**
> Unauthorized changing of parameters can have severe consequences. This is why the password is only available for authorized technicians.

4.4 Menu navigation without password

Values can only be read and reset in this part of menu navigation.

This part ends when the password is entered. Menu navigation starts from the top again after the password is entered.

4.4.1 Oxygen statistics (O₂)

This menu item displays the minimum and maximum oxygen values measured since the last reset. The statistics can also be restarted with the current value.

Fig. 15: Displaying and resetting the oxygen statistics
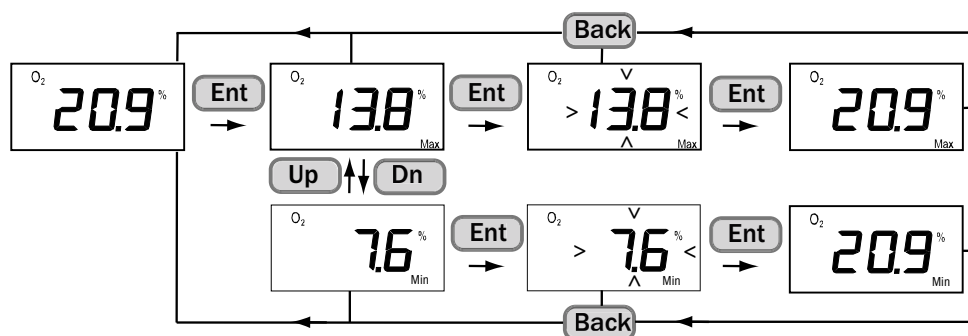
4.4.2 Temperature statistics (T)

This menu item displays the minimum and maximum temperature values measured since the last reset. The statistics can also be restarted with the current value.

Fig. 16: Displaying and resetting the temperature statistics
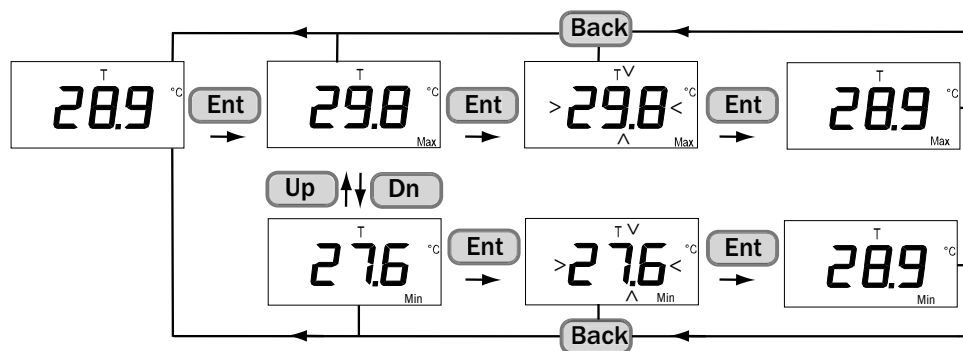
4.4.3 Calibration gas, actual value (CAL.C)

1 Freezes the analog output.
2 Displays the current O_2 concentration measured.

Fig. 17: Calibration gas, actual value display
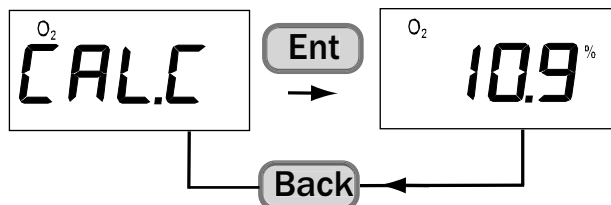
4.4.4 Signal intensity (SIL)

1 Compares the current signal intensity of the laser on the receiver against the signal level from the factory calibration.
2 The signal intensity serves to determine contamination on the optics. Important: The laser signal can be amplified so that values above 100% are possible.

Fig. 18: Signal intensity display
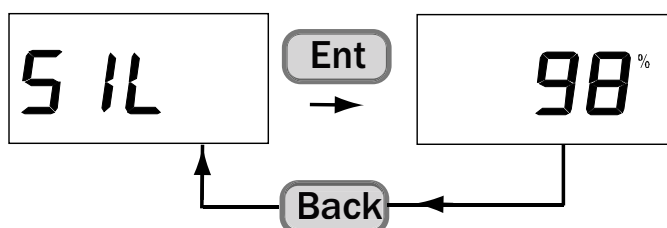
4.4.5 Display of active and undeleted errors (ERR)

This menu displays all active error messages. Figure 22 describes how the errors are displayed and deleted. The display shows *E 0* when all errors have been deleted. Refer to the Error Table for significance of error numbers, see "Error Table", page 90.

Fig. 19: Displaying all errors currently existing
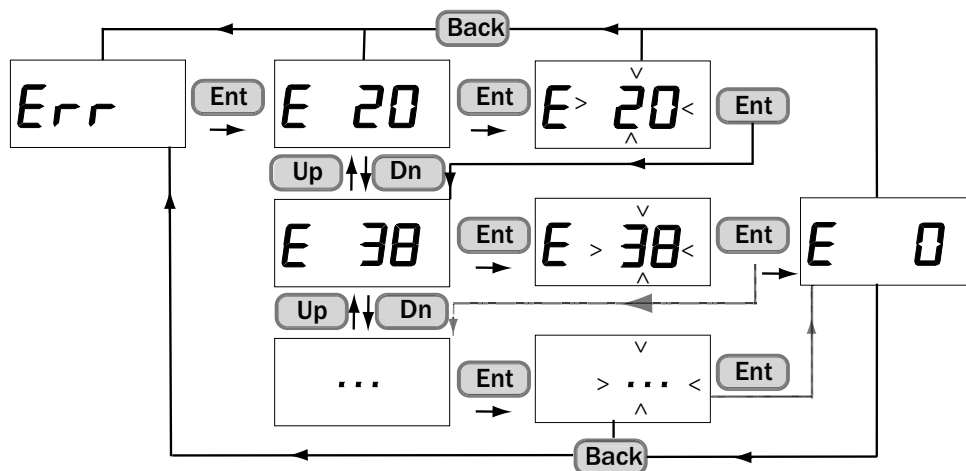
4.4.6   Entering the password (PAS)

1 Entering the password makes additional menu items available.
2 These additional menu items remain accessible for 30 minutes.
3 Observe the safety instructions, see "Safety information on using the password:", page 33.

+i   Menu navigation starts from the top again after the password is entered (Measured value display).

Fig. 20: Entering the password
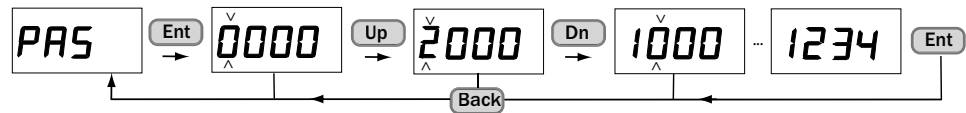
4.5   Menu navigation with password authorization

The maintenance level is open for all interfaces after the password has been entered.

NOTICE:
● After entering the password via the keypad, it is recommended to return to the oxygen statistics display after completing password protected functions.
● Even though the password expires in 30 minutes, maintenance functions remain available until you return to the basic functions in the menu structure. A message is not sent via the keypad when the password expires.

4.5.1   Process pressure: Display and settings

1 Enter the average pressure in the sample gas. Further information, see "Pressure compensation", page 62.
   Adjustable range: 800 to 1400 mbar.

Fig. 21: Reading out and changing the process pressure
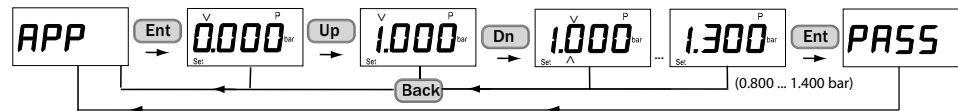
4.5.2 H_2O content in process gas: Settings (H2O)

1 Enter the average H_2O value in the sample gas. Further information, see "Compensation of ambient parameters", page 61.
   Adjustable range: 0 ... 600 g/m^3·

Fig. 22: Humidity in process gas setting
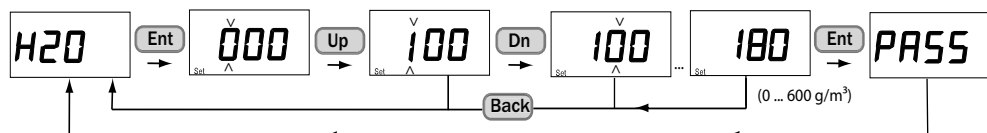
4.5.3 CO_2 content in process gas: Settings (CO2)

1 Enter the average CO_2 value in the sample gas.
Adjustable range: 0 … 100% vol.

Fig. 23: CO_2 sample gas setting
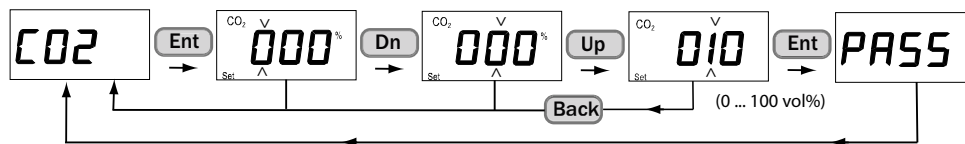
4.5.4 One-point calibration (CAL1)

Figure can be found in Section Adjustment, *see "One-point adjustment using the keypad", page 72*.

4.5.5 Two-point calibration (CAL2)

Figure can be found in Section Adjustment, *see "Two-point adjustment using the keypad", page 76*.

4.5.6 Analog output display and settings (AOU)

1 Press *Ent* to display the current output value on the analog output.
2 To set fixed output values for the analog output (0, 4, 12, 20 mA), press Ent and use *Up* and *Dn* to select the analog output value.

Fig. 24: Displaying and setting the analog output value.
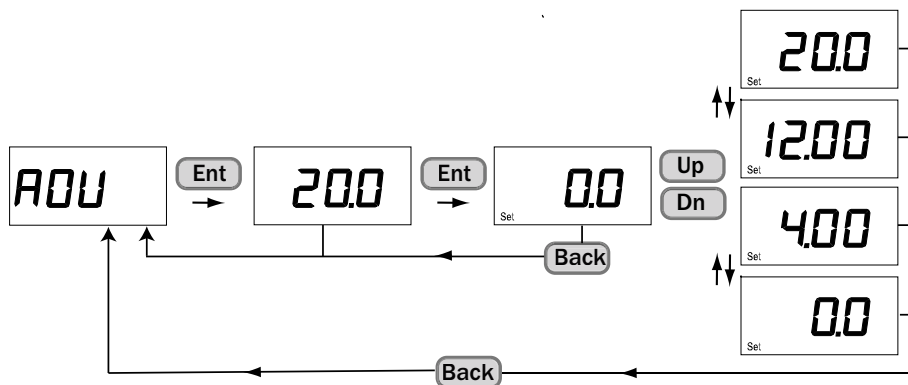
4.5.7 Resetting to the factory calibration (FAC)

The adjustment is reset to factory setting.
(Gain value: 1, offset value: 0).

Fig. 25: Resetting to the factory setting for oxygen measurement
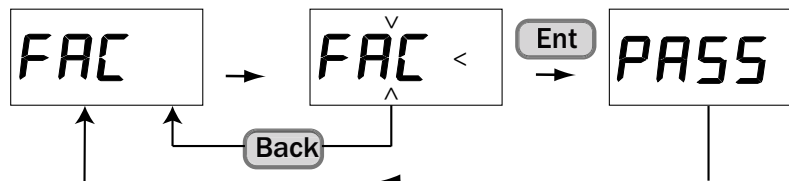
4.5.8 Scaling the analog output (ASCL)

The analog output can be scaled freely.

1 After pressing *Ent*, use submenu item *Set Lo* to set the oxygen value to be transferred with the lower mA value (4 mA or 0 mA).
2 Use submenu item *Set Hi* to set the oxygen value to be transferred with the upper mA value (20 mA).

Fig. 26: Scaling the analog output
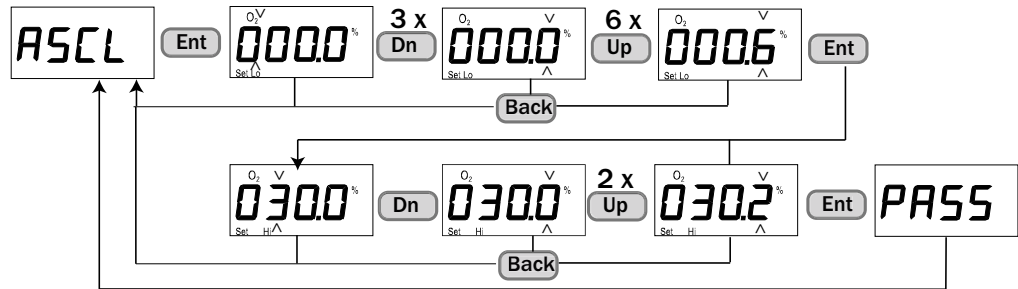
4.5.9 Digital output (ALA)

1 Press *Ent* to display the current switching position.
2 To check the switching function, press *Ent* and use *Dn* and *Up* to select the desired switching function *OPE* (open) or *CLO* (closed).

Fig. 27: Checking and changing the digital output state
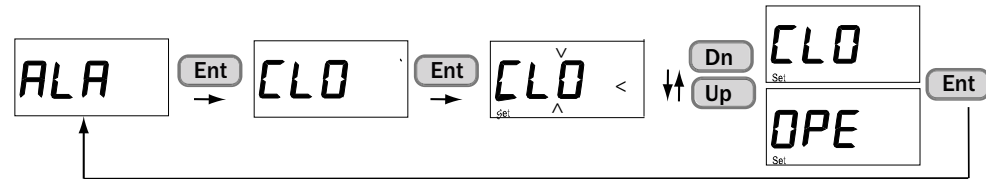
4.5.10 Resetting the measuring device (rESE)

The device is restarted.

Fig. 28: Restart of the TRANSIC121LP oxygen sensor
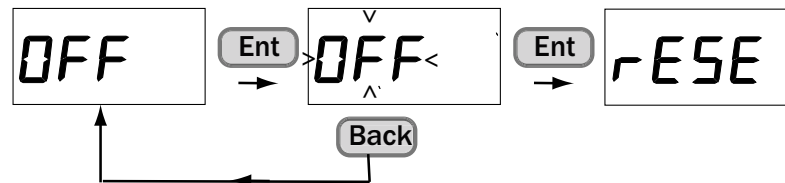
4.6   Serial interface commands

The serial interface commands are valid for the maintenance interface and the RS-485 interface.

Element	Significance	Text style used
SAMPLE	Name of the command or utility program	UPPER CASE BOLD
{variable}	Specifies several options from which the user must select one, several or all options.	Lower case letters {in curly brackets}
[option]	Specifies optional elements.	Lower case letters in [square brackets]
. , : ;	Punctuation marks are part of the command and must be entered as such.	Lower case letters
<cr>	Stands for pressing Enter (on the computer keyboard)	Lower case letters

Table 2: Significance of command line elements

Property	Description / value
Baud rate	19200
Data bits	8
Parity	None
Stop bits	1

Table 3: Standard settings for the serial interface of the TRANSIC121LP

4.6.1   List of serial interface commands

Serial interface command	Description
?	Display device information
??	Display device information with overwriting in POLL mode
ADDR	Display/set device address
CALCS	Display measuring parameters
CINFO	Display calibration information
CLOSE	Close serial interface (POLL mode)
DATE	Display/set date
ECHO	Set Echo mode
ERRS	Display errors detected
FORM	Set output format
HELP	List commands
INTV	Display/set continuous output interval
OPEN	Open communication line
PARAM	Display all changeable parameter values
PASS	Output password
R	Start continuous output
S	Stop continuous output
SAVE	Save parameters in EEPROM
SEND	Send measuring results
SERI	Display/set serial communication settings

Table 4: List of serial interface commands without password

Serial interface command	Description
SERI2	Display/define serial communication settings for RS-485
SIL	Measure signal level
SMODE	Display/set serial communication mode
SMODE2	Display/set serial communication mode for RS-485
STATS	Display status information
TIME	Display/set time
VERS	Display product name and software version
XPRES	Set pressure for compensation

Table 4: List of serial interface commands without password

Serial interface command	Description
ADJUST	Hold outputs for calibration
CO2	Display/set CO_2 for compensation
COXY1	Perform one-point adjustment
COXY2	Perform two-point adjustment
DB	Display status of display range
ENV	Set several/all ambient parameters with one command
ERR	Display error control status
ERRL	Display error protocol
ERRT	Display error Table
FCRESTORE	Reset factory calibration
H2O	Display/set H_2O for compensation
ICAL	Calibrate analog output
ITEST	Set test current for analog output
LTC	Display status of laser temperature controller
MEA	Display measuring status
OUT	Display output status
OUT_PARAMS	Display/set output parameters
PRES	Display/set pressure for compensation
RELAY_MODE	Display/set relay operating mode
RESET	Reset device
RSEL	Display/set relay switching point
SCI1	Display status of serial maintenance interface
SCI2	Display status of serial RS-485
STATUS	Display status of submenu item

Table 5: List of additional serial interface commands with password

4.7 Output of measuring results

4.7.1 Start continuous output (command R)

Starts RUN mode. Outputs values defined with the command *FORM* (see "Format measuring results (command FORM)", page 45). Command *INTV,* see "Display/set continuous output interval (command INTV)", page 41) defines the output interval. Command S (see "Stop continuous output (command S)", page 41) stops RUN mode.

Syntax: R<cr>

Example:

```
>r
Oxygen =    21.0
Oxygen =    21.0
Oxygen =    21.0
```

4.7.2 Stop continuous output (command S)

Stops RUN mode and switches the serial output to STOP.

Syntax: S<cr>

Example:

```
>S
>
```

4.7.3 Display/set continuous output interval (command INTV)

Sets the frequency for measured value output in RUN mode (see "Start continuous output (command R)", page 41).

Syntax: INTV [Value] [Unit]<cr>

Value	=	Time interval in which results are output (0 ... 255)
Unit	=	Interval time unit, S for seconds, MIN for minutes or H for hours

Example:

```
>intv
INTERVAL : 1   ? 5
UNIT S ? min
```

4.7.4 Send measuring results (command SEND)

Outputs the last results (in accordance with *FORM*, see "Format measuring results (command FORM)", page 45) in STOP mode. The command can be used with an address in POLL mode.

Syntax:

SEND [Address]<cr>

SEND [Formatting string]<cr

Address	=	Device address
Formatting string	=	Character string specifying the output format for the measuring results

Example:

```
>send   20.9   20.8   24.5
```

4.7.5   Display/set serial communication mode (command SMODE)

Defines the mode of the serial interface via which the command is entered (maintenance or RS-485 interface). Possible modes are STOP, POLL and RUN. Command *SAVE* (see "Save parameters (command SAVE)", page 58) saves the setting.

Syntax: SMODE [Mode]<cr>

Mode	=	Serial communication mode, possible modes are STOP, POLL and RUN

Example:

```
>smode
SMODE          : STOP ?
>
```

4.7.6   Display/set serial communication mode for RS-485 (command SMODE2)

Defines the communication mode for the RS-485 interface. Possible modes are STOP, POLL and RUN. Command *SAVE* (see "Save parameters (command SAVE)", page 58) saves the setting.

Syntax: SMODE2 [Mode]<cr>

Mode	=	Serial communication mode, possible modes are STOP, POLL and RUN

Example:

```
>smode2
SMODE          : STOP ?
>
```

4.7.7   Display/define serial communication settings (command SERI)

Sets the parameters for serial communication.

> **!** **NOTICE:**
> This command defines the parameters of the serial interface via which the command is entered (maintenance interface or RS-485 interface).

Valid baud rates for the maintenance interfaces are 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200. The maximum baud rate for the RS-485 interface is 38400.

> **!** **NOTICE:**
> To be able to use the new settings, save them in EEPROM with command *SAVE* (see "Save parameters (command SAVE)", page 58) and then reset the device with command *RESET* (see "Reset (command RESET)", page 59).

Syntax: *SERI* [Baud] [Data] [Parity] [Stop]<cr>

Baud	=	Valid baud rates are 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200 (max. baud rate for the RS-485 interface is 38400)
Data	=	Number of data bits (7 or 8)
Parity	=	Parity (n = none, e = even, o = odd)
Stop	=	Number of stop bits (1 or 2)

Example:

```
>seri

BAUD RATE       : 19200 ?
DATA BITS       : 8          ?
PARITY          : NONE ?
STOP BITS       : 1          ?
```

4.7.8   Display/set serial communication for RS-485 (command SERI2)

Defines the parameters for the RS-485 interface. The command can be entered via the maintenance interface. Valid baud rates are 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400.

> **!** **NOTICE:**
> To be able to use the new settings, save them in EEPROM with command *SAVE* (see "Save parameters (command SAVE)", page 58) and then reset the device with command *RESET* (see "Reset (command RESET)", page 59).

Syntax: SERI2 [Baud] [Data] [Parity] [Stop]<cr>

Baud	=	Valid baud rates are 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400.
Data	=	Number of data bits (7 or 8)
Parity	=	Parity (n = none, e = even, o = odd)
Stop	=	Number of stop bits (1 or 2)

Example:

```
>seri2

BAUD RATE       : 19200 ?
DATA BITS       : 8          ?
PARITY          : NONE ?
STOP BITS       : 1          ?
```

4.7.9   Display status of serial maintenance interface (command SCI1)

Displays and sets the status of the maintenance interface with the associated variables.

Syntax: SCI1<cr>

Example:

```
>sci1
*** SERVICE INTERFACE (SCI1) ***:
Mode        : STOP
Seri        : 19200 8 NONE 1

SERI        : 19200 8 NONE 1
ECHO        : ON
SMODE       : STOP
```

4.7.10 Display status of serial RS-485 interface (command SCI2)

Displays the status of the serial RS-485 interface with the associated variables.

Syntax: SCI2<cr>

Example:

```
>sci2
*** SERVICE INTERFACE (SCI2) ***:
Mode        : STOP
Seri        : 19200 8 NONE 1

SERI        : 19200 8 NONE 1
ECHO        : ON
SMODE       : STOP
```

4.7.11 Display measuring status (command MEA)

Displays the measurement status with the associated variables.

Syntax: MEA<cr>

Example:

```
>mea
*** OXYGEN MEASUREMENT (MEA) ***
Mode          : NORMAL
State         : PEAK_SEARCH
OP (DAC/mA)   : 20960 / 1.92
...
```

4.7.12 Format measuring results (command FORM)

Configures the output format for the commands *SEND,* see "Send measuring results (command SEND)", page 41 and *R,* see "Start continuous output (command R)", page 41, and can therefore also be changed as required.

Syntax: FORM [x]<cr>

| X   =   Formatting string |

The formatting string comprises the data to be shown and the associated formatting commands.

▶ Select one or more of the following variables by entering the abbreviation after the command *FORM*:

Abbreviation	Data
O2	Filtered O_2 results
TGASC	Gas temperature (Centigrade)
TGASF	Gas temperature (Fahrenheit)
TIME	Time elapsed since last reset
DATE	Date (set by user, comes after the time elapsed since last reset)
ERR	Error category (0 = no error, 1 = non-fatal, 2 = fatal)
ADDR	Measuring device address (0 ... 99)

Table 6: Abbreviations and variables in the formatting string

Following formatting commands are available:

Formatting command	Description
x.y	Change value for length (whole numbers and decimal places). The changed length parameters are used for all following variables.
\t	Tab stop
\r	Enter key
\n	Line feed
\xxx	Any character code (decimal value with three digits)

Table 7: Commands in formatting string

Formatting command	Description
""	String constant
U5	Field and length of the unit; units are output in standard width when U is entered without length specification.

Table 7: Commands in formatting string

+**i**   # can be used for \.

Examples:

Configuration of an output format comprising the oxygen measuring result (displayed with 3 decimal places) and the gas temperature in degrees Centigrade (also displayed with 3 decimal places). Text strings are inserted after the measured values for the output units. Tab stop \t separates the various formatting commands and character \r for Enter starts a new line after each measured result output. Command *SAVE* (see "Save parameters (command SAVE)", page 58) saves the setting.

```
>form 2.3 O2 \t "%O2" \t 2.3 TGASC \t "C" \r \n
>save
EEPROM (basic) saved successfully
EEPROM (op) saved successfully
EEPROM (op_log1) saved successfully
EEPROM (op_log2) saved successfully
>send
2.504%O2 28.065 C
```

Command *FORM* without parameters outputs the current formatting string:

```
>form
```

Example:

```
2.3 O2 \t "%O2" \t 2.3 TGASC \t "C" \r \n
The standard output format is used with command FORM /:
>form /
F0
>send
Oxygen =    21.0
```

4.7.13   Display/set date (command DATE)

Sets the date.

Syntax: DATE [YYYY] [MM] [DD]<cr>

YYYY	=	Current year
mm	=	Current month
DD	=	Current day

Example:

```
>date
YEAR    :  2003 ?
MONTH   :  7 ?
DAY     :  17 ?
>
```

NOTICE:
The device does not have a real-time clock so that the date set by the user is reset to 0000-01-01 after every switch-on.

4.7.14   Display/set time (command TIME)

Displays the time elapsed since the last device switch-on. The time can be set to the real time by entering the current time as a parameter. The time switch switches from 23:59:59 to 00:00:00.

> **+i**   The device does not have a real-time clock so that the time set by the user is reset to 00:00:00 after every switch-on.

Syntax: TIME [hh:mm:ss]<cr>

hh	=	Hours
mm	=	Minutes
ss	=	Seconds

Examples:

```
>time
03:28:32
>time 11:23:01
11:23:01
>
```

4.8 Network operation

4.8.1 Display/set device address (command ADDR)

> [!] **NOTICE:** A unique address must be assigned to each device before connecting using a bus.

Command *ADDR* is used to define the address of a device.

Command *CLOSE*: see "Close serial interface in Poll mode (command CLOSE)", page 48. After closing communication, the address must be known for future communication with the device.

Command *SAVE,* see "Save parameters (command SAVE)", page 58: Save.

Syntax: *ADDR* [Address]<cr>

Address	=	Address of device in the range from 0 … 99 (standard = 0)

4.8.2 Open communication line (command OPEN)

Opens communication with a device with the specified address. The device switches serial mode from POLL to STOP. The address of the opened device is included in the reply message. In the example, the text in *Italics* is not echoed unless the user is using local echo.

Syntax: `OPEN {Address}<cr>`

Address	=	Device address

Example:

```
>open 4
TRANSIC100LP: 4 line opened for operator commands
>
```

4.8.3 Close serial interface in Poll mode (command CLOSE)

Closes the device and switches to POLL mode. Unless an addressable command is issued, all output is suppressed until the device is reset or the *OPEN* command used. If a serial mode is set to POLL with command *SMODE*, see "Display/set serial communication mode for RS-485 (command SMODE2)", page 42 and the setting is saved to EEPROM with command *SAVE,* see "Save parameters (command SAVE)", page 58, the device starts in POLL mode after a reset (with command *RESET,* see "Reset (command RESET)", page 59) , and output is also suppressed after the start.

Syntax: CLOSE<cr>

Example:

```
>close
line closed
```

4.8.4 Set Echo mode (command ECHO)

In RS232C mode, the device echoes everything back to the user as standard. The Echo function is automatically disabled in RS-485 mode. In the example below, the two commands in *Italics* are typed by the user but not seen on the screen unless using local echo.

Syntax: `ECHO [on/off]<cr>`

on	=	Echo on
off	=	Echo off

Example:

```
>echo on
VERS
TRANSIC100LP 9165087 0000 / 1.36
echo on
ECHO            : ON
```

4.9 Commands for access at maintenance level

⚠️ **DANGER: Hazard through incorrect parameter settings**
Incorrect settings for parameters can have severe consequences. This is why the password is only available for authorized technicians.

4.9.1 Enter password (example PASS)

Entering the password allows access to the maintenance level (SERVICE). The maintenance commands remain available for 30 minutes after the password has been entered. All other passwords or the command *PASS* without parameter activate the basic commands (BASIC).

Syntax: `PASS [Password]<cr>`

Example:

```
>pass 2020
>
(2020 is a password example)
```

The password allows access to the maintenance level via the serial interface and the integrated keypad. A message is sent via the serial interface when the password has expired (only in STOP mode):

NOTE: PASSWORD EXPIRED

4.10 Commands for calibration and adjustment

4.10.1 Hold outputs for calibration (command ADJUST)

Retains the current values for all outputs or releases the outputs again.

This command serves to check the calibration based on a known span gas or for online adjustments so that measured value changes do not disturb process control.

Syntax: *ADJUST* [on/off]<cr>

Example:

```
>adjust on
Outputs (analog, relay, POLL/Run and MT300) frozen
>
```

4.10.2 Set water content for compensation (command H2O)

Allowable range is 0 ... 600 g/m^3 H_2O.

Use the *SAVE* command to store the setting in EEPROM, see "Save parameters (command SAVE)", page 58.

Syntax: H_2O [Water]<cr>

Water	=	Water content in measured gas (g/m^3 H_2O)

Example:

```
>H2O 100
WATER(g/m3)  : 100      ?
```

4.10.3 Set carbon dioxide content for compensation (command CO2)

Use the *SAVE* command to store the setting in EEPROM, see "Save parameters (command SAVE)", page 58. Allowable range is 0 ... 100 vol% CO_2.

Syntax: *CO2* [Carbon dioxide]<cr>

Carbon dioxide	=	CO_2 concentration in measured gas (vol% CO_2)

Example:

```
>co2 10
CO2(%)  : 10      ?
```

4.10.4 Set several/all ambient parameters with one single command (command ENV)

Syntax: *ENV* [Pressure] [Water] [Carbon dioxide]<cr>

Pressure	=	Pressure setting (bar(a))
Water	=	Water content in measured gas (g/m³ H_2O)
Carbon dioxide	=	CO_2 concentration in measured gas (vol% CO_2)

Example:

The ENV command without parameters displays the current values for ambient parameters and allows entering new values. Press Enter to confirm the current setting.

```
>env
PRESSURE(bar)  : 1.013    ?
H2O (g/m3)     : 0        ?
CO2 (vol%)     : 0        ?
>
Set pressure 1.000 bar(a), water content 50 g/m3 and CO2 content  20 vol% CO2:
>env 1 50 20
PRESSURE(bar)  : 1.000
H2O (g/m3)     : 50
CO2 (vol%)     : 20
>
```

4.10.5 Calibrate analog output (command ICAL)

Calibrates the current output. Calculates and sets the values for parameters Gain (GI) and Offset (OI).

Syntax: ICAL<cr>

Example:

```
>ical
 Ilow  (mA)  ? 3.42
 Ihigh (mA)  ? 17.6
>
```

4.11 Scaling and setting the analog output

4.11.1 Display/set output parameters (command OUT_PARAMS)

Syntax: *OUT_PARAMS<cr>*

Example:

```
>out_params
NONFATALI (mA) : 3.000    ?
FATALI (mA)    : 3.000    ?
I4             : 1        ?
OUTMAXO2 (%)   : 20.000   ?
OUTMINO2 (%)   : 0.000    ?
```

NONFATALI	=	Current output (in mA) for non-fatal error
FATALI	=	Current output (in mA) for fatal error
I4	=	Parameter to determine whether the current output range starts with 0 or 4 mA:
		When I4 = 0, the current output is 0...20 mA
		When I4 = 1, the current output is 4...20 mA
OUTMAXO2 (%)	=	Oxygen concentration OUTMAXO2 (%) is set for current output 20 mA
OUTMINO2 (%)	=	Oxygen concentration OUTMINO2 (%) is set for current output 0/4 mA

4.11.2 Display/set pressure for compensation (command PRES)

1 Sets the pressure for compensation.
2 Use the SAVE command to store the setting in EEPROM, see "Save parameters (command SAVE)", page 58.

Syntax: *PRES [pressure]<cr>*

| Pressure | = | Pressure of the measured gas (bar(a)) |

> **+i** Saving the settings with command *SAVE* prevents the settings being lost at the next reset.

```
>pres 1.300
PRESSURE(bar)  : 1.300    ?
>save
EEPROM (basic) saved successfully
EEPROM (op) saved successfully
EEPROM (op_log1) saved successfully
EEPROM (op_log2) saved successfully
>
```

Set pressure for compensation (command XPRES)

This command is suitable for systems where the pressure value is measured continuously and sent to the oxygen measuring device.

> **!** NOTICE: The setting *CANNOT* be saved in EEPROM with command *SAVE*.

Syntax: *XPRES [Pressure]<cr>*

| Pressure | = | Pressure setting (bar(a)) |

Example:

```
>xpres 1.300
PRESSURE(bar)  : 1.300    ?
```

4.12 Checking the analog output

4.12.1 Set test current for analog output (command ITEST)

Starts and stops the mode for checking the current output.

Syntax: `ITEST [Current]<cr>`

Where	
current	= test current (mA)

Example:

```
>itest 4
Test current set to 4 mA. Use ITEST to stop Test mode.
>itest
Current Test mode stopped.
>
```

4.13 Relay operation

4.13.1 Display/set relay operating mode (command RELAY_MODE)

Sets the relay operating mode, see "Display/set relay operating mode (command RELAY_-MODE)", page 53.

Syntax: *RELAY_MODE* [warn-alarm / fault_alarm / high_open / low_open]<cr>

warn_alarm	=	Relay open when maintenance request exists for error
fault_alarm	=	Relay open when error exists
high_open	=	Relay open when measuring result above upper point
		Relay closed when measuring result below lower point
low_open	=	Relay open when measuring result below lower point
		Relay closed when measuring result above upper point

! **NOTICE:**
The contact relay is momentary.

4.13.2 Display/set relay switching point (command RSEL)

Sets the relay switching points.

Syntax: *RSEL*<cr>

Example:

```
>rsel
LO POINT (%O2) : 10.0      ?
HI POINT (%O2) : 11.0      ?
```

4.14   Device information and other general commands

4.14.1   Display device information (command ?)

Outputs basic device information. Command *STATUS* displays the status of various objects, see "Display status of submenu item (command STATUS)", page 58.

Syntax: *?<cr>*

Example:

```
>?
*** TRANSIC100LP ***
Device        : TRANSIC100LP
SW version    : 9165087 0000 / 1.36
SNUM          : 12345678
Calibrated    : 2009-11-24
Calib. text   : Normal
ADDR          : 0
```

4.14.2   Display device information with overwriting in POLL mode (command ??)

As in command *?*, command *??* outputs basic device information and the addressing can be overwritten with *??* in POLL mode. This allows accessing a device with an unknown address to determine the address.

Syntax: *??<cr>*

Example:

```
>??
*** TRANSIC100LP ***
Device        : TRANSIC100LP
SW version    : 9165087 RC01 / 1.36
SNUM          : 12345678
Calibrated    : E2009-11-24
Calib. text   : Normal
ADDR          : 91
```

> **NOTICE:**
> The output is delayed with *??* depending on the address assigned to the device.

4.14.3   Display measuring parameters (command CALCS)

Displays all parameters the device can measure.

Syntax: *CALCS<cr>*

Example:

```
>calcs
O2           - Filtered O2 results
TGASC        - Gas temperature (centigrade)
TGASF        - Gas temperature (fahrenheit)
```

4.14.4   Display calibration information (command CINFO)

Displays information from the last adjustment.

Syntax: *CINFO*<cr>

Example:

```
Factory calibration:
Calibrated    : 2009-11-24
Calib. text   : Normal

Cal. point 1:
Given oxygen              : 0.00
Gas temperature (C)       : 20.81
Ref path temperature (C)  : 21.90

Cal. point 2:
Given oxygen              : 21.00
Gas temperature (C)       : 20.81
Ref path temperature (C): 21.90
...
```

4.14.5   Display status of display range (command DB)

Displays the status of the display range.

Syntax: *DB*<cr>

Example:

```
*** DISPLAY BOARD (DB) ***
Mode            : NORMAL
State           : NORMAL
Fault HW state  : OFF
Display state   : O2
Red led         : OFF
Green led       : SLOW
Relay           : CLOSE
RELAY_MODE      : FAULT_ALARM
LO POINT (%O2)  : 10.0
HI POINT (%O2)  : 11.0
...
```

4.14.6   List commands (command HELP)

Using this command without a parameter lists the commands accessible with the entered password. Using the command with a command name as parameter displays a detailed description of the respective command.

Syntax: *HELP* [Command]<cr>

Com-mand	=	Name of the desired command

Example:

```
>help
?       Prints information about the device
??      Prints information even in POLL mode
.
.
.
>
```

4.14.7 Display status of laser temperature controller (command LTC)

Displays the state of the laser temperature controller with the associated variables.

Syntax: *LTC<cr>*

Example:

```
>ltc
*** LASER TEMPERATURE CONTROLLER (LTC) ***
Mode          : ON
State         : TEMP_OK
Set Temp (C)  : 29.074
Temp (C)      : 29.073
Diff (C)      : -0.001
PID Output    : -773
DAC Output    : 29227
```

4.14.8 Display output status (command OUT)

Displays the status and settings of the analog output controller and the associated variables.

Syntax: *OUT<cr>*

Example:

```
>out
*** ANALOG OUTPUT (OUT) ***
Mode          : NORMAL
State         : NORMAL
Oxygen  (%)   : 0.00
Current (mA)  : 3.00
DAC Output    : 50000

GI            : 1.0000
OI            : 0.0000
NONFATALI (mA) : 3.000
FATALI (mA)   : 3.000
I4            : 1
OUTMAXO2 (%)  : 20.000
OUTMINO2 (%)  : 0.000
```

4.15 Display all changeable parameter values (command PARAM)

Displays the current values of all parameters that can be set by the user.

Syntax: *PARAM*<cr>

Example:

```
>param
Customer Interface
SERI          : 19200 8 NONE 1
ECHO          : ON
SMODE         : STOP
Service Interface
SERI          : 115200 8 NONE 1
ECHO          : ON
SMODE         : STOP
Common Serial parameters
ADDR          : 0
INTV          : 1 S
FORM          :  F0
Analog Output
OUTMINO2 (%)  : 0.000
OUTMAXO2 (%)  : 25.000
I4                        : 1
NONFATALI (mA) : 3.000
FATALI (mA)   : 3.000
Relay Output
RELAY_MODE    : FAULT_ALARM
LO POINT (%O2) : 10.0
HI POINT (%O2) : 11.0
Measurement parameters-
INSTALLATION  : Process measurement
PRESSURE(bar) : 1.000
H2O (g/m3)    : 50
CO2 (vol%)    : 20
```

4.15.1 Measure signal level (command SIL)

Checks the signal level. The laser signal intensity is compared to the signal intensity (factory calibration) originally set. The result is shown as 0 ... 100 % of the original signal intensity set. This allows measuring the contamination on optical surfaces.

Syntax: *SIL*<cr>

Example:

```
>sil
Signal level is 100% compared to signal level at factory
```

4.15.2 Display statistic information (command STATS)

Displays statistic information.

Syntax: *STATS*<cr>

Example:

```
>stats
All cleared    : 2006-01-18 13:40:04
Uptime (h)     : 140
Resets         : 7
O2 max:21.06
O2 min         : 4.91
Tg max         : 29.71
Tg min         : 23.39
Ti max         : 32.53
Ti min         : 24.55
```

4.15.3   Display status of submenu item (command STATUS)

Displays the settings and status of all submenu items.

Syntax: *STATUS*<cr>

Example:

```
>status
Submenu items are mode and status:

*** LASER TEMPERATURE CONTROLLER (LTC) ***
Mode          : ON
State         : TEMP_OK
*** OXYGEN MEASUREMENT (MEA) ***
Mode          : MODE2
State         : PEAK_LOCKED
Run Time Func.: OFF
*** ANALOG OUTPUT (OUT) ***
Mode          : NORMAL
State         : NORMAL
*** ERROR CONTROL (ERR) ***
Mode          : ON
State         : NO ERRORS
*** CUSTOMER INTERFACE (SCI2) ***:
Mode          : STOP
*** SERVICE INTERFACE (SCI1) ***:
Mode          : STOP
*** DISPLAY BOARD (DB) ***
Mode          : NORMAL
State         : NORMAL
>
```

4.15.4   Display product name and software version (command VERS)

Displays the device name and software version.

Syntax: *VERS*<cr>

Example:

```
>vers
TRANSIC100LP 9165087 0000 / 1.36>status
```

4.16   Using storage

4.16.1   Save parameters (command SAVE)

> [!] **NOTICE:**
> Remember to save parameter changes with the command *SAVE* so that the changes
> are not lost.

Saves the parameters from RAM to EEPROM.

Syntax: *SAVE*<cr>

Example:

```
>save
EEPROM (basic) saved successfully
EEPROM (op)  saved successfully
EEPROM (op_log1) saved successfully
EEPROM (op_log2) saved successfully
```

4.17 Resetting the measuring device

4.17.1 Reset (command RESET)

Resets the transmitter. This has the same effect as switching the transmitter off and on again.

Syntax: *RESET<cr>*

Example:

```
>reset
Resetting...
TRANSIC100LP 9165087 0000 / 1.36
2011
...
```

4.17.2 Restoring factory calibration

Restore factory calibration (command FCRESTORE)

Open the Terminal program with the valid serial communication settings and enter the command with password:

Syntax: *FCRESTORE<cr>*

Example:

```
>fcrestore
Customer calibration removed - remember SAVE command
Save the changes by issuing the command:
>save
```

4.18 Errors

4.18.1 Display error control status (command ERR)

Displays the error control status and active errors.

Syntax: *ERR<cr>*

Example:

```
>err
*** ERROR CONTROL (ERR) ***
Mode            : ON
State           : WARNING
ERRORS:
WARNING         : WATCHDOG RESET OCCURRED
>
```

4.18.2 Display Error protocol (command ERRL)

Displays the events in the Error protocol.

Syntax: *ERRL<cr>*

Example:

```
>err
*** ERROR CONTROL (ERR) ***
Mode            : ON
State           : WARNING
ERRORS:
WARNING         : WATCHDOG RESET OCCURRED
>
```

4.18.3   Display errors detected (command ERRS)

Displays all errors active in the device.

Syntax: *ERRS<cr>*

Example:

```
>errs
ERROR: LOW SIGNAL
ERROR: FP SLOPE FAILURE
>
```

4.18.4   Display Error Table (command ERRT)

Displays the Error Table.

Syntax: *ERRT<cr>*

Example:

```
>errt
# :St :Cnt  :CategoryError text
 1:OFF:    0:FATALEEPROM BASIC PARAMS NOT AVAILABLE
 2:OFF:    0:FATALEEPROM OPERATION PARAMS NOT AVAILABLE
...
31:OFF:    0:NON FATALSIGNAL LEVEL LOW
32:OFF:    0:NON FATALSIGNAL CUT
...
52:OFF:    0:WARNINGEEPROM LOG&STATS CORRUPTED
53:OFF:    0:WARNINGWATCHDOG RESET OCCURRED
```

5 Setting ambient parameters

5.1 Compensation of ambient parameters

The TRANSIC121LP can compensate the temperature, pressure of the operating environment as well as water and CO_2 content of the background gas.

Ambient parameters	Standard	Activated	Remarks
Operating pressure (process pressure)	Standard ambient parameters: Pressure: 1 bar(a).	Must be activated, ambient parameters must be set.	The pressure outside the process in which the measuring device enclosure is installed should be normal ambient air pressure. For further information see page 17.
Humidity	Water content 0 g/m3H_2O		
CO2	Relative carbon dioxide concentration 0 vol% CO_2, compensation is deactivated.		
Temperature	2 integrated temperature sensors: Inner temperature Process temperature	Automatic, always active	A significant difference between process gas temperature and the temperature in the measuring device enclosure can influence the measured value result.

Table 8: Compensation of ambient parameters

The typical effect of the error depending on the process pressure is shown in the non-compensated curve in Page 37. The error magnitude is smallest at normal ambient air pressure.

Fig. 29: Effect of process pressure compensation
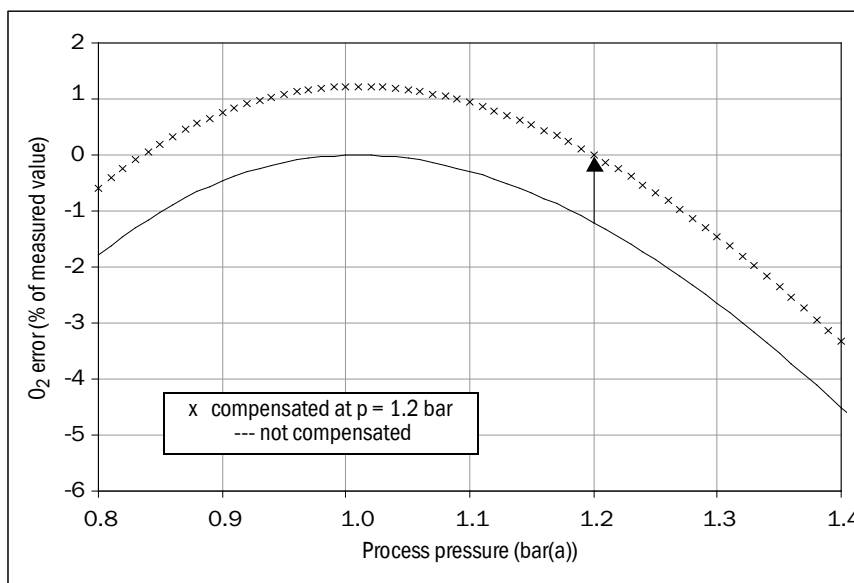
5.1.1 Pressure compensation

Setting the value of the average process pressure value compensates the measurement error more or less to zero in the immediate vicinity of the pressure value in question.

▶ Set the average pressure as parameter for the device. Either use the keypad, see "Process pressure: Display and settings", page 36, or the serial interface, see "List of serial interface commands", page 39.

"Effect of process pressure compensation", page 61 illustrates the effect of pressure compensation where the average process pressure is set to 1.2 bar(a). The original error of approximately 1% of the measured value at 1.2 bar(a) is compensated to zero. Pressure dependency remains for other values.

Pay particular attention that setting the pressure compensation does not shift the parabola-like curve in "Effect of process pressure compensation", page 61 along the X-axis. This means, even with compensation activated, pressure changes of the compensation value have a more significant effect than with 1.013 bar(a).

> **!** **NOTICE:**
> To disable pressure compensation, reset the average process pressure value to the standard ambient air pressure of 1.013 bar(a). The magnitude of pressure compensation is zero with this setting.

> **+i** The allowable pressure range for compensation is 0.800 … 1.400 bar(a).

5.1.2 Background gas effects

Individual absorption line widths of O_2 gas are sensitive to intermolecular collisions between O_2 and background gas molecules. This affects the measured O_2 values. The magnitude of this effect depends on the amount and type of background gas molecules. TRANSIC121LP factory calibration is carried out using dry N_2 and O_2 mixtures. Humidity and CO_2 concentrations of the calibration gases are 0%. Apart from dry N_2, all background gases result in a percentage measured value error for O_2 measurement.

> **+i** All gases, apart from N_2, influence the measured value.
> Contact Endress+Hauser Customer Service for information on the influence of further background gases.

Carbon dioxide and water vapor are the most common gases requiring compensation. Compensation for the average water and CO_2 contents of the background gas is integrated. The compensation is based on manual user settings for the values for the water and CO_2 content of the background gas in the device. The water content is expressed in terms of absolute humidity in g/m_3 H_2O. Conversion Table, see "Humidity Conversion Table", page 104. The conversion formulas can be found in Section "Water content of background gas", page 63.

> **!** **NOTICE:** Adapting compensation values to ambient conditions
> • When humidity and CO_2 compensation is/are activated, and when the ambient conditions deviate from the ambient conditions during adjustment:
> 1 Set the water and CO_2 content according to the adjustment environment.
> 2 These settings then have to be changed back to represent those of the operating conditions when the TRANSIC121LP is reinstalled in the process.

! NOTICE: Deactivating humidity and CO_2 compensation
   ▶ Set the values for the water and CO_2 content of the background gas to zero (factory setting).

Water content of background gas

The dependency on water content is expressed as absolute humidity in g/m³ H_2O because relative humidity is strongly dependent on the temperature.

▶ Calculate the absolute humidity in g/m³ H_2O with the following equations:

$$H_2O \ (g/m^3) \ = \ C \times P_W/T$$

T	=	gas temperature in K (= 273.15 + T °C)
P_W	=	water vapor pressure in hPa
C	=	216.679 gK/J

$$P_W \ = \ P_{WS} \times RH\,(\%) \, / \, 100$$

RH(%) = relative humidity and P_{WS} = saturation pressure of the water vapor, or

$$P_{WS} \ = \ 1000 \ x \ 10^{\,28.59051 - 8.2\log T + 0.0024804\,T - 3142/T}$$

T	=	as specified above

Example for calculating absolute humidity in g/m³:

Gas temperature is 40°C and relative humidity is 90%.

1 First calculate the water vapor pressure
  P_W: P_W (hPa) = P_{WS} (40 °C) × 90/100 = 66.5
2 Use this result to calculate absolute humidity:
  H_2O (g/m³) = 216.679 × 66.5 / (273.15 + 40 °C) = 46.0

The Table below gives a quick overview of the values for converting temperature and relative humidity into absolute humidity as well as the effect these conditions have on the O_2 measured value of the device.

			Effect of humidity on measured O_2 values (% of measured value)	
T °C	%RH	g/m³ H_2O	Dependency	Dilution
−20	50	0.5	0.0	−0.1
−20	90	1.0	0.0	−0.1
0	50	2.4	−0.1	−0.3
0	90	4.4	−0.2	−0.5
25	50	11.5	−0.4	−1.6
25	90	20.7	−0.7	−2.8
40	50	25.6	−0.9	−3.6
40	90	46.0	−1.6	−6.6
60	50	64.9	−2.1	−9.8
60	90	116.8	−3.6	−17.7
80	50	145.5	−4.2	−23.4
80	90	262.0	−6.3	−42.1

Table 9: Table to convert temperature and relative humidity to absolute humidity

The water content of the background gas influences the oxygen measuring result:

1 The water molecules contained by the background gas displace a certain amount of oxygen molecules.
2 Collisions between the water and oxygen molecules affect the shape of the oxygen absorption lines.

The first effect is the dilution of the oxygen concentration of the measured gas (water displaces oxygen so there is a lower oxygen concentration in the measured gas). This is not compensated during measurement. Only the second effect is due to the measuring principle and can be compensated.

The dependency due to the measuring principle is shown in the 4th column of "The Table below gives a quick overview of the values for converting temperature and relative humidity into absolute humidity as well as the effect these conditions have on the O2 measured value of the device.", page 63. This is compensated and eliminated when the water content of the measured gas is entered into the measuring device storage.

The 5th column of "The Table below gives a quick overview of the values for converting temperature and relative humidity into absolute humidity as well as the effect these conditions have on the O2 measured value of the device.", page 63 shows the dilution effect. This effect is much stronger than the measuring principle effect. This is also valid for the water content compensation because it is the actual decrease of oxygen content in the measured gas due to water displacing oxygen in the gas mixture.

Setting the water content for compensation

- Syntax for input via the serial interface, see "Set water content for compensation (command H2O)", page 50.
- Setting via the user interface, see "Humidity in process gas setting", page 36.

Setting the CO_2 concentration in background gas

The effect of CO_2 on the measured O_2 value is so small that in most circumstances CO_2 compensation is not necessary. The CO_2 dependency is expressed in terms of relative CO_2 concentration (percent per volume CO_2).

> **NOTICE:**
> The gas pressure value must be specified for CO_2 compensation.

Setting the carbon dioxide content for compensation

- Syntax for input via the serial interface, see "Set carbon dioxide content for compensation (command CO2)", page 51.
- Setting via the user interface, see "CO2 sample gas setting", page 37.

Influence of further background gases

- For further information on the influence of further background gases on oxygen measurement, see "Influence of background gases on oxygen measurement", page 105.

6   Adjustment

Definition of calibration and adjustment for these Operating Instructions

- Calibration: The comparison between the measured value of the device and a reference concentration
- Adjustment: Change the device measured value so that it corresponds to the reference concentration.

! Read the instructions through carefully before making any settings or parameter changes. Endress+Hauser accepts no responsibility for parameter or setting changes nor adjustments made by the user. Contact Endress+Hauser Customer Service when you require technical support or help.

! **CAUTION:** Differences between calibration and adjustment of the different TRANSIC121LP variants
Calibration and adjustment of the variants for installation in processes and with sample gas cells differ slightly from calibration and adjustment of the ambient gas measurement version. Make sure you read the correct Section. *Section 8 covers calibration and adjustment of the ambient gas measurement version.*

⚠ *WARNING: Observe all safety instructions, see "Safety information", page 18.*

6.1   Hardware layouts for calibration and adjustment

Fig. 30: TRANSIC121LP in process

1 = Front of the device
2 = Allen screws

Getting started

1 Switch the TRANSIC121LP on at least 15 minutes before calibration or adjustment.
2 Calibration: Simply observe the measured values displayed by the measuring device.
3 The serial interface as well as the keypad on the front of the device can be used for adjustment:
▶ Open the front cover of the measuring device with a 4 mm hex socket (Allen) key.
– Serial interface :
▶ Connect the TRANSIC121LP with the computer via the serial interface cable.
▶ Open the Terminal program with the respective serial communication setting (standard setting: 19200/8/N/1).
▶ Connect the gas supply, see "Setting up the gas supply for calibration and adjustment", page 66, and calibrate/adjust, see "Calibration", page 78, and/or see "Information on adjustment", page 79.

6.1.1 Setting up the gas supply for calibration and adjustment

The TRANSIC121LP can be calibrated and adjusted with ambient air or bottled gas.

6.1.1.1 *Using ambient air*

See for further information on this calibration method.

6.1.1.2 *Using bottled gas and with sample gas cell*

1 Ensure the O-ring is seated securely in the groove.
2 Insert the probe into the sample gas cell.
3 Make sure that no overpressure builds up in the sample gas cell.
4 Push the probe against the sample gas cell and turn it clockwise (see Figure 35).
5 The gas inlets of the sample gas cell are fitted with Swagelok gas connections for Ø 6 mm tubes. A 6 mm to 1/4" adapter is delivered.
6 Let the gas flow out without hindrance. This avoids an overpressure in the chamber.

> ⚠️ **WARNING: Risk of poisoning by escaping gas**
> Damage to health is possible during calibration and adjustment with toxic gases.
> ▶ Ensure that escaping gas is safely discharged.

> ⚠️ **WARNING: Risk of oxidization by high oxygen concentration**
> Calibration and adjustment with oxygen enriched gases >25 vol% could have an oxidizing effect.
> Ensure that escaping gas is safely discharged.

Fig. 31: Fastening the TRANSIC121LP probe in the sample gas cell
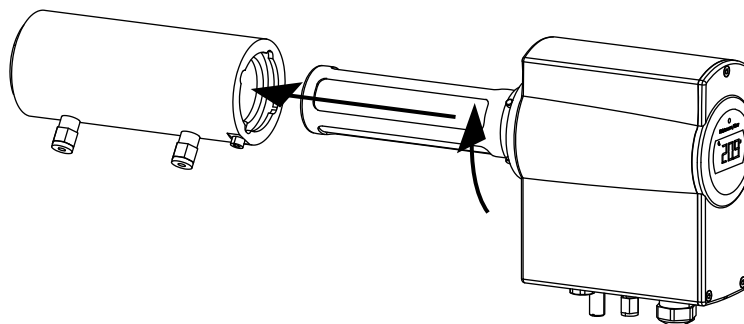
6.1.2   Calibration and adjustment in the process

> **!** **NOTICE**: For adjustment in process, fit an optional test gas inlet and PTFE filter on the TRANSIC121LP.

> **⚠** **WARNING**: Risk of injury through pressure
> The device may burst or leak when the process pressure is too high.
> ▶ Pay attention to the specifications for the flange variants and sample gas cell, see "Pressure suitability", page 101.

▶ The TRANSIC121LP does not have to be removed from the process with this adjustment method.
▶ Feed the span gas through the optional test gas inlet in the bottom of the electronics housing of the measuring device.

Typical calibration accuracy is within ±0.2% O_2 for a reference volume flow of 5 … 9 l/min. Calibration uncertainty increases when the volume flow is significantly below 5 l/min.

The effect of the process gas flow rate (in the range 0 … 20 m/s) on adjustment precision is negligible. Adjustment precision decreases with a high process gas flow rate.

The strength of unwanted counter diffusion through the filter depends on the O_2 concentration difference between span gas and process gas. For example, if you are using 100%N_2 as a reference and the process gas has 2% O_2, the result is better than when the process gas has 21% O_2.

> **+i**
> ● Use a sufficiently high volume flow for optimum adjustment results.
> ● With low span gas volume flow, high adjustment precision is only achieved with process gas flow rates near zero.

6.1.2.1   *Connections and systems*

The calibration gas inlet of the TRANSIC121LP is fitted with a Swagelok screw fitting for pipes with 6 mm outer diameter. A non-return valve with an opening pressure of approx. 1.7 bar is used. The first opening pressure can be higher than 1.7 bar when the non-return valve has not been used for some time. Endress+Hauser therefore recommends using a flow monitor, e.g., a rotameter, to monitor the calibration gas flow. This allows to set the gas flow to the required value.

> **⚠** **WARNING**: Escaping span gas can enter the process
> ▶ Ensure the span gas is compatible with the process gas.

6.1.2.2   *Connecting the gas*

1 Remove the plug of the TRANSIC121LP gas inlet.
2 Fasten the span gas tube to the gas inlet using a 14 mm wrench. Do not overtighten the inlet.

> **!** **NOTICE**: Prevent contamination of the gas inlet
> If span gas is not connected:
> ▶ Use the plug for the optional TRANSIC121LP gas inlet.
>   This prevents dust or dirt depositing on the gas inlet.

> **!** **NOTICE**: Prevent process gas escaping
> If span gas is not connected:
> ▶ Use a plug for the optional gas inlet.
>   Although the non-return valve prevents process gas from escaping, the plug on the optional TRANSIC121LP gas inlet can also be used.

6.1.2.3   *Adjusting gas flow*

3   Open the gas cylinder valve with care to avoid pressure surges.
4   Completely open the flowmeter.
5   Slowly increase the pressure setting of the controller until the gas flow can be detected with the rotameter
6   Use the flowmeter to adjust the volume flow to the desired value.
7   Pay attention to the volume flow for optimum adjustment precision.
    For further information on adjustment precision and volume flow, *see "Calibration and adjustment in the process", page 67*.
8   Observe Fig. "Volume flow against pressure, Swagelok SS-CHSM2-KZ-25 non-return valve", page 68 for adjustment without flowmeter. Information on the relation between span gas volume flow and span gas pressure of the optional test gas inlet can be found there.

Fig. 32:   Volume flow against pressure, Swagelok SS-CHSM2-KZ-25 non-return valve
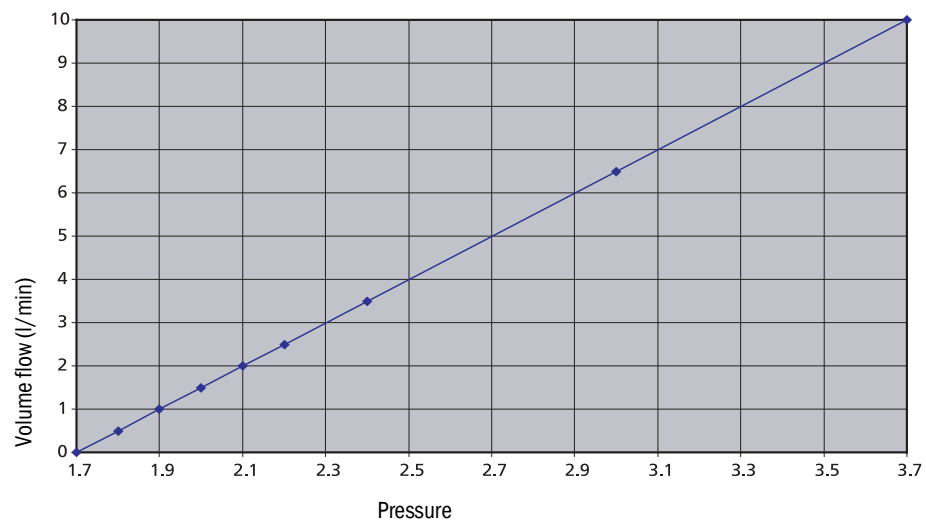
6.1.3   Information on calibration gases

- Factory calibration: Mixtures of dry N_2 and O_2.
- Humidity / CO_2 concentration of calibration gases: 0 %.
- Gases recommend for adjustment: Nitrogen gas mixtures
- A gas flow rate of about 5 l/min is adequate for TRANSIC121LP calibration and adjustment. Shorter response times during calibration and adjustment require a higher volume flow. The higher the gas volume, the higher the gas pressure. Select an adequate tubing size for the escaping gas.

> **!** **NOTICE:**
> Allow enough time for the gas concentration to stabilize when doing calibrations/adjustments.

6.2   Calibration

The analog output can be frozen for calibration. Use function *Cal.C*, see "Example:", page 50 with the keypad. Use the command *Adjust*, see "Hold outputs for calibration (command ADJUST)", page 50 for input via the serial interface.

6.2.1   Using ambient air

- Normal ambient air provides a convenient way to calibrate the TRANSIC121LP because the oxygen concentration of dry ambient air is constant at 20.95 vol% O_2.
  - ▶ Ensure the sensor is completely in the ambient air. Important: Pay attention to measured oxygen value of 21.0% O_2 ±0.2% O_2 .
  - ▶ Correct the humidity.
    The following Figure (Table 10) shows the calibration display expected for the ambient air as function of the temperature (°C) and relative humidity (% r.h.).

The following diagram shows the measured oxygen values (in % O_2) for a gas concentration of 20.95% O_2 with varying humidity values. The diagram shows examples for measured values when measuring wet gases without r.h. corrections having been entered in the TRANSIC121LP (i.e.the relative humidity is set to 0% r.h.). Both gas dilution effect and r.h. dependency effect are included in the Table.

Temp (°C)	(% r.h.)										
	0	10	20	30	40	50	60	70	80	90	100
0	21.0	21.0	21.0	21.0	20.9	20.9	20.9	20.9	20.9	20.9	20.8
5	21.0	21.0	21.0	20.9	20.9	20.9	20.9	20.8	20.8	20.8	20.8
10	21.0	21.0	20.9	20.9	20.9	20.8	20.8	20.8	20.7	20.7	20.7
15	21.0	21.0	20.9	20.9	20.8	20.8	20.7	20.7	20.6	20.6	20.6
20	21.0	20.9	20.9	20.8	20.8	20.7	20.6	20.6	20.5	20.4	20.4
25	21.0	20.9	20.8	20.8	20.7	20.6	20.5	20.4	20.3	20.3	20.2
30	21.0	20.9	20.8	20.7	20.6	20.4	20.3	20.2	20.1	20.0	19.9
35	21.0	20.9	20.7	20.6	20.4	20.3	20.1	20.0	19.8	19.7	19.6
40	21.0	20.8	20.6	20.4	20.2	20.1	19.9	19.7	19.5	19.3	19.1
45	21.0	20.8	20.5	20.3	20.0	19.8	19.5	19.3	19.1	18.8	18.6
50	21.0	20.7	20.4	20.1	19.7	19.4	19.1	18.8	18.5	18.2	17.9
55	21.0	20.6	20.2	19.8	19.4	19.0	18.6	18.3	17.9	17.5	17.2
60	21.0	20.5	20.0	19.5	19.0	18.5	18.1	17.6	17.1	16.7	16.2
65	21.0	20.4	19.7	19.1	18.5	17.9	17.3	16.8	16.2	15.6	15.1
70	21.0	20.2	19.4	18.7	17.9	17.2	16.5	15.8	15.1	14.4	13.8
75	21.0	20.0	19.1	18.2	17.3	16.4	15.5	14.7	13.8	13.0	12.2
80	21.0	19.8	18.7	17.5	16.5	15.4	14.4	13.4	12.4	11.4	10.4

Table 10: Oxygen measured values for relative humidity

6.2.2 Using bottled gas

- Preparations for calibration with bottled gas can be found in Section Gas flow adjustment, see "Setting up the gas supply for calibration and adjustment", page 66.
- When calibration conditions (gas pressure, humidity and CO_2 concentration) are different from the operating conditions of the measuring device, set the ambient parameters of the measuring device to the adjustment environment for the adjustment duration. These settings must then be changed back to represent the process conditions when the TRANSIC121LP is reinstalled in its operating environment. Further information on setting the ambient parameters of the TRANSIC121LP can be found under "Calibrate analog output (command ICAL)", page 51 (serial input) and "Process pressure: Display and settings", page 36 and "H$_{20}$ content in process gas: Settings (H2O)", page 36 (keypad).
- Let the gas flow in.
- Wait until the measured value has stabilized.
- Now compare the display value of the measuring device with the calibration gas specification.
- Set the parameters for pressure, humidity and temperature corresponding to the process conditions.
- Ensure the analog output is no longer held.

6.2.3 Adjustment

1. Enter the password. (Using the keypad, see "Entering the password (PAS)", page 36, using the serial interface, see "Enter password (example PASS)", page 50).
2. Access to the adjustment functions is open for 30 minutes after the password is entered. Functions in progress are not interrupted after expiry of 30 minutes. Enter the password again to execute more password-protected functions.
3. Make sure that no error messages are active as these could affect adjustment. Malfunction messages, see "Display Error protocol (command ERRL)", page 59 using the serial interface and "Display of active and undeleted errors (ERR)", page 35 using the keypad.
4. Make sure that the ambient parameters of the adjustment environment have been set before adjustment.
5. Set the values for pressure, humidity and CO_2 concentrations of the calibration gas. Calibration gases have a humidity of 0 g/m³ H_2O. The CO_2 concentration of nitrogen gas mixtures is -0 vol% CO_2.
6. Reset the ambient parameters after adjustment to the values of the process gas. Further information on the compensation of ambient parameters can be found in "Compensation of ambient parameters", page 61.

6.2.4 Adjustment options

- One-point adjustment via the serial interface
- One-point adjustment using the keypad
- Two-point adjustment via the serial interface
- Two-point adjustment using the keypad
- Restoring factory calibration

> +**i**
> - The reference concentration used determines whether the gain or offset parameter value is changed.
>   - Change to the offset value: Oxygen concentration < 10.5% O_2
>   - Change to the gain value: Oxygen concentration > 10.5% O_2
> - Two-point adjustment: Always returns new gain and offset values.

6.2.5 One-point adjustment via the serial interface

One-point adjustment procedure via the serial interface (command COXY1)

This adjustment calculates and sets a new gain or offset parameter value (depending on the reference concentration used).

1 Enter the password, .
2 The analog output can be held during an online adjustment with the command *ADJUST ON*.
   Input:

```
>adjust on
Outputs (analog, relay, POLL/Run and MT300) frozen
```

3 When adjustment conditions (gas pressure, humidity and CO_2 concentration) are different from the operating conditions of the measuring device, set the ambient parameters of the measuring device to the adjustment environment for the adjustment duration. These settings must then be changed back to represent the process conditions when the TRANSIC121LP is reinstalled in its operating environment. Further information on setting the ambient parameters of the TRANSIC121LP can be found in Section 5.
4 Enter command *COXY1* and confirm with the Enter button.
5 Connect the gas inlet and let the gas flow in.
6 The adjustment starts. The following commands are now available for selection:
   – *Enter* - output the most current measuring result
   – *R + Enter* – continuous output of measuring results. Press Enter to terminate output mode.
   – *Esc* – to terminate the calibration
7 Wait until the measured value has stabilized. Enter the span gas concentration and press *Enter*. The new gain or offset parameter value is calculated and displayed.
   The following is displayed after entering the command *COXY1*:

```
>coxy1

Customer calibration
Current condition/settings:
Pressure (bar)        : 1.013
H2O (g/m3)            : 0
CO2 (vol%)            : 0
Gas temperature (C)   : 23.64
Internal temperature (C): 24.84

If parameters are not correct, cancel calibration with ESC and change parameters.
Connect ref gas to cuvette.

Connect ref gas to cuvette.
O2 (%):  20.52 Ref  ?
O2 (%):  20.51 Ref  ?
O2 (%):  20.51 Ref  ?
O2 (%):  20.51 Ref  ? 20.50

Calibration data:
Pressure setting (bar)      : 1.013
Measured oxygen             : 20.51
Given oxygen                : 20.50
Gas temperature (C)         : 23.65
Ref path temperature (C)    : 24.85
New Gain                    : 1.000
Calibration ready - remember SAVE command
>save
```

8   Now enter command *SAVE,* see "Save parameters (command SAVE)", page 58, and press *Enter*. The new values are stored in EEPROM.

```
>save
EEPROM (basic) saved successfully
EEPROM (op) saved successfully
EEPROM (op_log1) saved successfully
EEPROM (op_log2) saved successfully
```

9   Enter command *ADJUST OFF* and press *Enter*. The adjustment is completed and the measuring results are displayed again.

```
>adjust off
Outputs to normal state
```

6.2.6   One-point adjustment using the keypad

One-point adjustment (function CAL1)

1   Check that no error messages are active.
    Active error messages influence adjustment. Malfunction messages, see "Error display", page 90. (Serial interface) and "Display of active and undeleted errors (ERR)", page 35 (keypad) Error Table, see "Error Table", page 90.
2   Enter the password in menu *PAS*.
3   Select menu item *Cal1*. This holds the analog output.
4   Connect the span gas.
5   Enter the known O_2 value and confirm with Ent.
6   The measured value display blinks.
7   Feed calibration gas.
8   Wait until the display shows a stable value.
9   Confirm with *Ent*.
    PASS is displayed when the calibration is successful. The device now calculates the new gain and offset settings and starts to display the new measured value.
10 Press *Ent* twice to end the one-point adjustment.

Fig. 33: One-point adjustment using the keypad
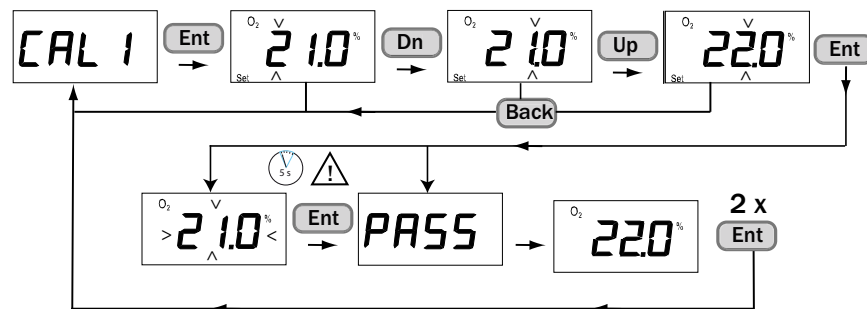
> **+i**   The adjustment can be aborted at any time with *Back*.

> **+i**   The reference concentration used determines whether the gain or offset parameter value is changed.
> – Change to the offset value: Oxygen concentration < 10.5% O_2
> – Change to the gain value: Oxygen concentration > 10.5% O_2

6.2.7   Two-point adjustment via the serial interface

Perform two-point adjustment (command COXY2)

This command starts a two-point adjustment.

Syntax: *COXY2<cr>*

Example:

```
>coxy2
Customer calibration

Current condition/settings:
Pressure (bar)          : 1.013
H2O (g/m3)              : 0
CO2 (vol%)              : 0
Gas temperature (C)     : 23.66
Internal temperature (C) : 24.85

If parameters are not correct, cancel calibration with ESC and change parameters

Connect ref gas #1 to cuvette
O2 (%)                  :  20.99 Ref1  ? 21

Connect ref gas #2 to cuvette
O2 (%)                  :  10.05  Ref2 ? 10

Calibration data:
Pressure setting (bar)    : 1.013

Point #1
Measured oxygen         : 20.99
Given oxygen            : 21.00
Gas temperature (C)     : 23.65
Ref path temperature (C) : 24.84

Point #2
Measured oxygen         : 10.05
Given oxygen            : 10.00
Gas temperature (C)     : 23.66
Ref path temperature (C) : 24.85
New Gain                : 0.995
New Offset              : 0.990

Calibration ready - remember SAVE command
>save
```

Two-point adjustment via the serial interface

This adjustment calculates and sets new gain and offset parameter values. A two-point adjustment uses one gas to adjust the lower limit value of the measuring range and a different gas to adjust the upper limit value of the measuring range. These can be, for example, pure nitrogen (0.0% O_2) and an N_2/O_2 mixture (for example, 21% O_2). The minimum difference between the two span gas concentrations in two-point adjustment should be at least 4% O_2. It makes no difference whether the gas is first used for the lower or upper span.

1 Enter command *PASS XXXX* (the password) and confirm with Enter.
2 Enter command *ADJUST ON* and confirm with Enter. The analog output can be held during an online adjustment.

```
>adjust on
Outputs (analog, relay, POLL/Run and MT300) frozen
```

3 When adjustment conditions (gas pressure, humidity and CO_2 concentration) are different from the operating conditions of the measuring device, set the ambient parameters of the measuring device to the adjustment environment for the adjustment duration. These settings must then be changed back to represent the process conditions when the TRANSIC121LP is reinstalled in its operating environment. Further information on setting the ambient parameters of the TRANSIC121LP can be found in Section 5 of this Manual.

4 Enter command *COXY1* and confirm with the Enter button.

5 Connect the gas inlet and let the gas flow in.

6 The adjustment starts. The following commands are now available for selection:
   – *Enter* - output the most current measuring result
   – *R + Enter* – continuous output of measuring results. Press Enter to terminate output mode.
   – *Esc* – to terminate the calibration

7 Wait until the measured value has stabilized. Enter the span gas concentration for the first span and press *Enter*. The following is displayed after the command *COXY2* has been entered (example):

```
>coxy2
Customer calibration
Current condition/settings:
Pressure (bar)        : 1.013
H2O (g/m3)            : 0
CO2 (vol%)            : 0
Gas temperature (C)   : 23.66
Internal temperature (C): 24.85
If parameters are not correct, cancel calibration with ESC and change parameters.
Connect ref gas #1 to cuvette

O2 (%):  20.99 Ref1  ?
O2 (%):  20.99 Ref1  ?
O2 (%):  20.99 Ref1  ?
O2 (%):  20.99 Ref1  ? 21
Connect ref gas #2 to cuvette
```

8 Now the second span gas has to be fed. Wait until the measured value has stabilized. Enter the span gas concentration for the second span and press *Enter*. The new gain and offset parameter values are now calculated and displayed.

```
Output:
O2 (%):  10.05  Ref2 ?
O2 (%):  10.05  Ref2 ?
O2 (%):  10.05  Ref2 ?
O2 (%):  10.05  Ref2 ? 10
Calibration data:
Pressure setting (bar) : 1.013
Point #1
Measured oxygen       : 20.99
Given oxygen              : 21.00
Gas temperature (C)   : 23.65
Ref path temperature (C): 24.84
Point #2
Measured oxygen       : 10.05
Given oxygen              : 10.00
Gas temperature (C)   : 23.66
Ref path temperature (C): 24.85
New Gain       : 0.995
New Offset     : 0.990
Calibration ready - remember SAVE command>save
>
```

9 It is possible that an error message can appear and new values are not calculated:
   Error: Calibration points too close - Not calibrated
   In this case, repeat the two-point adjustment with calibration gases that differ by at least 4 vol% O2.

10 Enter command *SAVE* and confirm with *Enter*. The new values are stored in EEPROM.

```
>save
EEPROM (basic) saved successfully
EEPROM (op) saved successfully
EEPROM (op_log1) saved successfully
EEPROM (op_log2) saved successfully
```

11 Enter command *ADJUST OFF* and confirm with *Enter*. The adjustment is completed and the measuring results are displayed again.

```
>adjust off
Outputs to normal state
```

6.2.8 Two-point adjustment using the keypad

**Two-point adjustment (function CAL2)**

The procedure is the same as for one-point calibration but the adjustment continues automatically with the second reference point.

This adjustment calculates and sets new gain and offset parameter values. A two-point adjustment uses one gas to adjust the lower limit value of the measuring range and then a different gas to adjust the upper limit value of the measuring range. These can be, for example, pure nitrogen (0.0% O_2) and an N_2/O_2 mixture (for example, 21% O_2). The minimum difference between the two span gas concentrations in two-point adjustment should be at least 4% O_2.

When adjustment conditions (gas pressure, humidity and CO_2 concentration) are different from the operating conditions of the measuring device, set the ambient parameters of the measuring device to the adjustment environment for the adjustment duration. These settings must then be changed back to represent the process conditions when the TRANSIC121LP is reinstalled in its operating environment. Further information on setting the ambient parameters of the TRANSIC121LP can be found in Section 5 of these Operating Instructions.

1   Check that no error messages are active.
    Active error messages influence adjustment. Malfunction messages, see "Error display", page 90. (Serial interface) and see "Display of active and undeleted errors (ERR)", page 35 (keypad) Error Table, see "Error Table", page 90.
2   Select menu item *Cal2*. This holds the analog output.
3   First close off the gas for the *first (lower limit)* reference point.
4   Enter the known span gas value and confirm with *Ent*.
5   The measured value display blinks.
6   Feed calibration gas.
7   Wait until the display shows a stable value.
8   Enter the known span gas value and confirm with *Ent*.
9   Now close off the gas for the second (*upper limit)* reference point.
10 Confirm with *Ent*. The display now shows *Set hi* and the adjustment for the second (upper) reference point starts and "Set Hi 10.0 %" is displayed.
    PASS is displayed when the calibration is successful. The display now shows the O_2 value when no further input is made.
11 The device now calculates the new gain and offset settings and starts to display the new measured result.
12 Press *Ent* twice to end the two-point adjustment.

Fig. 34: Two-point adjustment using the keypad
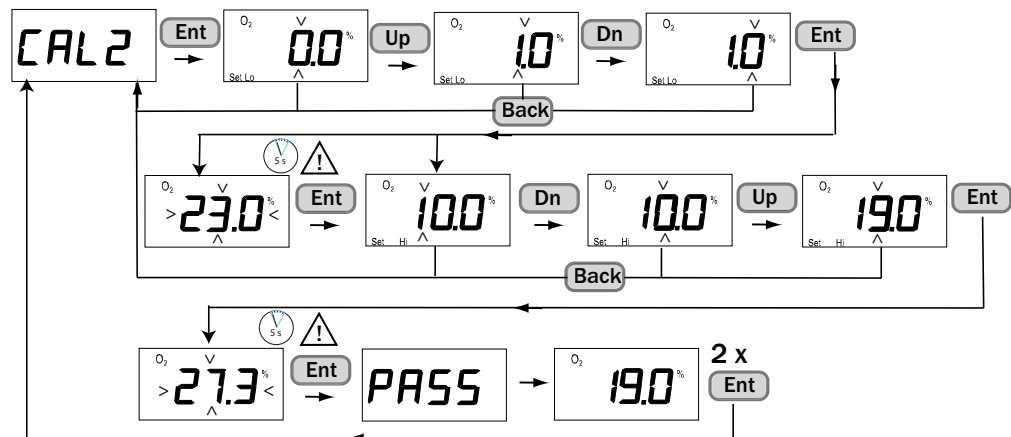
+i   The adjustment can be aborted at any time with *Back*.

+i   The reference concentration used determines whether the gain or offset parameter
        value is changed.
        –   Change to the offset value: Oxygen concentration < 10.5% O_2
        –   Change to the gain value: Oxygen concentration > 10.5% O_2

6.3   TRANSIC121LP adjustment for ambient gas measurement

! This Section solely describes the adjustment and calibration of the TRANSIC121LP variant for ambient gas measurement.
Read the complete Section 6 for comprehensive information on the calibration and adjustment procedure for the TRANSIC121LP for ambient gas measurement.

! **NOTICE:** Particular care for calibration and adjustment
With the ambient measurement configuration, it is assumed that the probe and measuring device enclosure are installed in an environment with a varying O_2 concentration.
This presents special demands on calibration and adjustment of the TRANSIC121LP version for ambient gas measurement because the calibration and adjustment gas should be present in both the probe and the measuring device enclosure.
Endress+Hauser recommends the following procedure for a simpler approach:
– For calibration (test of device): Use normal ambient air or 21.0% O_2 calibration gas. See see "Calibration", page 78.
– For adjustment: Use one-point adjustment with 21.0% O2 adjustment gas and sample gas cell, see "Information on adjustment", page 79.

6.3.1   Setting up the gas supply

This TRANSIC121LP version requires the calibration and adjustment gas to be present in the probe as well as inside the measuring device enclosure.

This requirement is most easily fulfilled by performing calibration and adjustment with gas that has an O_2 concentration close to normal ambient air O_2 concentrations (20.95% O_2).

When using calibration or adjustment gas concentrations significantly different from ambient air, it should be noted that:

– For calibration (test of device), it is possible to correct the TRANSIC121LP measured value for the error caused by the calibration configuration, see "Using calibration gas", page 78.

Take the required measures for adjustment so that the adjustment gas concentration is also present in the measuring device enclosure.

Using ambient air

For further information on the calibration method, see "Using ambient air", page 78 .

Using bottled calibration and adjustment gas

1 Ensure the O-ring is seated securely in the groove.
2 Insert the probe into the sample gas cell.
3 Push it against the sample gas cell and turn it clockwise 45°, see "Fastening the TRANSIC121LP probe in the sample gas cell", page 66.
4 The gas inlets of the sample gas cell are fitted with 1/8" NPT or Swagelok gas connections for Ø 6 mm tubes, see "Installing the sample gas line", page 23.
5 Let the gas flow out without hindrance. This avoids an overpressure in the chamber.

The ambient gas measurement version of TRANSIC121LP requires the calibration and adjustment gas to be present in the probe as well as inside the measuring device enclosure. In the configuration described above, the gas in the measuring device enclosure would be normal ambient air so calibration/adjustment gas O_2 concentration must be at or close to ambient air (20.95 O_2).

6.3.2 Calibration

6.3.2.1 *Using ambient air*

For information on calibration with ambient air, .

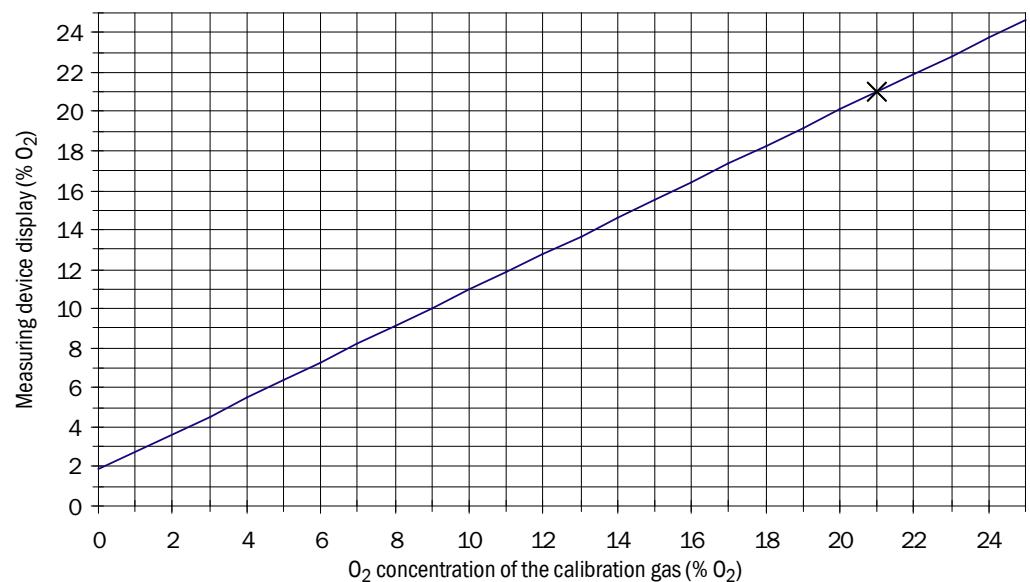#### 6.3.2.2 *Using calibration gas*

Endress+Hauser recommends using normal ambient air for calibrating the TRANSIC121LP version for ambient gas measurement.

If a calibration gas (such as synthetic air or a gas with precise O_2 concentration) is used, cont.

The TRANSIC121LP does not show the calibration gas concentration correctly because only the probe is in the calibration gas. The correct measured value can be taken from the diagram below (Fig. 35).

The Figure shows the measured value when only the sample gas cell (and not the measuring device enclosure) is exposed to the calibration gas.

Fig. 35: TRANSIC121LP measured values depending on the O_2 concentration in the calibration gas

6.3.2.3 *Information on calibration gases*

- Factory calibration: Mixtures of dry N_2 and O_2
- Humidity / CO_2 concentrations: 0%.
- Gases recommend for adjustment: Nitrogen gas mixtures.
- When using the sample gas cell: Volume flow for calibration and adjustment about 0.5 l/min higher volume flow for shorter response times. The higher the gas volume, the higher the gas pressure. Select an adequate tubing size for the escaping gas.

> **!** NOTICE:
> Allow enough time for the gas concentration to stabilize when doing calibrations/adjustments.

6.3.3   Calibration method

Hold outputs for calibration via serial interface (command ADJUST)

see "Hold outputs for calibration (command ADJUST)", page 50.

Check of calibration via keypad (function Cal.C)

see "Calibration gas, actual value (CAL.C)", page 35

6.3.4   Information on adjustment

- Endress+Hauser recommends a one-point adjustment with a dry O_2/N_2 gas mixture with an O_2 concentration of about 21% O_2 for this TRANSIC121LP variant.
- The adjustment gas concentration must be in both the probe and the enclosure of the measuring device. Further information, see "Adjustment", page 70 and see "Setting up the gas supply", page 77.

6.3.5   Adjustment

1. Enter the password. (Using the keypad, see "Entering the password (PAS)", page 36, using the serial interface, see "Enter password (example PASS)", page 50)
2. Access to the adjustment functions is open for 30 minutes after the password is entered. Functions in progress are not interrupted after expiry of 30 minutes. Enter the password again to execute more password-protected functions.
3. Make sure that no error messages are active as these could affect adjustment. Malfunction messages, see "Error display", page 90. (Serial interface) and see "Display of active and undeleted errors (ERR)", page 35 (keypad)
4. Make sure that the ambient parameters of the adjustment environment have been set before adjustment.
5. Set the values for pressure, humidity and CO_2 concentrations of the adjustment gas. Calibration gases have a humidity of 0 g/m³ H_2O. The CO_2 concentration of nitrogen gas mixtures is -0 vol% CO_2.
6. Reset the ambient parameters after adjustment to the values of the process gas. Further information on the compensation of ambient parameters can be found in "Compensation of ambient parameters", page 61.

6.3.6   Adjustment options

- One-point adjustment (O_2 concentration at 21.0%) via the serial interface.
- One-point adjustment (O_2 concentration at 21.0%) via the keypad.
- Restoring factory calibration

6.3.7   One-point adjustment via the serial interface

One-point adjustment: Either the gain or offset value of the measurement is changed. When the O_2 concentration of the span gas is >10.5% O_2, the one-point adjustment returns a new gain value otherwise a new offset value.

One-point adjustment (command COXY1)

This command performs a one-point adjustment. While the program waits for the input of the O_2 concentration, command *R* can be used to trigger continuous output of the current O_2 measured value. Pressing *Enter* once (on the computer keyboard) terminates Print mode. Pressing *Esc* once cancels the adjustment. Syntax: *COXY1<cr>*

Example:

```
>coxy1
Customer calibration
Current condition/settings:
Pressure (bar)            : 1.013
H2O (g/m3)                : 0
CO2 (vol%)                : 0
Gas temperature (C)       : 23.64
Internal temperature (C)  : 24.84
If parameters are not correct, cancel calibration with ESC and change parameters

Connect ref gas to cuvette.
O2 (%):  21.20 Ref  ?
O2 (%):  21.20 Ref  ?
O2 (%):  21.20 Ref  ?
O2 (%): 21.19 Ref  ? 21

Calibration data:
Pressure setting (bar)  : 1.013
Measured oxygen         : 21.20
Given oxygen            : 21.00
Gas temperature (C)     : 23.65
Ref path temperature (C): 24.85
New Gain                : 0.990
Calibration ready – remember SAVE command>save
```

One-point adjustment via the serial interface

This adjustment calculates and sets a new gain or offset parameter value (depending on the reference concentration used).

1 Enter command *PASS XXXX* (the password) and then press *Enter* (on the computer keyboard).
2 Enter command *ADJUST ON* and press *Enter*.

>adjust on

Outputs (analog, relay, POLL/Run and MT300) frozen

This command holds the current values of all outputs. This command should be used during online adjustment so that measured value changes do not disturb process control. This step can be omitted when the device to be adjusted has been removed from the process or is separated from process control.

When adjustment conditions (gas pressure, humidity and CO_2 concentration) are different from the normal operating conditions of the measuring device, set the ambient parameters of the measuring device to the adjustment environment for the adjustment duration. These settings must then be changed back to represent the process conditions when the TRANSIC121LP is reinstalled in its operating environment. Further information on setting the ambient parameters of the TRANSIC121LP can be found in Section 5 of this Manual.

3 Enter command *COXY1* for one-point adjustment and press *Enter*.
4 Connect the gas inlet and let the gas flow in.

The calibration starts. The following commands are now available for selection:

- *Enter* - output the most current measuring results or terminate continuous Print mode
- *R + Enter* - continuous output of measuring results with an interval of about 1 second. Press *Enter* to terminate Print mode.
- *Esc* – to terminate the calibration

5 Wait until the measured value has stabilized. Enter the span gas concentration and press *Enter*.
   The new gain or offset parameter value is calculated and displayed.
   The following is displayed after entering the command *COXY1*:

```
>coxy1
Customer calibration
Current condition/settings:
Pressure (bar)          : 1.013
H2O (g/m3)              : 0
CO2 (vol%)              : 0
Gas temperature (C)     : 23.64
Internal temperature (C) : 24.84

If parameters are not correct, cancel calibration with ESC and change parameters

Connect ref gas to cuvette.
O2 (%):  20.52 Ref  ?
O2 (%):  20.51 Ref  ?
O2 (%):  20.51 Ref  ? 20.50

Calibration data:
Pressure setting (bar)  : 1.013
Measured oxygen         : 20.51
Given oxygen            : 20.50
Gas temperature (C)     : 23.65
Ref path temperature (C) : 24.85
New Gain                : 1.000
Calibration ready – remember SAVE command
>save
```

6 Enter command *SAVE* and press *Enter*. The new values are stored in EEPROM.

```
>save
EEPROM (op) saved successfully
EEPROM (op_log1) saved successfully
EEPROM (op_log2) saved successfully
```

7 Enter command *ADJUST OFF* and press *Enter*.

```
>adjust off
Outputs to normal state
The adjustment is finished and the output returns to displaying the measurement
results.
```

6.3.8 One-point adjustment using the keypad (function CAL1)

When adjustment conditions (gas pressure, humidity and CO_2 concentration) are different from the operating conditions of the measuring device, set the ambient parameters of the measuring device to the adjustment environment for the adjustment duration. These settings must then be changed back to represent the process conditions when the TRANSIC121LP is reinstalled in its operating environment. Further information on setting the ambient parameters of the TRANSIC121LP, see "Setting ambient parameters", page 61.

1 Check that no error messages are active.
   Active error messages influence adjustment. Malfunction messages, see "Error display", page 90. (Serial interface) and see "Display of active and undeleted errors (ERR)", page 35 (keypad) Error Table, see "Error Table", page 90.
2 Enter the password in menu *PAS*, see "Entering the password (PAS)", page 36.
3 Select menu item *Cal1*. This holds the analog output.
4 Connect the span gas.
5 Enter the known O_2 value and confirm with *Ent*.
6 The measured value display blinks.
7 Feed adjustment gas.
8 Wait until the display shows a stable value.
9 Confirm with *Ent*.
   PASS is displayed when the calibration is successful. The device now calculates the new gain and offset settings and starts to display the new measured value.
10 Press *Ent.* twice to end one-point adjustment.

Fig. 36: One-point adjustment using the keypad
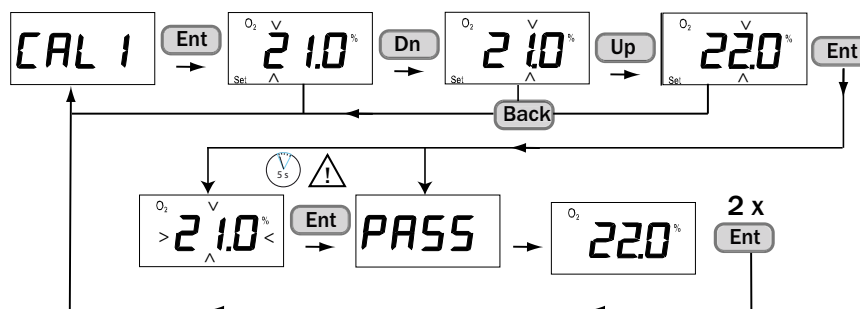
+**i**   The adjustment can be aborted at any time with *Back*.

+**i**   The reference concentration used determines whether the gain or offset parameter value is changed.
   – Change to the offset value: Oxygen concentration < 10.5% O_2
   – Change to the gain value: Oxygen concentration > 10.5% O_2

6.3.9 Restoring factory calibration

Restore the TRANSIC121LP factory calibration via the serial interface, see "Restoring factory calibration", page 59, via the keypad, see "Resetting the measuring device (rESE)", page 38.

7 Maintenance

7.1 Field maintenance

7.1.1 Assembly and disassembly

7.1.1.1 *Safety information for assembly and maintenance work*

EX	▶ Only use original Endress+Hauser spare parts. For devices used in potentially explosive atmospheres: ▶ Maintenance and inspection should only be carried out by experienced/trained personnel with knowledge of the rules and regulations for potentially explosive atmospheres.

⚠	**WARNING:** Risk of burns through hot gases ▶ With process temperatures >65°C (149 F), let the TRANSIC121LP cool down before starting maintenance work.
⚠	**WARNING:** Toxic gases escaping ▶ Ensure the seals are fitted. ▶ Incorrect sealing materials lead to leaks. ▶ Check the installation regularly for leaks.

⚠	**WARNING:** Risk of fire through reaction with oxygen ▶ Keep components with sample gas contact free from grease and dust.
⚠	**WARNING:** Risk of injury through pressure ▶ Only assembly and disassemble the TRANSIC121LP when free from pressure

+i	When necessary, provide separating elements to ensure safe installation and removal.

⚠	**WARNING:** Risk of injury through pressure Oxygen measurement only functions in the range 0.8 … 1.4 bar(a) Do not use the flange with M5 screws when the pressure to be expected is above 0.5 bar(g) or the plant is designed for such pressures. ▶ Only use components designed for the process pressure in the application. ▶ Observe the components pressure conditions, see "Dimensions and mechanics", page 100. ▶ Observe regional regulations.

!	**CAUTION:** Plant-specific hazards during maintenance work ▶ Observe local regulations with regard to plant-specific protective equipment during maintenance work.

⚠	**CAUTION:** Laser beam invisible ▶ Switch the TRANSIC121LP off during cleaning. Cleaning tools positioned on the probe can reflect the laser beam coming out of the probe.

⚠	**WARNING:** Corrosive components can endanger operation ▶ Check all parts, especially those made of stainless steel, for corrosion and exchange these parts as necessary. Corrosion on device parts can impair safety with regard to explosion protection, leak tightness and pressure.

!	**NOTICE:** Risk of damage to the TRANSIC121LP through dust or humidity ▶ Only open the TRANSIC121LP in a dry environment free from dust.

7.1.2   Cleaning the optical components

Check the signal strength.

- TRANSIC121LP maintenance
- Maintenance warning
- Error signal that indicates excessive light loss in the sensor.
  Inquiry via keypad, see "Signal intensity (SIL)", page 35.

> **!** NOTICE: Endress+Hauser recommends cleaning the optical components when the signal strength is below 80%.

Using solvents to clean the optical components

When using solvents to clean the optical components, ensure the solvent used is compatible with the sealing material of the sensors.

Cleaning the mirror and lens

Fig. 37: Location of the mirror in the oxygen measuring probe
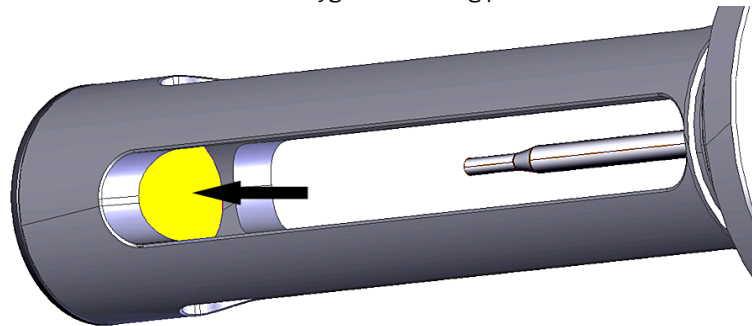
Fig. 38: Location of the lens in the oxygen measuring probe
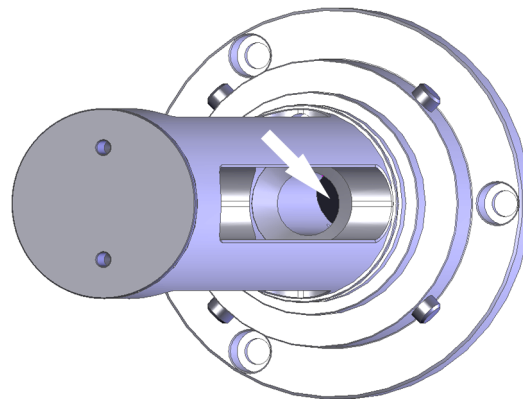
> **!** NOTICE: Do not damage the lens
> The lens is located in a ø 11.5 mm cavity and is hard to reach. (See arrow in Fig. 47)

1 Remove the filter. Instructions, see "Cleaning the filter", page 87.
2 Use a jet of clean air to clean loose particles off the mirror (instrument air or better). Continue with step 3 when the optics are still contaminated.
3 Tip distilled water with soap mixed in onto the mirror and let it work.
4 Then rinse with distilled water.
5 Dry with compressed air (instrument air or better quality).
6 If the surface is still contaminated, tip pure ethanol or isopropanol onto the surfaces. Let the chemicals work in for maximum 15 minutes.
7 Rinse the optical components with distilled water after cleaning.
8 Dry with compressed air (instrument air or better quality).
9 After cleaning, the surface should appear clean without oil stains, contamination or dust. Refit the filters after cleaning.

> **!** **NOTICE:** Damage to the lens and mirror through mechanical cleaning.
> During the cleaning process described above, never attempt to clean the optical components by rubbing (e.g., with cotton swabs or cleaning a cloth).

> **+i** Cleaning the TRANSIC121LP optics is easiest with an optics cleaning set from Endress+Hauser. Part No., see "Spare parts", page 88.

7.1.3 Filter maintenance

> **+i** **NOTICE:** Control the filter regularly.
> ▶ Check the filter regularly.
> ▶ Change the filter when clogged.

> ⚠️ **WARNING:** The filter can contain acidic or toxic substances
> ▶ Observe relevant safety regulations.
> ▶ Depending on its components, the filter must be disposed of according to legal regulations, or as hazardous waste when necessary.

Checking the PTFE filter

The PTFE filter needs to be checked and exchanged regularly to provide adequate gas flow to the sensor volume.

Replacing the PTFE filter:

1 The PTFE filter is retained by an O-ring on the base of the transmitter measuring probe. Grasp the filter firmly, slide it over the O-ring and pull the filter out. Only grip the filter as described above. Remove the used O-ring seal.

2 Replace the O-ring seal with a new one. Roll the seal carefully into the groove at the base of the oxygen measuring probe. Be careful not to damage the O-ring by excessive sliding or friction along the metal edges of the probe.

3 When the filter end is to be lubricated to ease installation, only use inert, oxygen-compatible lubricants suitable for seals and the process, such as, for example, DuPont Krytox®. Slide and lock the filter into place by holding the filter only by the solid part at the open end of the filter or (if necessary) by pressing at the closed tip of the filter with your fingers.

Fig. 39: Stainless steel filters and PTFE filters
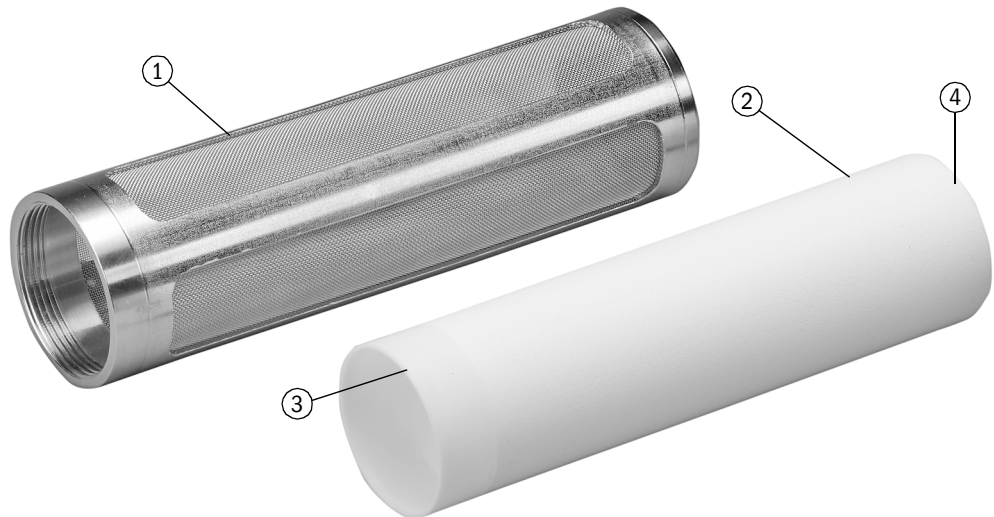
1	Stainless steel filter
2	PTFE filter
3 + 4	Positions that can be touched by hand

7.1.4   Cleaning the filter

Cleaning the stainless steel filter

1 Remove the filter from the TRANSIC121LP.
2 Clean the filter.
3 Dry the filter thoroughly.
4 Ensure air can flow through the filter mesh.
5 Refit the filter.

The stainless steel filter needs to be replaced when it remains dirty or clogged despite thorough cleaning. Part No., see "Spare parts and accessories", page 88.

PTFE filter

> **!** **NOTICE**: Never touch the PTFE filter surfaces
> ► Only touch the PTFE filter as marked in Figure Page 86. Avoid touching, rubbing or scraping the active surfaces of the PTFE filter as this can clog the filter.

The PTFE filter protects the optical components against liquids and dust. It is permeable to water vapor and solvents.

7.2   Spare parts and accessories

Spare parts

Designation	Order code
Set, flange seal, FKM	2064909
Set, flange seal, GYLON	2060195
Set, O-ring 47* 2, FKM (bayonet connection)	2064907
Set, O-ring 47* 2, KALREZ (bayonet connection)	2060193
Steel mesh filter	2060192
Set, steel mesh filter, PTFE filter, seal FKM	2064911
Set, steel mesh filter, PTFE filter, seal Kalrez	2060191
Set, O-ring 33.05* 1.78 FKM (filter)	2064917
Set, O-ring 33.05* 1.78 Kalrez (filter)	2060184
PTFE filter	2060181
Set, PTFE filter, seal FKM	2064918
Set, PTFE filter, seal Kalrez	2060099
Screw fitting M20*1.5 to 1/2"NPTf CUZN	2060179

Accessories

Designation	Order code
Set, flange assembly, M5 FKM 0.5 bar	2064905
Set, flange assembly, M5 Kalrez 0.5 bar	2060196
Set, flange assembly, M8 FKM PN10	2068216
Set, flange assembly, M8 Kalrez PN10	2068214
Set, flange assembly, clamping flange, FKM PN10	2068359
Set, flange assembly, clamping flange, Kalrez PN10	2068225
Set, flange assembly, welding adapter, FKM PN10	2068358
Set, flange assembly, welding adapter, Kalrez PN10	2068224
Set, sample gas cell, with seal FKM	2064906
Set, sample gas cell, with seal Kalrez	2060194
Assembly bracket for sample gas cell wall fitting	4066692
Set, wall fitting	2060176
Interface cable, serial	2059595
Weather protection (flange assembly)	2065120
Weather protection (wall assembly)	2065084
PELV power supply unit, 100-240VAC/24V/50W	7028789
Optics, cleaning set	2072979

8   Troubleshooting

8.1   Function errors

The TRANSIC121LP monitors its operation. Monitoring includes:

1 Self-test
2 Error detection during operation
3 Error output

8.1.1   Self-test

A self-test is always carried out when the TRANSIC121LP is switched on.

External conditions can cause the self-test to fail, for example, when the lens or mirror are steamed up due to strong condensation in the probe. The signal level is insufficient. The TRANSIC121LP is reset after 10 minutes when the self-test fails due to external factors.

8.1.2   Error control and error categories

There are 3 error categories:

● Fatal errors: Lead to a permanent error state.
● Nonfatal errors: Deactivated automatically when certain conditions are fulfilled. These errors can also be deactivated manually.
● Warnings: Measurement continues but a maintenance request is reported. Warnings can be deactivated manually.

All errors are always cleared during a start.
All error events are stored in an EEPROM error memory.

8.1.3 TRANSIC121LP behavior when errors occur

TRANSIC121LP	Fatal error	Non-fatal error	Warnings
Analog output	Programmable, Fail High or Fail Low	Programmable, Fail High or Fail Low Standard = 3 mA	Normal operation
LED	Red LED blinks rapidly	Red LED blinks slowly	Yellow LED blinks
Digital output	Open	Open	Closed; optional: Open when the digital output is used for signaling warnings.
Display	Error codes are displayed	Error codes are displayed	Measured value is displayed
Maintenance interface	STOP mode: Sends error message RUN mode: O2 value = ***.** POLL mode: O2 value = ***.**	STOP mode: Sends error message RUN mode: O2 value = ***.** POLL mode: O2 value = ***.**	STOP mode: Sends error message RUN mode: Normal operation POLL mode: Normal operation
Error counter	Error counter(s) incremented	Error counter(s) incremented	Error counter(s) incremented
Error log	Error is written to log	Error is written to log	Error is written to log

Table 11: Device status for error and warnings

Emergency shutdown state

If a processor or memory error occurs, the TRANSIC121LP switches to the emergency shutdown state and cannot be started:

Analog output	0.0 mA
LED	Red LED on
Digital output	Open

8.1.4 Error display

Via keypad, see "Display of active and undeleted errors (ERR)", page 35.

8.1.5 Error Table

The Error Table shows the errors detected by the TRANSIC121LP software. The most severe errors are listed first. The error text associated with each error gives a description of the error cause.

Error No.	Error category	Error text	Cause
1	FATAL	EEPROM BASIC PARAMS NOT AVAILABLE (EEPROM basic parameters not available)	Error in EEPROM (Contact Endress+Hauser Customer Service)
2	FATAL	EEPROM OPERATION PARAMS NOT AVAILABLE	Error in EEPROM (Contact Endress+Hauser Customer Service)
3	FATAL	LASER CURRENT OUT OF RANGE	Error in laser control (Contact Endress+Hauser Customer Service)
4	FATAL	SIGNAL LEVEL HIGH	Signal level high Typical: Light incidence too strong Use a filter, see "Spare parts", page 88.
5	FATAL	LASER TEMPERATURE SENSOR FAILURE	Laser temperature sensor error (Contact Endress+Hauser Customer Service)
6	FATAL	GAS 1 TEMPERATURE SENSOR FAILURE	Temperature sensor error, process gas (Contact Endress+Hauser Customer Service)
7	FATAL	GAS 2 TEMPERATURE SENSOR FAILURE	Temperature sensor error, enclosure (Contact Endress+Hauser Customer Service)
8	FATAL	IO-EXPANDER CONNECTION	Hardware error (Contact Endress+Hauser Customer Service)

Table 12: Error Table

Error No.	Error category	Error text	Cause
9	FATAL	LCD-DRIVER CONNECTION	No connection with display (Contact Endress+Hauser Customer Service)
10	FATAL	ADC2	Hardware error (Contact Endress+Hauser Customer Service)
11	FATAL	DIGIPOT CONNECTION	No connection with digital potentiometer (gain and offset control) (Contact Endress+Hauser Customer Service)
12	FATAL	PELTIER	Error in laser block/hardware error (Contact Endress+Hauser Customer Service)
13	FATAL	LASER CURRENT MEASURE-MENT	Laser current error/hardware error (Contact Endress+Hauser Customer Service)
14	FATAL	FRONT END CONTROLS	Hardware error (Contact Endress+Hauser Customer Service)
15	FATAL	PELTIER CURRENT SENSE	Peltier current direction/hardware error (Contact Endress+Hauser Customer Service)
16	FATAL	VAC LIMIT REACHED	Laser aging allows wavelength to drift/hardware error (Contact Endress+Hauser Customer Service)
17	FATAL	SUPPLY VOLTAGES	Supply voltage outside the allowed range. Check voltage supply/cables.
31	NONFATAL	SIGNAL LEVEL LOW	Signal level low. Check optical components for contamination.
32	NONFATAL	SIGNAL CUT	Signal interrupted. Check optical path. Check optical components for contamination.
33	NONFATAL	LASER TEMPERATURE NOT REACHED	Laser temperature has not been reached. Check ambient conditions (temperature).
34	NONFATAL	PEAK LOST	Absorption line lost. Not enough oxygen in enclosure.
35	NONFATAL	TOO LOW SUPPLY VOLTAGE	Supply voltage outside the allowed range. Check voltage supply/cables.
36	NONFATAL	ANALOG OUTPUT LOAD TOO HIGH	Analog output load too high. Check specifications for voltage supply unit and cables. (See Technical Data, Page 100).
37	NONFATAL	NO MEASUREMENT RESULTS	No measuring results (results from other errors)
38	NONFATAL	ANALOG OUTPUT RANGE	Oxygen concentration value measured outside set output range. Adjust the output range settings when necessary.
51	WARNING	SIGNAL QUITE LOW	Transmission (SIL) <20% Maintenance request for optical components, see "Cleaning the optical components", page 84.
52	WARNING	EEPROM LOG&STATS CORRUPTED	Non-critical hardware error: EEPROM protocol and statistics erroneous. (Contact Endress+Hauser Customer Service)
53	WARNING	WATCHDOG RESET OCCURRED	Reset through software error.

Table 12: Error Table

9 Shutdown

9.1 Safety information: Shutting down

- TRANSIC121LP: Open the display cover only for operation purposes. Never open the side covers when voltage is switched on.

> **CAUTION:** Never divert the laser beam
> Never insert an optical instrument into the measuring gap to possibly divert the laser beam whilst the TRANSIC121LP is switched on.

All safety regulations for shutdown can be found in Section *Installation* under "Installation", page 18 and in Section *Maintenance* under "Safety information for assembly and maintenance work", page 83.

9.2 Preparations for shutdown

- ▶ Inform all connected locations.
- ▶ Passivate/deactivate the safety devices.
- ▶ Stop the inflow.
- ▶ Save the data.

9.3 Switching the TRANSIC121LP off

- ▶ Switch the TRANSIC121LP voltage supply off.

9.4 Protecting a shutdown TRANSIC121LP

- ▶ Store in a protected, dust-free and dry place.
- ▶ Observe the storage temperature (see "Ambient conditions", page 99).

9.5 Disposal

- ▶ The TRANSIC121LP can easily be disassembled into its components which can then be sent to the respective raw material recycling facilities.
- ▶ Dispose of the TRANSIC121LP as industrial waste.

> ▶ Observe the respective valid local regulations for the disposal of industrial waste.

9.6 Shipping the TRANSIC121LP to Endress+Hauser

> **NOTICE:** Hazard through process residues on the device
> ▶ Clean the TRANSIC121LP before shipping to Endress+Hauser.

10   Specifications

10.1   Compliances

The technical design of this device complies with the following EU directives and EN standards:

- Directive 2014/30/EU (Low Voltage Directive, Harmonization of the laws)
- Directive 2011/65/EU (Restriction of the use of certain hazardous substances in electrical and electronic equipment – "RoHS")
- EN 61326-1 (Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements (IEC 61326-1:2012))
- EN 50581 (Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances)

10.1.1   Electrical protection

- Protection class III: Low voltage protection
- Safety requirements in accordance with DIN EN IEC 61010-1:2011.
- Supply with low voltage protection PELV (in accordance with EN 60204).
  A 24V PELV power supply unit is mandatory for supplying the TRANSIC121LP to ensure electrical safety.

10.1.2   Approval in Canada

10.1.3   Canadian Registration Number (CRN)

Province	CRN
Alberta [1]	0F18864.52
British Columbia	0F18864.51
Manitoba	0F18864.54
Ontario	0F18864.5
Quebec	CSA-0F18864.56
Saskatchewan	CSA-0F18864.56

[1] *Observe the following for product versions with clamping flange:* When a clamping flange is used in Alberta, a clamping flange with CRN approval of a third-party supplier must be used.

10.1.4   Technical limit values for Canada

CRN No.	0F18864.51
Maximum Allowable Working Pressure (MAWP)	150 psi (10 bar)
Minimum Design Metal Temperature (MDMT)	−4 … 176 °F (−20 … 80 °C)

10.2   Ex approvals

| EX |
– FM approval: Class I, Division 2
  FM sensor approval: Class I, Division 1 and 2
– Gas groups A, B, C, D
– Approved for installation indoors and outdoors with enclosure classification IP66
– Temperature class: T4

10.3   Technical Data

+i   The TRANSIC121LP equipment depends on the application.
      Refer to the system documentation delivered with the TRANSIC121LP for the fitted
      equipment.

10.3.1   Dimensions and drill pattern

Fig. 40: Dimensions and drill holes, wall bracket in mm (inches)
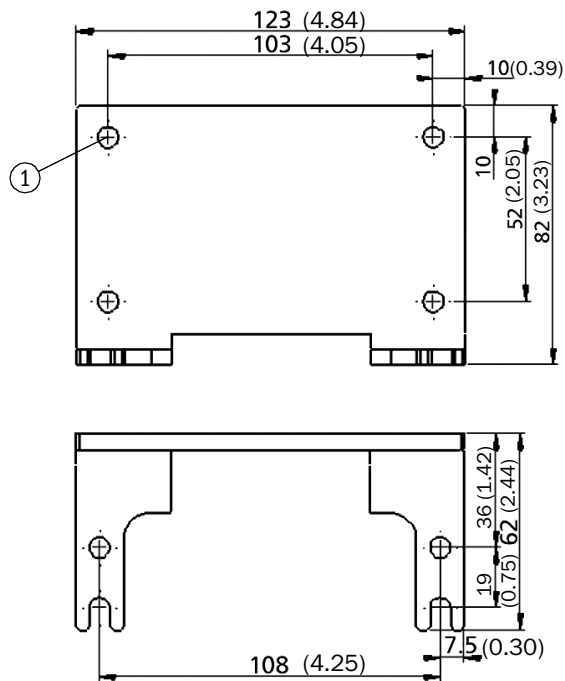
All specifications in mm (inches)

1   =   ø 6.5 mm, four pieces

Fig. 41: Dimensions, fitting the flange with M5 screws suitable up to 0.5 bar (7.25 psi)
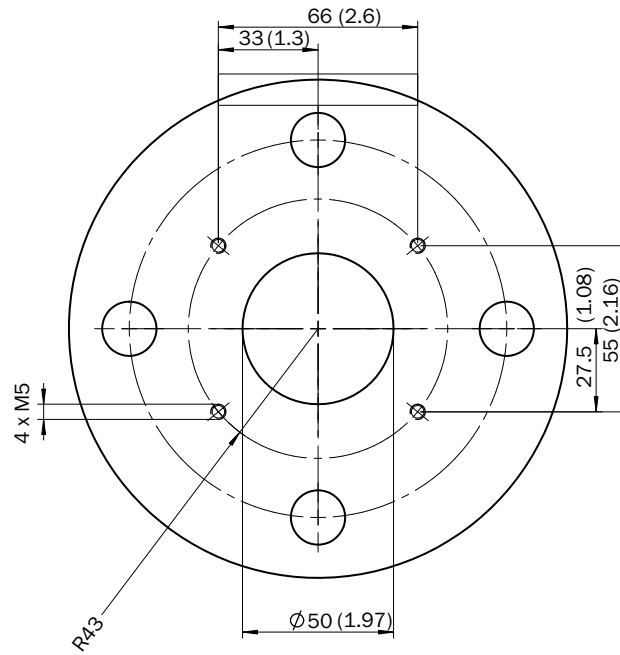
All specifications in mm (inches)

When installing with a tube with an outer diameter > 80 mm, do *not* drill M5 through-holes to prevent leakage from the process.

Fig. 42: Dimensions, fitting the flange with M8 screws suitable for PS=10 bar (150 psi)
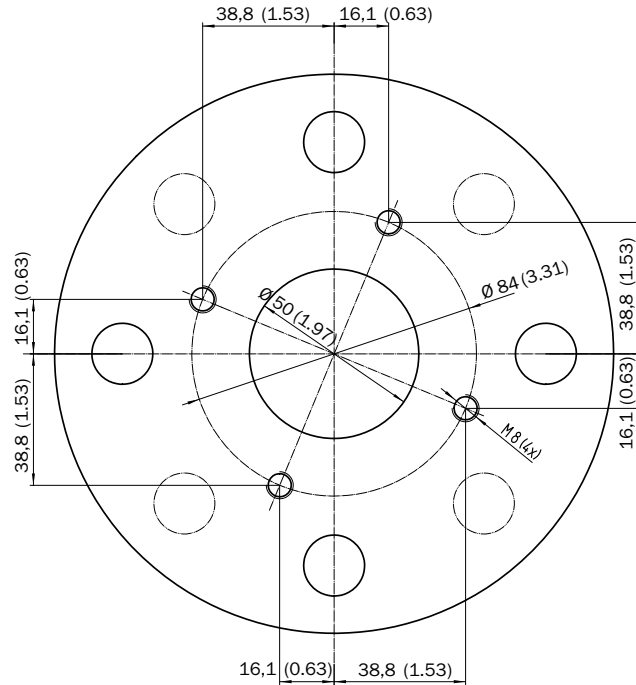
All specifications in mm (inches)

Fig. 43: Adapter flange, clamping flange DIN32676 3"/DN65, suitable for PS= 10 bar (150 psi)
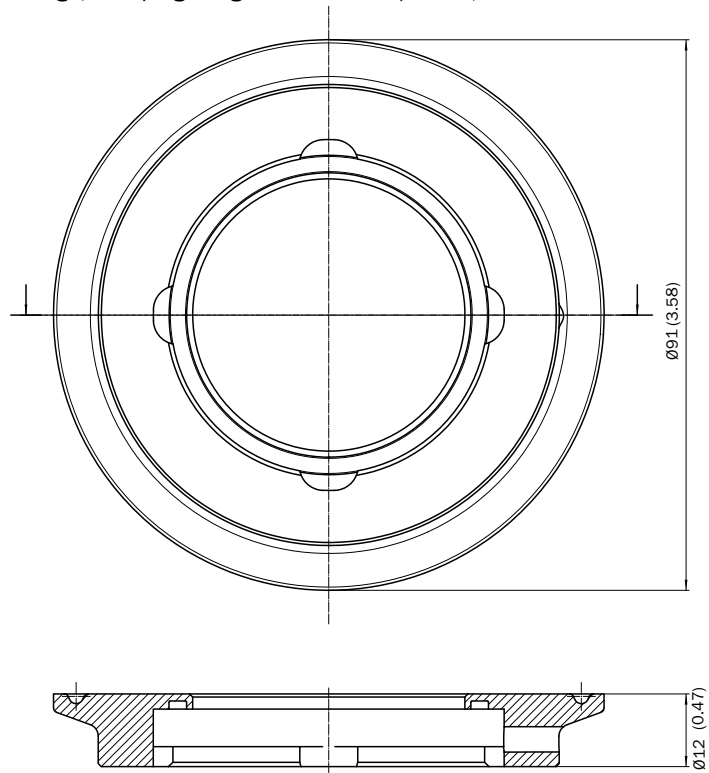
All specifications in mm (inches)

Fig. 44: Adapter flange, weldable, suitable for PS = 10 bar (150 psi)
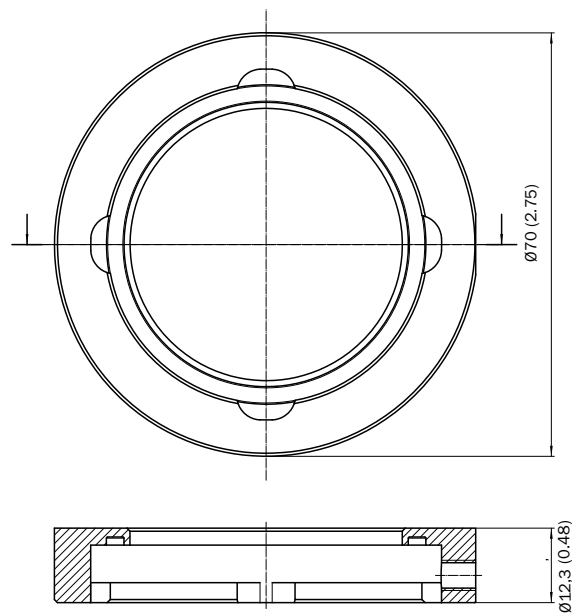
All specifications in mm (inches)

Fig. 45: TRANSIC121LP with flange adapter for process measurements
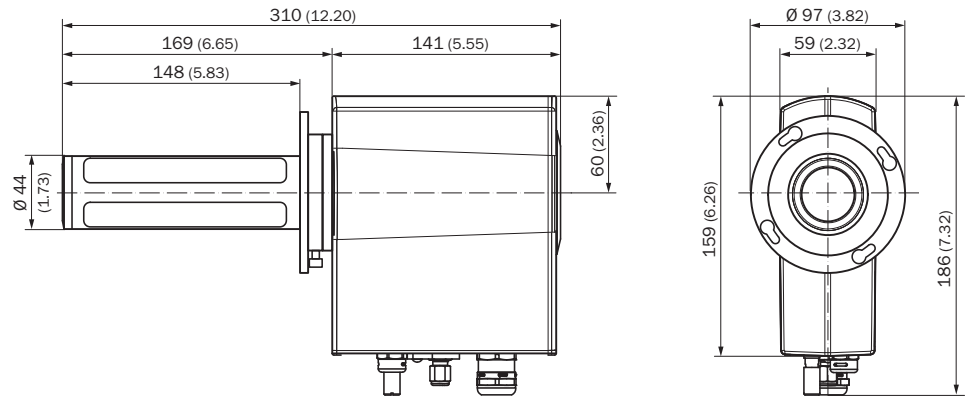
All specifications in mm (inches)

Fig. 46: TRANSIC121LP with wall bracket for ambient measurements
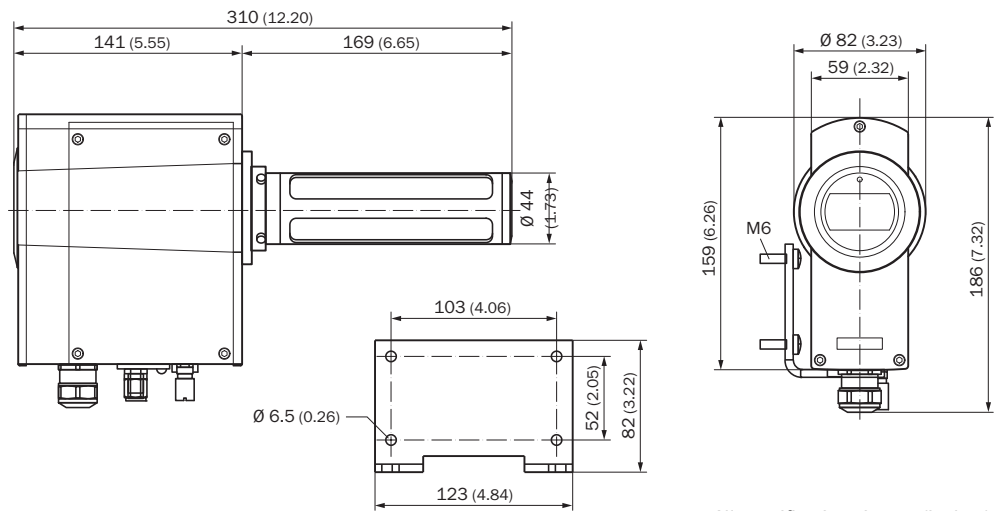
All specifications in mm (inches)

Fig. 47: TRANSIC121LP with wall bracket and sample gas cell, suitable for PS=10 bar (150 psi)

All specifications in mm (inches)

Fig. 48: TRANSIC121LP, weatherproof cover for wall fitting

All specifications in mm (inches)

Fig. 49: TRANSIC121LP weatherproof cover for flange fitting
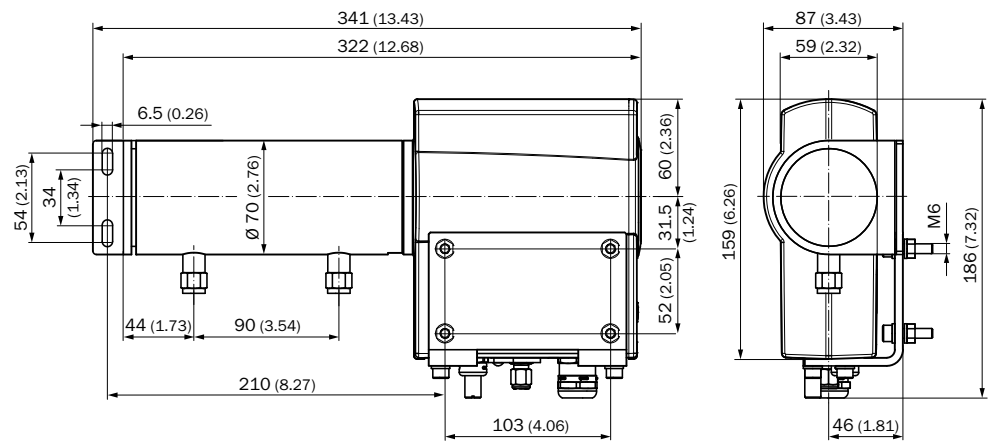
All specifications in mm (inches)

10.3.2 Measured value recording

Measuring ranges (scalable) ● Version for process measurement ● Version for ambient gas measurement	0 ... 21% O_2 2 ... 21% O_2
Precision	±0.2% O_2
Temperature dependence in T-range	±2% of measured value, max. dT/dt 1 °C/min
Stability	Zero point drift ±0.1% O_2 / year
Measurement response time (T_{63}/T_{90}) in *still* air – without filter – with stainless steel mesh – with stainless steel mesh and PTFE	10 s / 20 s 10 s / 25 s 30 s / 70 s
Operating pressure range	0.8 ... 1.4 bar(a) (11.6 ... 16.5 psi)
Start time	2.5 min
Warming up time (according to specification)	3 min

Display	7-segment LCD
LED	Two-colored: Red/green

10.3.3 Ambient conditions

Operation location	● Outdoors or indoors. ● No direct sunlight. Use a weatherproof cover when necessary.
Operating temperature range[1] – for probe (installed in process) – for electronics (housing) – for TRANSIC121LP (ambient air measurement)	−20 ... 80 °C (−4 ... 176 °F) −20 ... 60 °C (−4 ... 140 °F) −20 ... 60 °C (−4 ... 140 °F)
Storage temperature range	−40 ... 80 °C (−40 ... 176 °F)
Operating pressure range (measuring condition)	0.8 ... 1.4 bar(a), (11.6 ... 16.5 psi)
Air humidity	100% r.h. non-condensing
Altitude	Up to 2000 above sea level
Electrical compliance	In accordance with DIN EN 61010-1
EMC	In accordance with DIN EN 61326-1
Safety information	Laser product of protection class 1 (IEC 60825-1:2014-05); for information on eye-safe use of the TRANSIC121LP, see Page 9.

[1] MDMT specification for Canada, see "Technical limit values for Canada", page 93.

10.3.4   TRANSIC121LP inputs and outputs

Interfaces	
Voltage supply Allowed input range	11 … 36 V DC PELV
Power input Maximum Typical	6 W at 80 °C 3 W at 25 °C
Maximum power consumption U_{in} = 11 VDC U_{in} = 24 VDC	550 mA 250 mA
Analog output Maximum load Precision Temperature dependence	0/4 … 20 mA, source 500 Ω ±0.05% of full-scale value ±0,005% / °C
Serial output (2-wire, not isolated)	RS-485
Alarm/control relay	30 VAC, 1 A/ 60 VDC, 0.5 A
Serial output (NOTE: Only for maintenance)	RS-232C
Connections	Screw terminals, 0.5…1.5 mm² RJ45 connection for RS-232C
Display	7-segment LCD
LED	Two-colored: Red/green
Resistance between signal ground and ground	10 MΩ

10.3.5   Dimensions and mechanics

Dimensions	TRANSIC121LP transmitter
Transmitter dimensions (H × W × D)	306 × 184 × 74 mm³ (12.05 x 7.24 x 2.91 inch³)
Weight	2.2 kg (4.85 lbs)
Enclosure material	G-AlSi10Mg (DIN 1725)
Enclosure classification	IP66
Flange	Can be attached to DIN/ANSI standard flanges. Minimum flange sizes: ● DIN EN 1092 DN50: Fitted with M16 DIN 933 or similar ● ANSI ASME B16.5 (150) 2.5": Fitted with UNC 3/4"-10 or similar
Cable bushing	● Cable gland M20×1.5 ● Conduit screw fitting 1/2" NPT
Filter	● Stainless steel mesh, holes 0.31 mm, wire thickness 0.2 mm ● Hydrophobic PTFE filter, average pore size 8 μm
Materials with sample gas contact	● AISI 316 L(1.4404) ● FKM or Kalrez® Spectrum 6375 ● PTFE, SiN, MgF_2, quartz ● Polymer coating

10.3.6   Pressure suitability

For plant design[1]	• TS_{min}: −20 °C (−4 °F) • TS_{max}: 80 °C (176 °F) • PS: 10 bar (150 psi) [2] • V: 0.28 L • DN: 50 ... 65 mm (2" ... 3")

[1] Outside the measuring range (e.g., in error case); valid for transmitter, seals, sample gas cell and flange adapter with M8 screws). Not valid for flange adapter with M5 screws (0.5 bar).
[2] MAWP specification for Canada, see "Technical limit values for Canada", page 93.

! NOTICE:
▶ Do not use the TRANSIC121LP for unstable gases (e.g. acetylene).
▶ Observe local regulations with regard to pressure.
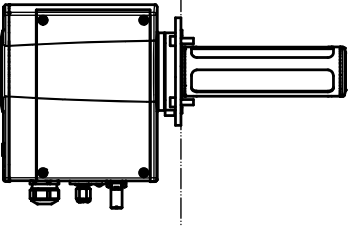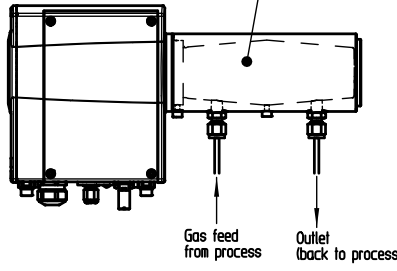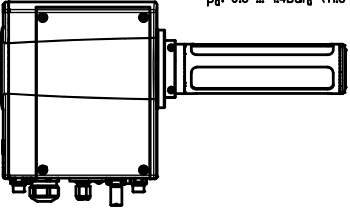
10.3.7   Options and accessories

Options	
Hydrophobic PTFE filter	Hydrophobic PTFE filter, average Pore size 8 µm
Sample gas cell volumes	V: 0.28 L
T_{90} response time with 1 l/min gas sample flow rate Sample gas cell weight	11 s 2.2 kg

10.4   Control drawing

CONTROL DRAWING
Installation and wiring instructions for nonincendive safe operation of the TRANSIC121LP

TRANSIC121LP Oxygen Transmitter is approved for Class I, Division 2, Groups A, B, C and D.
Sensor for Class I, Division 1 and 2, Groups A, B, C and D hazardous indoor and outdoor
locations with an enclosure rating IP66. Temperature class T4.

In-line installation

**Class I
Division 2**

Ambient environment

O_2: Normal ambient O_2 concentration constant 21Vol% O_2
T_a: -20 … +60°C (-4 … 140°F)
p_a: Normal ambient pressure variations only

**Class I
Division 1, 2**

Measurement environment
(process side)

O_2: 0 … 25Vol% O_2
T_p: -20 … +80°C (-4 … 176°F)
p_p: 0.8 … 1.4bar$_a$ (11.6 … 20.3psi)
PSmax=10bar, V=0.28L,
DN=50mm (2") / 65mm (3")

Sample cell installation

**Class I
Division 2**

Ambient environment

O_2: Normall ambient O_2 concentration, constant 21Vol% O_2
T_a: -20 … +60°C
p_a: Normal ambient pressure variations only

**Class I
Division 1, 2**

Measurement environment
(sampling cell contents)

O_2: 0 … 25Vol% O_2
T_p: -20 … +80°C (-4 … 176°F)
p_p: 0.8 … 1.4bar$_a$ (11.6 … 20.3psi)
PSmax=10bar, V=0.28L,
DN=50mm (2") / 65mm (3")

Gas feed
from process

Outlet
(back to process)

Ambient measurement

**Class I
Division 2**

Measurement environment
Entire transmitter in varying O_2 concentration

O_2: 2 … 25Vol% O_2
T_a: -20 … +50°C (-4 … 122°F)
p_a: 0.8 … 1.4bar$_a$ (11.6 … 20.3psi)

INSTALLATION NOTES:

Uin = 11 … 36VDC, Pmax = 6VA

For screw terminal connections use conductor AWG 20-16.

Always connect unpowered wires to transmitter to avoid sparks on hazardous area.
Make sure that power on switch under yellow protective cover is in ON position before making any wiring.

Install using Division 2 wiring methods as specified by the NEC or CEC, as applicable.

11   Annex

11.1   Type code

TRANSIC Oxygen Transmitter			TRANSIC121LP-	
Version	In-situ (measuring range: 0 … 25 vol% O_2)	With flange adapter <0.5 bar		A
	Ambient measurement (measuring range 2 … 25 vol% O_2)	With wall bracket		B
	Extractive (measuring range: 0… 25 vol% O_2)	With sample gas cell PN10 and wall bracket		C
	In-situ (measuring range: 0 … 25 vol% O_2)	With flange adapter PN10		F
	In-situ (measuring range: 0 … 25 vol% O_2)	With welding adapter PN10		G
	In-situ (measuring range: 0 … 25 vol% O_2)	With 3" clamping flange PN10		H
Filter type[1]		No filter [2]	1	
		Stainless steel mesh	2	
		PTFE filter with stainless steel mesh	3	
Output range[3] (configurable during start-up)[4]		O_2 (0 … 5 vol%)		A
		O_2 (0 … 10 vol%)		B
		O_2 (0 … 15 vol%)		C
		O_2 (0 … 20 vol%)		D
		O_2 (0 … 25 vol%)		E
	Output range from	_____vol% O_2 to _____vol% O_2		X
Analog output[5] (configurable during start-up)[4]		4 … 20 mA	1	
		0 … 20 mA	2	
Error status for analog output (configurable during start-up)[4]		≤ 3 mA		A
		≥ 21 mA		B
Digital output (configurable during start-up)[4][6] Lower limit value: _____ vol% O_2 → Upper limit value: _____ vol% O_2 →		Digital output only opens when an error status exists	1	
		Digital output opens when the measured value underflows the lower limit value	2	
		Digital output opens when the measured value exceeds the upper limit value	3	
		Digital output opens for maintenance request	4	
Cable ducts[7]		Cable gland Ex M20 x 1.5 for cable Ø 8 … 11 mm		A
		Conduit screw fitting Ex 1/2" NPTf for inner thread		B
Span gas inlet		Without	1	
		Span gas inlet with non-return valve[8]	2	
Operating Instructions language		English		B
		German		C
		Spanish		D
		French		F
Approval		FM (USA and Canada)	1	
Mirror[9]	Mirrored front side – seal made of:	FFKM Kalrez® Spectrum (original)		B
		FKM FIM approval		C
	Mirrored rear side – seal made of:	FFKM Kalrez® Spectrum (original)		F
		FKM FIM approval		G

[1] *Recommendation:* Do not use PTFE filter for wet gases near the dew point.
[2] Only for use in clean gas or with a sample gas cell.
[3] Specifications only apply to the measuring range 0 … 25 vol% O_2.
[4] Requires service interface cable. Only perform outside potentially explosive atmospheres.
[5] Error status 3 mA only selectable for 4 … 20 mA.
[6] Standard setting: 10 vol%, 1 % hysteresis.
[7] Observe cable length (see Technical Data).
[8] *Recommendation:* Install a PTFE filter in the reference gas inlet.
[9] Mirror made of gold. Sensor material: Stainless steel 1.4404 (316 L).

Example: TRANSIC121LP- A 2 B 1 A 1 A 1 A 1 C

11.2 Humidity Conversion Table

Humidity value (absolute) in g/m³ H_2O

T(°C) \ (% r.h.)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
-40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
-20	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
-15	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2
-10	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
-5	0	0	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3
0	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5
5	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7
10	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	8	9	9
15	1	1	2	3	3	4	4	5	6	6	7	8	8	9	10	10	11	12	12	13
20	1	2	3	3	4	5	6	7	8	9	10	10	11	12	13	14	15	16	16	17
25	1	2	3	5	6	7	8	9	10	12	13	14	15	16	17	18	20	21	22	23
30	2	3	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	30
35	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
40	3	5	8	10	13	15	18	20	23	26	28	31	33	36	38	41	43	46	49	51
45	3	7	10	13	16	20	23	26	29	33	36	39	43	46	49	52	56	59	62	65
50	4	8	12	17	21	25	29	33	37	41	46	50	54	58	62	66	70	75	79	83
55	5	10	16	21	26	31	36	42	47	52	57	62	68	73	78	83	88	94	99	104
60	6	13	19	26	32	39	45	52	58	65	71	78	84	91	97	104	110	117	123	130
65	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	161
70	10	20	30	39	49	59	69	79	89	99	108	118	128	138	148	158	168	177	187	197
75	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240
80	15	29	44	58	73	87	102	116	131	146	160	175	189	204	218	233	247	262	277	291

Table 13: Humidity Conversion Table

11.3 Influence of background gases on oxygen measurement

Table for the influence of background gases on oxygen measurement

Gas	Coefficient	Unit
Acetone / Propanone (C_3H_6O)	−0.51	% of reading / (vol% acetone)
Acetylene / Ethyne (C_2H_2)	−0.47	% of reading / (vol% acetylene)
Argon (Ar)	+0.12	% of reading / (vol% argon)
Ethene (C_2H_4)	−0.53	% of reading / (vol% ethene)
Ethane (C_2H_6)	−0.49	% of reading / (vol% ethane)
Propane (C_3H_8)	−0.75	% of reading/ (Vol% propane)
Butane (C_4H_{10})	−1.02	% of reading / (vol% butane)
1-Butene (C_4H_8)	−0.89	% of reading / (vol% 1-butene)
Isopentane / 2-Methylbutane (C_5H_{12})	−0.71	% of reading / (vol% isopentane)
n-Hexane (C_6H_{14})	−0.90	% of reading / (vol% n-hexane)
Methane (CH_4)	−0.30	% of reading / (vol% methane)
Carbon monoxide (CO)	−0.06	% of reading / (vol% carbon monoxide)
Carbon dioxide (CO_2)	−0.15	% of reading / (vol% carbon dioxide)
Cyclohexane (C6H12)	−0.80	% of reading / (vol% carbon cyclohexane)
Dichloromethane (CH_2CL_2)	−0.38	% of reading / (vol% dichloromethane)
Dimethyl ether (C_2H_6O)	−0.44	% of reading / (vol% dimethyl ether)
Ethanol (C_2H_6O)	−0.32	% of reading / (vol% ethanol)
Hydrogen (H_2)	−0.48	% of reading / (vol% hydrogen)
Water (H_2O)	−0.03	% of reading / (g/m^3 water)
Helium (He)	+0.26	% of reading / (vol% helium)
Methyl isobutyl ketone ($C_6H_{12}O$)	−0.88	% of reading / (vol% methyl isobutyl ketone)
Novec^{TM}71	−0.61	% of reading / (vol% Novec^{TM}71)
Propanol (C_3H_8O)	−0.41	% of reading / (vol% propanol)
Tetrahydrofuran (C_4H_8O)	−0.58	% of reading / (vol% tetrahydrofuran)
Toluene (C_7H_8)	−0.74	% of reading / (vol% toluene)
Xylene (C_8H_{10})	−0.62	% of reading / (vol% xylene)

Example:

Gas mixture:	10% O_2
(all concentrations in vol%)	20% CH_4
	20% C_2H_6
	50% N_2
Relative error:	-0.3 x (20% CH_4) + -0.49 x (20% C_2H_6) = -15.8%
Absolute error:	10% O_2 x -0.158 = -1.58% O_2
TRANSIC121LP reading:	8.42%

> **+i** If you have questions concerning further background gases not listed here, please contact Endress+Hauser Service.

> +i An up-to-date Table *"Influence of background gases on oxygen measurement"* can be requested from Endress+Hauser Service.

11.4   Password

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