Anton Paar

Instruction Manual and Safety Information

L-Dens 3300

Density Sensors

Find out more

www.anton-paar.com

Disclaimer

This document contains information that may affect your safety and your legal rights and obligations. Please read this document carefully as the failure to read and follow the instructions and warnings in this document may result in serious injury to yourself or others, damage to your Anton Paar product, or damage to other objects in the vicinity. This document does not purport to cover every detail or variation in the equipment, nor does it purport to provide for every possible contingency met in connection with safety, installation, operation, or maintenance.

Anton Paar shall not be liable for any damage, injury or legal liability arising directly or indirectly from the use of this document. For details on the warranty and liability of the Anton Paar GmbH and other companies of the Anton Paar Group please refer to the Terms and Conditions on our website (https://www.anton-paar.com/us-en/terms-and-conditions/).

This document may contain errors or omissions. If you find any such errors, or if you would like to add more information to this document, please contact us at the address below. Anton Paar assumes no responsibility for any errors or omissions in this document.

Changes, copyright, trademarks etc.

Address of the producer:
Anton Paar GmbH
Anton-Paar-Str. 20
A-8054 Graz / Austria
Tel: +43 (0) 316 257-0
Fax: +43 (0) 316 257-257
E-Mail: info@anton-paar.com
Web: www.anton-paar.com

Date: November 2025
Document number: E12IB003EN-J
Original instructions

Table of contents

1 Safety instructions

Read the documentation

- Read the documentation before using the product.
- Follow all hints and instructions in the documentation to ensure the correct use and safe functioning of the product.

1.1 General safety instructions

General

- The documentation is a part of the product. Keep it for the complete working life of the product and make it easily accessible to all persons involved with the product. If you receive any additions or revisions from Anton Paar, these must be treated as part of the documentation.
- Additional safety instructions are in the documents supplied depending on the ordered product version. The additional documents are an integral part of this instruction manual. Always comply strictly with the instructions in the additional documents.
- In this document, the designation L-Dens 3300 applies to both types, L-Dens 3300 with HMI and L-Dens 3300 without HMI. If something only applies to one of the two types, it is explicitly stated.

Liability

- This document does not claim to address all safety issues associated with the use of the product and samples. It is your responsibility to establish health and safety practices and to determine the applicability of regulatory limitations.
- Anton Paar only warrants the safe and proper functioning of the product if no modifications are made to mechanics, electronics, or software.
- Use the product only for the purpose described in the documentation. Anton Paar is not liable for damages caused by incorrect use of the product.
- The results delivered by the product depend on the correct function of the product and various other factors. We recommend that you have experts check the results (i.e., perform plausibility testing) before taking consequential actions based on the results.

General precautions

- Check the wetted parts of the product for chemical resistance to all samples and cleaning liquids.
- Comply with the local workplace safety regulations.

Installation

- The installation procedure shall only be carried out by authorized personnel who are familiar with the installation instructions.
- Use only accessories, consumables, or spare parts supplied or approved by Anton Paar.

Using the product

- Ensure that all operators have been trained beforehand to use the product safely and correctly.
- In case of damage or malfunction, stop operating the product. Do not operate the product under conditions that could result in damage to goods or injuries or loss of life.
- Do not operate the product outside its electrical, thermal and mechanical specifications.
- Do not step on the product.

Operation in areas with risk of explosion

- Sensors without an Ex sign are not explosion-proof and therefore must not be operated in areas with risk of explosion.

Service and repairs

- Service and repair procedures may be carried out only by authorized persons or by Anton Paar.

Disposal

- Concerning the disposal of the product, observe the legal requirements in your country. Contact your Anton Paar representative for further questions.

1.2 Conventions for safety messages and typography

Conventions for safety messages

The following conventions for safety messages are used in this document:

DANGER

Description of risk

Danger indicates a hazardous situation which, if not avoided, **will** result in death or serious injury.

WARNING

Description of risk

Warning indicates a hazardous situation which, if not avoided, **could** result in death or serious injury.

CAUTION

Description of risk

Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Description of risk

Notice indicates a situation which, if not avoided, could result in damage to property.

TIP: *Tip gives extra information about the situation at hand.*

1.3 Safety signs on the instrument

NOTICE

It is imperative that the warning signs remain clearly legible.

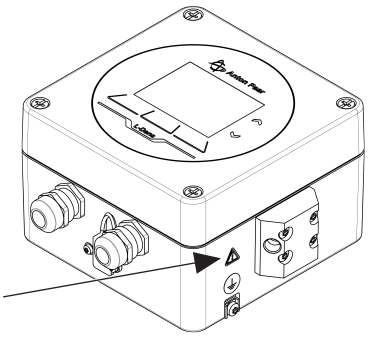


Fig. 1: *Position of warning signs on the instrument*

WARNING

Follow all warnings and cautions listed in this instruction manual.

2 Overview

The L-Dens 3300 with HMI and without HMI are process density sensors with an oscillating U-tube. L-Dens 3300 with HMI comes as an all-in-one solution which consists of an integrated controller, a high-quality display with user interface and capacitive keys. L-Dens 3300 without HMI is the cost-efficient version which has the same features, however, without display and HMI.

They enable continuous measurement of the process density and concentration in lab reactors, pilot plants, and production plants. The wide range of implemented application programs makes these sensors extremely versatile for the petroleum, chemical industry and public research institutes.

L-Dens 3300 provides an economic way of continuously monitoring the density and concentration of your process liquids with an accuracy of 1 x 10^{-3}g/cm³ at low flow rates.

Fig. 2: *L-Dens 3300*

The instrument is available with 2 different materials of the wetted parts:

- Glass
- Stainless steel

Features and benefits

- Economical solution of continuous density and concentration measurement
- 3-digit accuracy
- Stand-alone instrument
- High quality display with capacitive keys
- Wide range of implemented application programs
- Low cost for integration
- Compatible with the Pico 3000 Software

2.1 Intended use of the instrument

The L-Dens density sensors are process measuring instruments which are used for the measurement of density values of low viscous liquids.

For most of the liquid solutions and mixtures the density is directly proportional to the concentration. Therefore, density measurement is used to determine the concentration.

Applications

- Process density measurement
- Process concentration measurement
- Product detection
- Interface detection

Liquids to be measured

- All low-viscous liquids to which the oscillator is resistant
- Alcohol/water solutions
- Sugar/water solutions
- Chemicals (acids, bases, salts, ...)
- Hydrocarbons

3 Installation

WARNING

- Installations must comply with the intended area of use and the relevant national regulations and requirements.
- Installation, maintenance and service work must only be carried out by trained and authorized personnel.
- Make sure that the main line is empty and unpressurized before mounting or dismounting the sensor.
- The lines and instruments can be hot or cold. Wait until the entire station has reached a harmless temperature.

3.1 Installation checklist

1. Choose the location for the installation according to the installation conditions in Section 3.2 [▸ 7] and Section 3.3 [▸ 8].
2. Verify that the technical specifications of the sensor and the process adapter are suitable for the application, for example:
   - resistance of all wetted parts
   - max. and min. ambient and process temperature
   - max. and min. flow
   - max. pressure
3. Connect the sensor to the production line.
4. Make sure all connections are secure and leak-tight.
5. Clean the instrument and pipes of the production line to remove any deposits or contaminations accumulated by the installation process.
6. Perform electrical wiring, refer to Section 3.8 [▸ 11].
7. Apply power to start the measuring system.
8. Ensure that the main line is filled and free of bubbles.
9. Check the measuring results. If necessary, perform an adjustment, refer to Performing an adjustment.

3.2 Installation requirements

3.2.1 Flow rate

The oscillating U-tube principle of Anton Paar process density sensors does not require a flow. The minimum flow rate only indicates a limit to ensure proper temperature equilibrium for a high precision temperature measurement which is necessary for a high precision density measurement. A large difference between the ambient and process temperature in combination with a flow rate below the lower limit may cause deviation from the technical specifications.

The recommended maximum flow rate should not be exceeded to prevent cavitation. If the flow rate of the main pipe is within the flow rate specification of the sensor, the sensor can be installed in the main pipe. If the flow rate in the pipe line is above the upper limit of the flow rate specification, the sensor must be installed in a bypass system.

3.2.2 Vibrations

Strong vibration may influence the measurement. The sensor should be mounted on a rigid, vibration free base. If this is not possible, it is recommended to use vibration dampers (e.g. made of rubber) between the sensor and the mounting base. Vibrations can also be transferred to the sensor via the connection lines. If necessary, use flexible hoses or support them mechanically.

3.2.3 Ambient temperature

If there are major fluctuations of the ambient temperature or large differences between the ambient temperature and the process temperature, the bypass installation needs to be insulated in order to avoid measuring deviations due to the influence of ambient temperature.

NOTICE

Avoid exposing the sensor directly to sunlight.

3.2.4 Process temperature

The temperature dependency of the sensor is determined during the factory adjustment and is compensated in the respective temperature range. Sudden temperature changes need a short equalization time. Temperature changes faster than 1 °C/min may cause deviations in the measuring result.

3.2.5 Line pressure

Consider the maximum pressure rating of the sensor and the connections.

If there is a risk of forming gas bubbles, the line pressure must be higher than P_{min} according to the following definition:

- P_{min} = 2 x partial pressure of the dissolved gas
- P_{min} = 2 x vapor pressure of the volatile liquid components

Use compression type fittings to install the sensor into the pipe.

3.3 Installation point

The sensor operates in any mounting position or orientation and does not need a specific distance from elbows, valves or other equipment unless cavitation is caused.

All recommendations in this chapter are a summary of decades of experience in process measurement.

Fig. 3: *Installation points*

1. Recommended installation point
2. Recommended installation point
3. Do not install the sensor at the very top of a pipework in a horizontal section (the pipe is probably not filled completely)
4. There is always a risk of bubbles at the top of a downstream pipe
5. An installation in a vertical downwards section followed by an upwards section is possible. Just make sure that the pipe is filled. The installation can be an advantage if a lot of particles are in the medium.

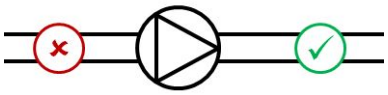


Fig. 4: *Recommended sensor installation with a pump*

Install a sensor at the pressure side of a pump because of risk of bubbles.

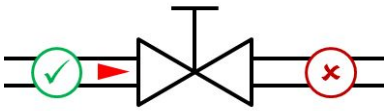


Fig. 5: *Recommended installation with a valve*

Install the sensor upstream a valve because of risk of bubbles.

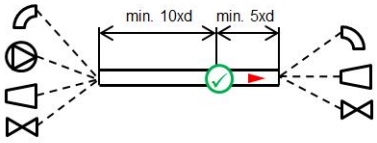


Fig. 6: *Recommended installation - general*

Very often pumps, valves, etc. create bubbles caused by cavitation which will influence a process measurement. We recommend that the distance should be 10 times the pipe diameter before the sensor and 5 times the pipe diameter after the sensor.

3.4 Installation orientation

The sensor can be installed horizontally and vertically.

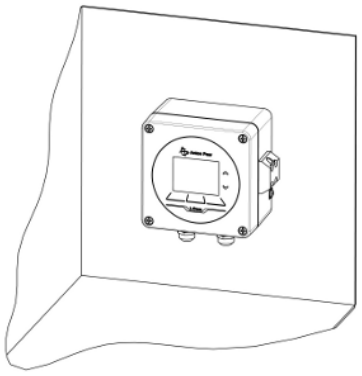


Fig. 7: *Vertical installation*

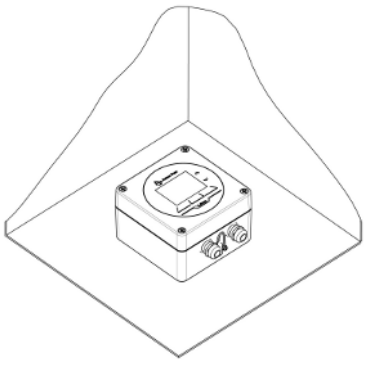


Fig. 8: *Horizontal installation*

3.4.1 Horizontal installation

There is no regulation regarding the flow direction.

3.4.2 Vertical installation

If there is a risk of solid deposits building up in the U-tube the liquid should flow from the upper connection to the lower connection.

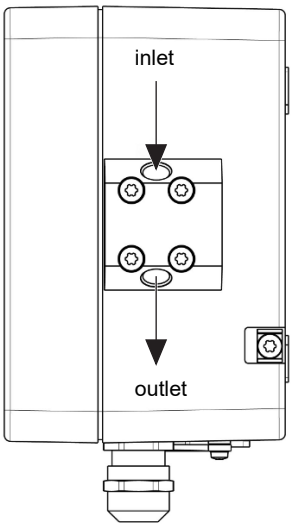


Fig. 9: *Vertical installation with the risk of deposits*

If there is a risk of bubbles forming in the U-tube the liquid should flow from the lower connection to the upper connection.

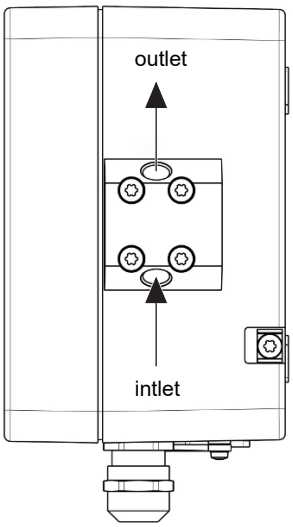


Fig. 10: *Vertical installation with the risk of bubbles forming*

3.5 Mounting

For fixation purposes 4 boreholes are provided in the housing of L-Dens 3300. The boreholes are accessible after lifting the housing cover (loosen of the 4 cross recessed head screws).

M6 screws can be used to fixate the housing.

Screw length = length for the fixation + 25 mm for the housing

NOTICE

- Lift the cover with great care to prevent damage to the cables leading to the display.
- Make sure that the sealing of the cover is not damaged before tightening the cover of the electronics housing.

It is allowed to turn the cover by 180°. It is NOT allowed to turn the cover by 90°, the housing will lose the tightness.

3.6 Process connection

The sensor itself has following process connection:

- DIN ISO 228 G 1/8"; thread depth: 7 mm

To seal an adapter with parallel thread, use the Anton Paar gasket mat. no. 191117 made of FFKM. Do not use a gasket made of PCTFE.

Adapters and gaskets are optionally available. Consider all instructions documents that are delivered together with the process adapter.

You can find the technical details of the adapters in Appendix B [▸ 26].

3.7 Bypass installation

Recommendation

- Hose diameter of the bypass should be min. DN 4.
- Ensure the bypass tubes are short and free of unnecessary bends.
- Place the sensor in the bypass at the same level as the main pipe! This prevents the formation of gas-filled cavities, which may restrict the necessary flow through the sensor, and enables self-emptying.
- We recommend using valves at the inlet and outlet of the bypass, a sample valve for taking reference samples and valves for cleaning the bypass lines.
- There are several options for generating the pressure difference necessary to force a sufficient flow through the bypass.
- Vent the lines after the installation.

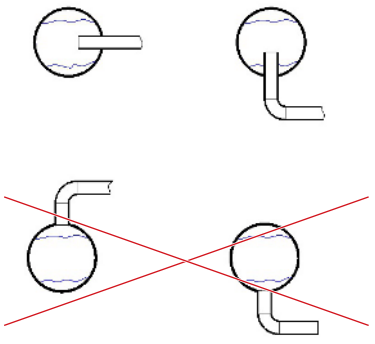


Fig. 11: *Sampling point*

The sampling point of the bypass system should be in the middle of the pipe.

Avoid installing the sampling point at the bottom of the pipe to avoid deposits in the bypass and the sensor.

Do not install the sampling point at the top of the pipe to avoid bubbles in the bypass and the sensor.

How to adjust the flow rate through the bypass:

The method described below applies to aqueous solutions.

1. A pressure gauge is necessary at the outlet of the density sensor.
2. Open the inlet valve to the bypass completely and close the outlet valve.
3. Read the pressure value.
4. Slowly open the outlet valve until the pressure shown on the pressure gauge has dropped 0.1 to 0.5 bar below the pressure you read with the closed valve.

Examples of bypass systems

– **Pressure difference with an orifice**
  – Recommended with a constant flow in the main pipe
  – Inflexible solution

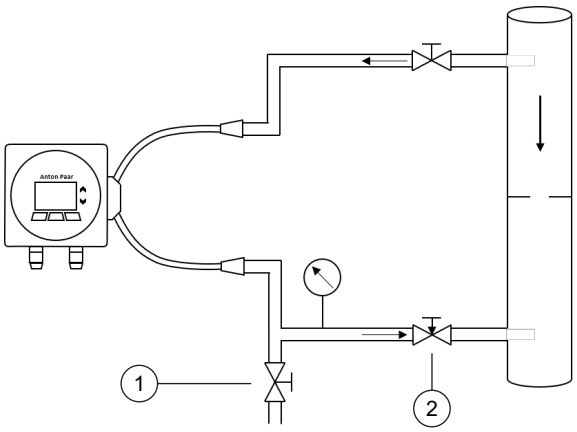


Fig. 12: *Pressure difference with an orifice*

1 Sampling outlet
2 Flow adjustment

– **Pressure difference with a valve**
  – Recommended with a constant flow in the main pipe
  – Needle valve in the main pipe recommended
  – Protect the main valve against manipulation

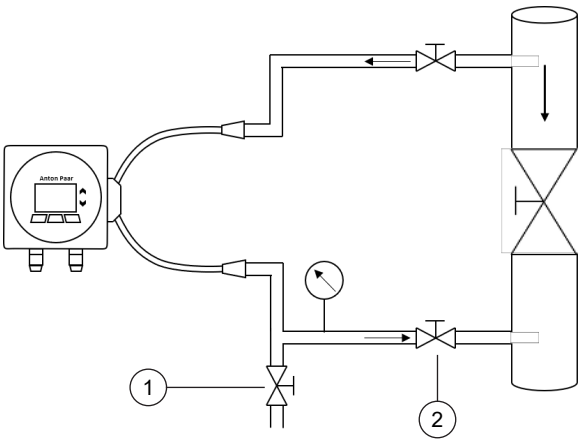


Fig. 13: *Pressure difference with a valve*

1 Sampling outlet
2 Flow adjustment

– **Pressure difference with reduced cross section (Venturi)**
  – Recommended with a constant flow in the main pipe

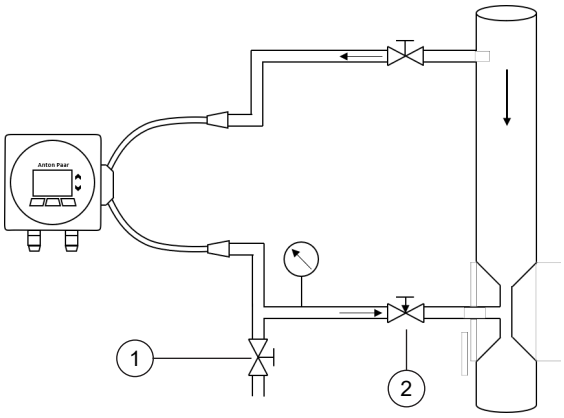


Fig. 14: *Pressure difference with a reduced cross section*

1 Sampling outlet
2 Flow adjustment

– **Pressure difference over a pump**
  – Recommended if the pump works constantly
  – Close the valve after the sensor to adjust the flow (needle valve preferred)

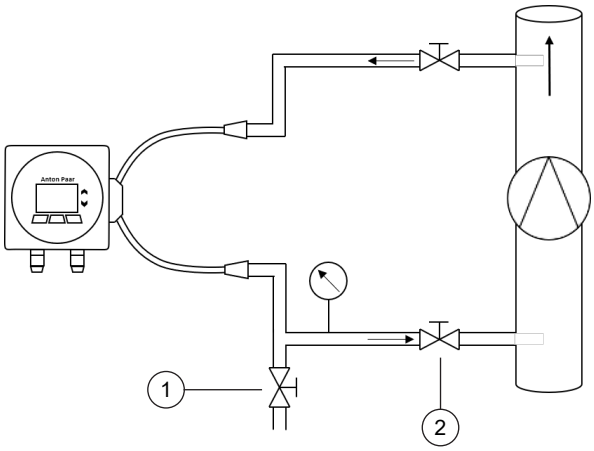


Fig. 15: *Pressure difference over a pump*

1 Sampling outlet
2 Flow adjustment

– **Pressure difference with a pump**
  – Technically best solution

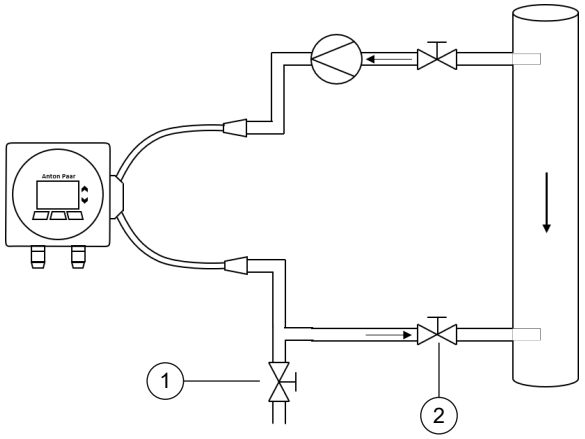


Fig. 16: *Pressure difference with a pump*

1 Sampling outlet
2 Flow adjustment

3.8 Electrical installation

DANGER

Risk of explosion

L-Dens 2300 density sensors are not certified according to ATEX or IECEx. The sensors must **NOT** be used in hazardous areas with risk of explosion.

WARNING

– The instruments have a functional insulation. Protection against potentially hazardous touch current has to be ensured by the customer in accordance to local regulations.
– Installation, maintenance and service work must only be carried out by trained and authorized personnel.
– Installations shall comply with the intended area of use and the relevant national regulations and requirements.
– The sensor must always be disconnected from the power supply when connecting/disconnecting wires to/from the sensor.

3.8.1 Cable gland

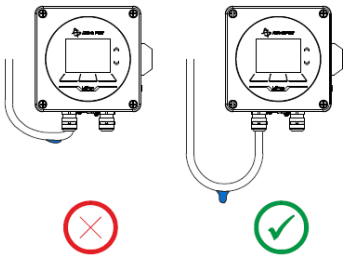


Fig. 17: *Cable inlet*

NOTICE

Contamination

Make sure the cable is mounted in a loop to avoid water contamination.

The USB port between the cable glands is to connect a computer with an installed Pico 3000 software.

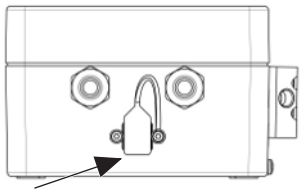


Fig. 18: *USB service connector*

Refer to Appendix A [▶ 22] for technical specifications of the cable glands.

3.9 Cables and preparation

WARNING

- The connecting cables must correspond to the local ambient conditions and the national regulations.
- Take mechanical stress into consideration when choosing the connecting cables.
- Choose the cables' diameters to ensure optimal sealing at the cable gland.
- Strain relief is provided by the correct assembly of the cable gland.

Refer to Appendix A [▸ 22] for the technical specifications of the cables.

Cable preparation

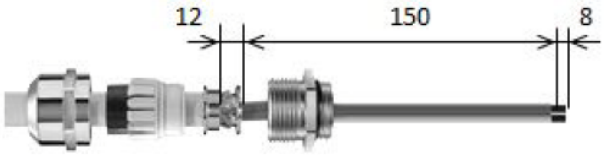


Fig. 19: *Cable preparation*

Shielding

Shield the cables on both sides. The connection of the shielding at the cable gland are shown in the figure above.

3.10 Grounding

The sensor must be solidly grounded.

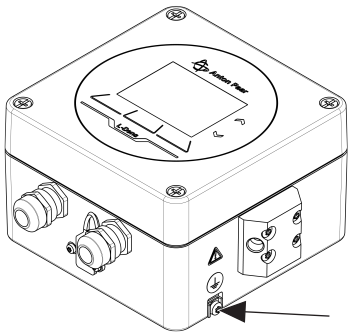


Fig. 20: *Screw terminal for ground connection*

Connect the ground terminal to earth.

If there is a risk of a potential difference between instrument earth and power supply, use an insulated power supply. If this is not possible use a suitable voltage equalizing cable between instrument and power supply.

3.11 Terminals

In order to get access to the terminals it is necessary to loosen the 4 cross recessed head screws and remove the cover from the sensor.

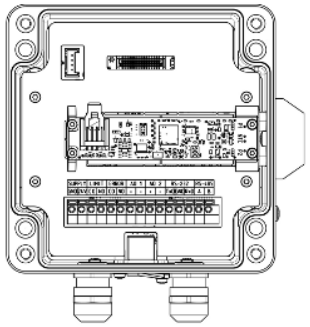


Fig. 21: *Sensor without cover*

NOTICE

Tightness of housing

It is allowed to turn the cover by 180°. It is NOT allowed to turn the cover by 90°, the housing will lose its tightness.

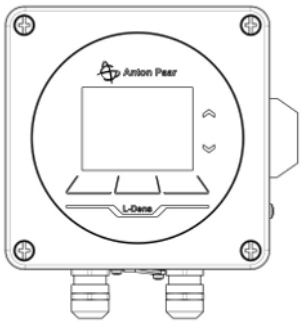


Fig. 22: *Sensor with cover in original position*

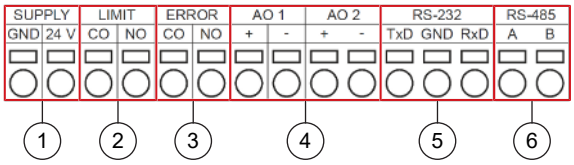


Fig. 23: *Terminals of L-Dens 3300*

1 *Power supply*
2 *Limit relay*
3 *Error relay*
4 *Analog output*
5 *RS 232 interface*
6 *RS 485 interface*

Refer to Appendix A [▸ 22] for the technical specifications of the terminals.

NOTICE

Damage of the electronics board

Pushing the push-in spring connection with excessive force may damage the electronics board.

3.11.1 Power supply

It is recommended to use an insulated high quality power supply with low ripple.

Refer to Appendix A [▶ 22] for the technical specifications of the required power supply.

3.11.2 Relay output

The sensor is delivered with two relays.

Refer to Appendix A [▶ 22] for the technical specifications of the relays.

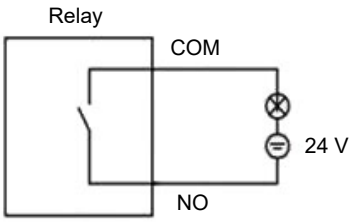


Fig. 24: *Block diagram of the relay output*

The limit relay

One or two measuring values can be controlled with the limit relay. Under normal conditions or without power supply, the limit relay is open. If the limit of one or both observed measuring values is above or below the limit, the relay will close.

This behavior can be inverted.

The error relay

Without power supply the error relay is open. After switch on, the error relay will close if no serious error (e.g. density sensor defective) occurs. If a serious error occurs, the error relay will open.

This behavior can be inverted.

3.11.3 Analog output

Two active galvanically insulated 4 to 20 mA interfaces are available. Any measuring value can be assigned to these outputs. The cable length is limited by the maximum load resistance of 500 Ω.

Refer to Appendix A [▶ 22] for the technical specifications of the analog output.

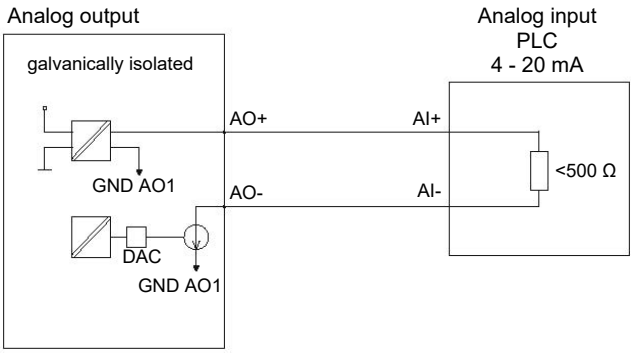


Fig. 25: *Block diagram analog output*

3.11.4 RS 232 and RS 485 interface

The RS 232 or RS 485 interface can be used for data communication. RS 232 and RS 485 interfaces are galvanically separated.

Refer to Appendix A [▶ 22] for the technical specifications of the RS 232 and RS 485 interface.

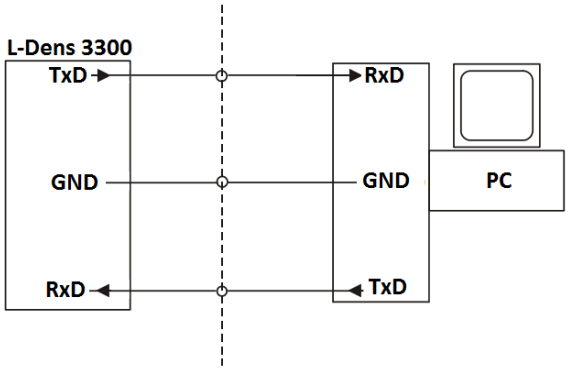


Fig. 26: *Block diagram of an RS 232 interface*

When connecting the instrument compare the interface settings (baud rate, data bits, parity). The interface settings must correspond for communication to work:

Interface settings:

- Baud rate: 9600 or 19200
- Stop bit: 1
- Parity: "None"

If it is not possible to communicate with RS 232, try to switch the cables on the TxD and RxD clamps.

If it is not possible to communicate with RS 485, try to switch the cables on the A and B clamps.

Transfer format depending on the application:

- T=␣24.45␣<C>␣D= 0.9470␣<g/ccm>
- T=␣25.41␣<C>␣C=␣15.15␣<%>
- T=␣25.41␣<C>␣C=␣12.66␣<°Brix>
- T=␣25.41␣<C>␣C=␣5.22␣<°Plato>
- T=␣25.41␣<C>␣C=␣5.22␣<%>w/w
- T=␣25.41␣<C>␣C=␣5.22␣<%>v/v

Each line is terminated by the characters Carriage Return (0x13) and Line Feed (0x10).

The value and unit of the temperature is according to the setting on the display, the value and unit of the density is always g/cm³.

4 Start-up and use

The L-Dens 3300 with HMI is equipped with an HMI which can be used to perform all settings. In addition, the Pico 3000 software is available to configure the instrument with a computer. The Pico 3000 software works with both models, the L-Dens 3300 w/o HMI and the L-Dens 3300 with HMI. The connection between PC and Pico 3000 is a USB 2.0 Type-B port.

4.1 Operation modes

It is possible to choose between two operation modes:

- Application mode
- Product selection mode

Application mode

In this mode it is possible to use the instrument with one application. So only one formula, one set of alarm limits, etc. can be used.

Product selection mode

You have to buy a license code for each instrument to use the "Product Selection Mode". The license code is related to the serial number of the instrument. Once the code is entered it is possible to change between both modes.

If you choose this mode, it is possible to define up to 31 products each using any of the available applications, so several applications can be used in the same instrument or the same application can be used with different product specific parameters (e.g. offsets, alarm limits, ...).

4.2 Configurating with the Pico 3000 software

The Pico 3000 software can be used to configure both models, the sensor without HMI and the sensor with HMI.

Intended use of the Pico 3000 software:

- Configure the instrument
- Backup and restore the configuration
- Read and export the measured data
- Read and export the system log
- Read and export the error log
- Firmware updates

NOTICE

The Pico 3000 software cannot be used for online data monitoring and recording.

4.2.1 Hardware and software requirements

The Pico 3000 software is designed to run on computers which fulfill the following minimum requirements:

Hardware requirements

- Processor: 1 GHz or faster
- RAM: 1 GB (32-bit) or 2 GB (64-bit)
- Display: 1024 x 768 resolution
- Graphics Card: DirectX 9 compatible with WDDM 1.0 or later driver
- Hard Disk Space: 5 GB free disk space on system drive
- Ports: USB port

Supported operating systems

- Microsoft Windows 10
  - 32 bit and 64 bit are supported
- Microsoft Windows 11
  - 32 bit and 64 bit are supported

4.3 Configuration with the HMI

4.3.1 Introduction

4.3.1.1 Main screen

After powering the instrument, the main screen appears. The screen is unlocked and displays up to four measurement values.

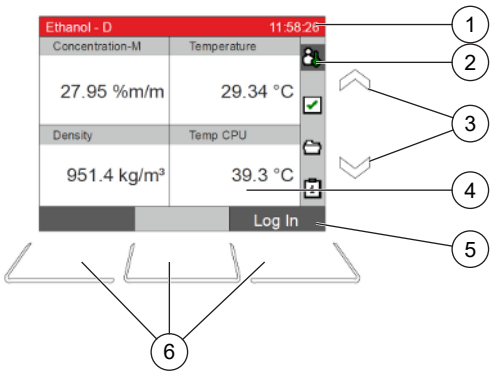


Fig. 27: *Unlocked main screen*

1 *Header*
2 *Side menu*
3 *Scroll keys for scrolling up/down*
4 *Main screen*
5 *Button bar*
6 *Three button keys that correspond to the displayed commands in the button bar*

The online screen does not offer touch functionality.

Use the keys to navigate.

After one minute (can be configured) the sensor will lock the buttons. Press both *Unlock* buttons to unlock the buttons.

To configure a sensor, press *Unlock* first and *Log In* in a second step.

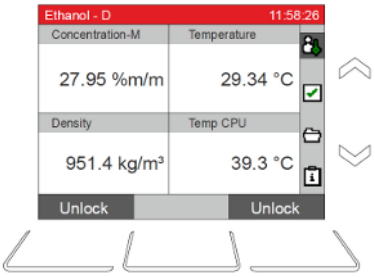


Fig. 28: *Locked screen*

4.4 Applications

There are different applications stored in the instrument. These applications are:

- Live Raw Data
- Anton Paar Function
- User Function
- Ethanol
- 2-Propanol (IPA)
- Sugar
- Extract of Wort
- Sodium Chloride
- Boric Acid
- Sulfuric Acid
- Hydrochloric Acid
- Group A - Crude Oil
- Group B - Refined Products
- Group D - Lubricating Oil

4.4.1 User function

User functions can be defined by the user and entered only via the Pico software.

Unlike the other applications, it is not possible to configure the parameters of this application while it is active. If you want to change settings of the user function, first activate another application (e.g. *Live Raw Data*).

Two different user functions can be implemented:

- Poly 2D - user function
- Table - user function

Poly 2D - user function

This application program uses a fifth order polynomial to calculate the concentration of a 2-components mixture. The program calculates the concentration from density and temperature.

$dx_1 = x_1 - \text{ref } x_1$

$dx_2 = x_2 - \text{ref } x_2$

$$R = (KA+KB*dx_1+KC*dx_1^2+KD*dx_1^3+KE*dx_1^4+KF*dx_1^5)+ (KG+KH*dx_1+KL*dx_1^2+KJ*dx_1^3+KK*dx_1^4)*dx_2+ (KL+KM*dx_1+KN*dx_1^2+KO*dx_1^3)*dx_2^2+ (KP+KQ*dx_1+KR*dx_1^2)*dx_2^3+ (KS+KT*dx_1)*dx_2^4+ (KU)*dx_2^5$$

Table 1: User function – Poly 2D

Media	
2-components mixtures	
Input values	
– Temperature [°C] – Density [kg/m³]	
The polynomial coefficients must be calculated with the units above. The units on the display can be different.	
Application parameter	
R	Result of the calculation [user defined unit]
KA to KU	Polynomial coefficients
x1	measurand 1 (standard = temperature [°C]
x2	measurand 2 (standard = density [kg/m³]
ref. x1	Reference value for measurand 1 (recommendation = average value)
ref. x2	Reference value for measurand 2 (recommendation = average value)
Identifier	Identifier field (max. 50 characters)
Description	Description field (max. 220 characters)
Type	Poly 2D
Unit	Unit of the output (max. 7 characters)
Name	Description of the value on the display
Precision	Number of decimal places
Low limit	Lower limit of the valid range
High limit	Higher limit of the valid range
Output values	
Concentration [user specific unit]	
Density at reference temperature [user specific unit]	

Table - user function

This application program uses a table to calculate the concentration or a density at reference temperature of a 2-components mixture. The program calculates the concentration from density and temperature. The maximum table size is 400 fields.

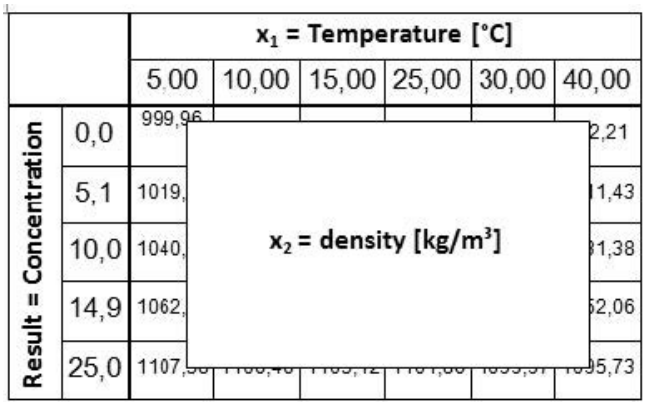


Fig. 29: *Example of table*

Table 2: User functions - table

Media	
2-components mixtures	
Input values	
Temperature [°C] Density [kg/m³] The table values must be entered with the units above. The units on the display can be different.	
Application parameter	
Columns Rows	Number of columns (1 to 400) Number of rows (1 to 400) Columns * Rows ≤ 400
x1	measurand 1 (temperature [°C])
x2	measurand 2 (density [kg/m³])
ref. x1	Reference value for measurand 1 (recommendation = average value)
ref. x2	Reference value for measurand 2 (recommendation = average value)
Identifier	Description field (max. 50 character)
Description	Description field (max. 220 character)
Type	Table
Unit	Unit of the output (max. 7 character)
Name	Above the measurand on the display
Precision	Number of decimal places
Low limit	Lower limit of the valid range
High limit	Higher limit of the valid range
Output values	
Concentration [user specific unit] Density at reference temperature [user specific unit]	

Following rules have to be considered:

- Columns: 1 to 400
- Rows: 1 to 400
- Maximum fields: 400 (columns*rows)
- Empty fields are allowed on the side of the matrix.
- Empty fields are not allowed in between two values

Concentration [%]	x1 = Temperature [°C] 5,00	10,00	15,00	25,00	30,00	40,00
0,0		999,7	999,1	997,04	995,64	992,21
5,1	1019,99	1019,56	1018,81	1016,51	1015,02	1011,43
10,0	1040,75	1040,14	1039,25	1036,71	1035,12	
14,9	1062,25	1061,47	1060,43	1057,65	1055,96	
25,0	1107,58	1106,46	1105,12	1101,86		

Fig. 30: *Example of a valid table*

Concentration [%]	x1 = Temperature [°C] 5,00	10,00	15,00	25,00	30,00	40,00
0,0		999,7	999,1	997,04	995,64	992,21
5,1	1019,99	1019,56	1018,81	1016,51	1015,02	1011,43
10,0	1040,75	1040,14	1039,25	1036,71	1035,12	
14,9	1062,25	1061,47	1060,43	1057,65	1055,96	
25,0	1107,58	1106,46		1101,86		

Fig. 31: *Example of an invalid table*

4.4.2 Ethanol

The alcohol concentration calculation follows the OIML R22 while the proof calculation is in accordance with the AOAC method.

Table 3: Ethanol

Media	
Ethanol/water solution	
Input values	
– Temperature – Density	
Measuring range	
Temperature	10 to 40 °C
Alcohol	0 to 100 % w/w
Application parameter	
T_{ref}	Reference temperature 0 to 40 °C
Output values	
Concentration-M	Alcohol concentration in % mass
Concentration-V	Alcohol concentration in % volume at T_{ref}
Proof	Alcohol concentration in Proof
H_2O	Water concentration in % mass
Density at T_{ref}	Density [g/cm³] at T_{ref}

4.4.3 Sugar

Sugar concentration measurement of water/sugar mixtures. CO_2 compensation is only possible with a constant value.

Table 4: Sugar

Media	
Aqueous sugar solutions, sugared soft drinks	
Input values	
– Temperature – Density	
Measuring range	
Temperature	10 to 80 °C (L-Dens 3300 SST)
Sugar concentration	Max. 90 °Brix
Application parameter	
Stored CO_2	to compensate the influence of the dissolved CO_2 on density
Output values	
Conc. Brix	Sugar concentration in % mass
Conc. g/L	Sugar concentration in g per liter at 20 °C
Conc. Oechsle	Sugar concentration in Oechsle
Conc. Balling	Sugar concentration in Balling
Density 20°C	Density [g/cm³] at 20 °C

4.4.4 Extract of wort

Extract of wort measurement.

Table 5: Extract of wort

Media	
Beer wort	
Input values	
– Temperature – Density	
Measuring range	
Temperature	10 to 80 °C (L-Dens 3300 SST)
Extract	0 to 35 °Plato
Application parameter	
none	
Output values	
Extract	Extract in °Plato [°P]
Density at T_{20}	Density [g/cm³] at 20 °C

4.4.5 Sodium chloride

Table 6: Sodium chloride

Media	
Sodium chloride/ water solution	
Input values	
– Temperature – Density	
Measuring range	
Temperature	0 to 60 °C (L-Dens 3300 GLS)
NaCl concentration	0 to 25% mass
Application parameter	
none	
Output values	
Conc. NaCl	Sodium chloride concentration in % mass

4.4.6 Boric acid

Table 7: Boric acid

Media	
Boric acid/ water solution	
Input values	
– Temperature – Density	
Measuring range	
Temperature	20 to 80 °C (L-Dens 3300 SST)
H_3BO_3 concentration	0 to 6% mass
Application parameter	
none	
Output values	
Concentration-M	Boric acid concentration in % mass
Conc. ppm	Boric acid concentration in ppm

4.4.7 Sulfuric acid

Table 8: Sulfuric acid

Media	
Sulfuric acid / water solution	
Input values	
– Temperature – Density	
Measuring range	

Temperature	0 to 60 °C (L-Dens 3300 GLS)
H_2SO_4 concentration	0 to 90% mass
Application parameter	
none	
Output values	
Conc. H_2SO_4	Sulfuric acid concentration in % mass

4.4.8 Hydrochloric acid

Table 9: Hydrochloric acid

Media	
Hydrochloric acid / water solution	
Input values	
– Temperature – Density	
Measuring range	
Temperature	10 to 60 °C (L-Dens 3300 GLS)
HCl concentration	0 to 37% mass
Application parameter	
none	
Output values	
Conc. HCl	Hydrochloric acid concentration in % mass

4.4.9 Petroleum product - group A, B, D

Table 10: Petroleum product – group A, B, D

Media	
Petroleum product – Group A - Crude oil – Group B - Refined products – Group D - Lubricating oil	
Input values	
– Temperature – Density	
Measuring range	
Temperature	10 to 80 °C (L-Dens 3300 SST)
Density range	0.6 to 1.2 g/cm³ corresponding to ASTM D1250; DIN 5157
Application parameter	
Tref	Reference temperature 60 °F; 15 °F; 20 °C; 29.5 °C
Output values	
°API@Tref	Density at ref. temp. [API]
SG@Tref	SG at ref. temp. [-]; water at 60 °F
Density@Tref	Density at ref. temp. [kg/m³]

4.4.10 2-Propanol (IPA)

Table 11: 2-Propanol (IPA)

Media	
2-Propanol/water solution	
Input values	
– Temperature – Density	
Measuring range	
Temperature	50 to 80 °C (L-Dens 3300 SST)
Concentration	34 to 100% mass
Application parameter	
none	
Output values	
Conc. IPA	IPA concentration in % mass

5 Troubleshooting

This section describes possible problems with the sensor, possible causes for a problem and how to solve it.

WARNING

Make sure that the main line is empty and unpressurized before mounting or dismounting the sensor.

The lines and instruments can be hot or cold. Wait until the entire process line has reached a harmless temperature.

5.1 Possible problems

Problems with the sensor output can be caused by the sensor or by unusual process conditions. The following process conditions can cause incorrect sensor output or sensor errors:

- Gas bubbles in the liquid
- Inhomogeneous liquid / sudden change of liquid compositions
- Sudden change in liquid pressure / pressure bursts
- Fast change in liquid temperature (> 1 °C/min)
- Flow rate of liquid too low or too high
- Sedimentation on the sensing element
- Excessive sensor vibration
- Mechanical shocks

The following information is based on the fact that the process conditions are stable and within the required conditions specified for the sensor.

Table 12: Troubleshooting

Problem	Diagnosis	Solution
No sensor output	Check if the power is supplied and the voltage is within specification	Provide power within specification
	Check the polarity of the wiring.	Correct connections or polarity
No density reading	– Unstable process conditions – Bubbles in the liquid	Check the sensor under stable conditions. If the problem still occurs, contact Anton Paar.
Incorrect density and/or temperature read-out	Wrong sensor constants	Check the sensor constants and compare them with the protocol received with the sensor.
	Sedimentation or fouling of the sensor	Clean the sensor.
	Sensor needs to be adjusted.	Adjust the sensor.

6 Upkeep and cleaning

To ensure trouble-free operation and operational safety, the sensor must be checked and cleaned regularly. We recommend the following intervals however, these have to be adapted to existing process conditions.

Daily

– Check the instrument and PLC for error messages.

Once a week

– Check the sensor and all associated fittings or connections for leaks
– Optical check for damages
– Optical check for corrosion

Customer specified intervals

– In general, we recommend to exchange the sealing once a year. Under certain process conditions (aggressive fluids, temperature, pressure, ...) the exchange interval has to be adapted depending on the sealing material and the process conditions.
– Verify the validity of the measurement results in order to identify any malfunction or deterioration in sensor performance.
– If a deviation is detected, flush the sensor with a cleaning liquid and perform a calibration and adjust the sensor as needed.
– Only use cleaning agents to which the wetted materials are resistant.

6.1 Replacing seals

– Wear appropriate personal protective equipment
– For removing the instrument from the line refer to Section 6.4 [▶ 20].
– Clean, rinse and dry the U-tube before disassembling the sensor. All remaining liquids in the sensing element can destroy the sensor during the exchange of the gaskets.
– Under certain process conditions (aggressive fluids, temperature, pressure, etc.), the internal gaskets have to be replaced carried out by an authorized Anton Paar service engineer. The replacement interval has to be defined by the customer according to the sealing materials and the process conditions.
– Within the sensor no gaskets need to be exchanged.

6.1.1 L-Dens 3300

1. Remove the four screws on the cover.
2. Remove the cover.
3. Loosen the internal screw of the ground connection.

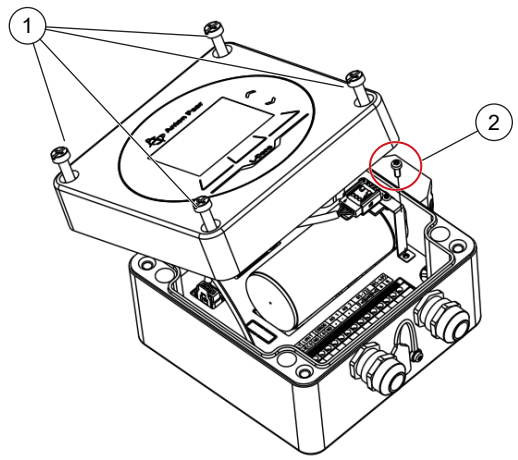


Fig. 32: *Opening the housing*

1 Fixing screws
2 Internal screw of the ground connection

4. Unscrew the fixing screws of the sensing element to disassemble the sensing element.

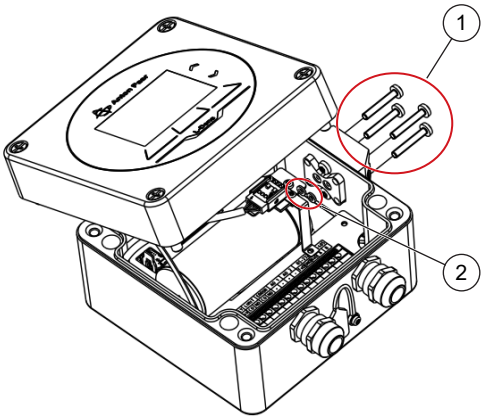


Fig. 33: *Disassembling the sensing element*

1 Fixing screws
2 Internal gaskets

5. Replace the internal gasket(s)
   - L-Dens 3300 version SST
     1 pcs flat gasket FKM (mat. no. 184052)
   - L-Dens 3300 version GLS
     2 pcs O-rings FFKM (mat no. 315256).

     ATTENTION: Before S/N 84728876, two flat gaskets (mat. no. 75052) were in use. Since S/N 84728876, two O-rings (mat. no. 315256) are in use.
6. Assemble the sensor in reverse order. The torque for the fixation screws of the sensing element is 64 cNm. Tighten the 4 screws crosswise.

   The housing cover is not square. Make sure it is positioned correctly!
7. Perform a pressure test:
   - L-Dens 3300 version SST = 16 bar
   - L-Dens 3300 version GLS = 6 bar

     —> no pressure drop within 5 minutes
8. Check the measuring results. If necessary, perform an adjustment according to Calibration and adjustment.

6.2 Cleaning

- Clean the sensor to prevent contamination or buildup of deposits.
- Clean the sensor housing avoiding chemicals that could corrode or damage the housing or the seals (e.g. warm water).
- If a high-pressure washer or steam is used, do not aim the seams, gaskets, electronics housing or HMI.

6.3 Software administration

The sensor and Pico 3000 firmware can be updated with the Pico 3000 software.

NOTICE

The Pico 3000 does not need to be updated. We recommend an update only after written demand from your Anton Paar representative.

6.4 Removing the instrument from the line

WARNING

- Beware of hazardous process conditions like temperature pressure or aggressive fluids.
- Beware of the heavy weight of the instrument.
- Wear protective equipment.
- The lines and instruments can be hot or cold. Wait until the entire process line has reached harmless temperature.
- Ensure the line is empty and unpressurized before removing the sensor.

1. Switch off the instrument (power supply, communication, …)
2. If the sensor is in a bypass system, close the bypass valves and lock the bypass valves, if required.
3. If the sensor is in a bypass system, open the sample valve and make sure not pressure remains in the bypass.
4. Disassemble the sensor.

6.5 Wetted parts

Refer to Appendix A [▶ 22] for the wetted parts of the sensor and the process adapters.

6.6 Storing and transporting

– Only use the original packaging for the storage and transportation.
– Do not store outdoors and avoid direct sunlight. Store the instrument in a dry, clean place. Remove transportation protection not until installation. Consider national regulations regarding the weight and lifting the instrument.

6.7 Packing the instrument for returns

– Clean all parts of the instrument before packaging. Make sure no spills remain on the instrument.
– Return the instrument in the original packaging material (box, foam piece, transport protection).

7 Maintenance and repair

7.1 Maintenance performed by an authorized Anton Paar representative

The product does not require a periodic maintenance by an authorized Anton Paar representative to retain warranty coverage.

However, under certain process conditions (aggressive fluids, temperature, pressure, etc.), the internal gaskets shall be replaced carried out by an authorized Anton Paar service engineer. [1]

The replacement interval shall be defined by the customer according to the sealing materials and the process conditions.

To fulfill requirements of regulatory authorities e.g. FDA 21 CFR 211.67, PIC/S 023-2 (5.5), Anton Paar offers services for compliant preventive maintenance and requalification for qualified Anton Paar products in case of software update, repair, and location change.[2]

Following parts are generally excluded from the warranty (wear and tear parts)

– O-Rings
– Gaskets

7.2 Repair performed by an authorized Anton Paar representative

In case your product needs repair, contact your local Anton Paar representative, who will take care of the necessary steps. If your product needs to be returned, request an RMA (Return Material Authorization Number). It must not be sent without the RMA and the filled “Safety Declaration for Instrument Repairs”. Please make sure it is cleaned before return.

Do not return products that are contaminated by radioactive materials, infectious agents or other substances that cause health hazards.

TIP: *Find the contact data of your local Anton Paar representative on the Anton Paar website (https://www.anton-paar.com) under “Contact”.*

[1] Please contact your Anton Paar representative to get an offer.

[2] For detailed information, please refer to general terms of delivery (GTD) on the Anton Paar website (https://www.anton-paar.com).

Appendix A Technical data

Appendix A.1 Technical specification

	L-Dens 3300	
Version	**GLS (Borosilicate Glass)**	**SST (Stainless Steel 1.4571)**
Operating conditions		
Sample types	low viscous liquids	
Process density	500 to 2000 kg/m³	
Process temperature [a]	-10 to 60 °C	10 to 80 °C (95 °C for 30 min)
Process pressure [a] absolute	max. 6 bar	max. 16 bar
Recommended flow rate [b]	10 to 70 L/h	10 to 80 L/h
Ambient conditions		
Temperature	-10 to 40 °C	
Humidity	0 to 95 % (relative humidity non-condensing)	
Degree of protection	IP 65	
Metrology All specifications are valid for correct installation, constant measuring conditions in the adjusted range and vibration levels < $1e^{-3}$ $(m/s^2)^2/Hz$.		
Measurement uncertainty	1 kg/m³ (1 x 10^{-3} g/cm³)	
Materials		
Housing material	L-Dens 3300 with HMI: wet coated aluminum, glass L-Dens 3300 w/o HMI: wet coated aluminium	
Wetted parts	Borosilicate glass PVDF FFKM	Stainless steel 1.4571 PVDF FKM
Dimensions & weight		
Instrument (L x W x H)	166 x 155 x 91 mm	
Inner diameter of oscillator	2.0 mm	2.1 mm
Process connection	2 x G 1/8" (internal thread)	
Weight	1.8 kg	
Electrical data		
Supply voltage	SELV/PELV DC 24 V ± 20 %	
Power consumption	max. 3 W	
Cable and cable glands		
Cable for power supply	Suggested cable type: LiYCY, shielded 2 pole cable OD 4.5 to 10 mm to ensure optimal sealing against the cable gland	
Cable glands	M16x1.5 EMC, earthing cones acc. to DIN 89345, brass nickel-plated cable diameter 4.5 to 10 mm	
Terminals		
Type	Push-in spring connection	
Wire cross section	0.2 to 1.5 mm² / AWG 24 to 16 (without ferrules) 0.25 to 0.75 mm² (with ferrule without plastic sleeve)	
Stripping length	10 mm / 0.4 inch	

	L-Dens 3300	
Version	**GLS (Borosilicate Glass)**	**SST (Stainless Steel 1.4571)**
Communication		
Available	2 x 4 to 20 mA active analog output RS 232, RS 485, Error and limit relay	
Analog current output		
Type	Galvanically isolated 4 to 20 mA active output according to NAMUR NE43	
Signal output current range	4 to 20 mA	
Full output current range (incl. fault current)	2 to 22 mA	
Accuracy	0.05 % FS (=0.01 mA) at 25 °C	
Resolution	14 bit	
Temperature coefficient	typ. 10 ppm/K of 20 mA max. 55 ppm/K of 20 mA	
Maximum load impedance	< 500 Ω	
Relay output (Error and limit relay)		
Type	floating contacts	
Maximum current I_{max}	1 A	
Maximum switching voltage U_{max}	SELV DC 28.8 V	
Contact resistance	max. 0.1 Ω	
Life time	min. 10^5 cycles (1 A, DC 28.8 V resistive load)	
RS 232 Interface Galvanic insulation via digital isolators Interface according to EIA (Electronics Industries Association) You can only use the RS 232 interface or RS 485 interface.		
Transfer speed	9600 and 19200 Bd	
Transfer protocol	N 8 1	
Parity check	none	
Data bits	8	
Stop bit	1	
Hardware handshake	no	
Software handshake	no	
Max. cable length (defined by standard)	15 m	
RS 485 Interface, Half Duplex Galvanic insulation via digital isolators Interface according to EIA (Electronics Industries Association) You can only use the RS 232 interface or RS 485 interface.		
Transfer speed	9600 and 19200 Bd	
Transfer protocol	N 8 1	
Parity check	none	
Data bits	8	

	L-Dens 3300	
Version	**GLS (Borosilicate Glass)**	**SST (Stainless Steel 1.4571)**
Stop bit	1	
Hardware handshake	no	
Software handshake	no	
Max. cable length (at 9600 Bd and a terminating resistance of 120 Ohm)	1200 m	
All in- and outputs (inlcuding relay outputs) have to accord with PELV (protective extra-low voltage) of EN 61140 or SELV specification of EN 60950, i.e. maximum voltage U_{max} must not exceed 24 V + 20% = 28.8 V and a maximum current I_{max}= 0.7 A.		

[a] *Attention: Also consider the specifications of the process connection.*

[b] *The recommended minimum flow rate ensures a highly accurate density measurement even with big differences between ambient and process temperature. The U-tube measuring principle can also measure without flow. The recommended upper flow rate is to avoid possible cavitation within the U-tube.*

Appendix A.2 Dimension drawings sensors

NOTICE
All dimensions are in [mm].

The dimensions of L-Dens 3300 with HMI and L-Dens 3300 without HMI are the same.

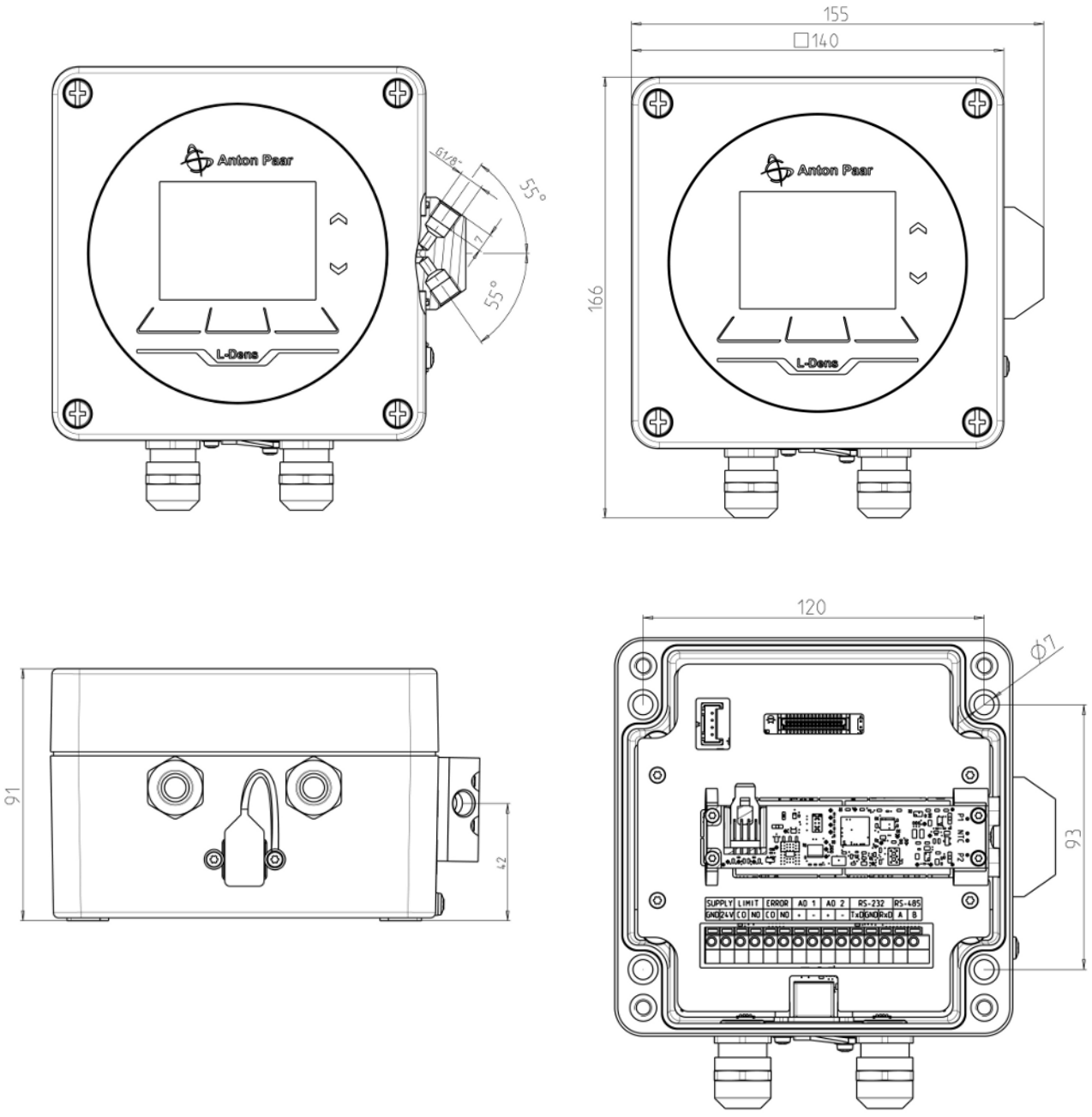
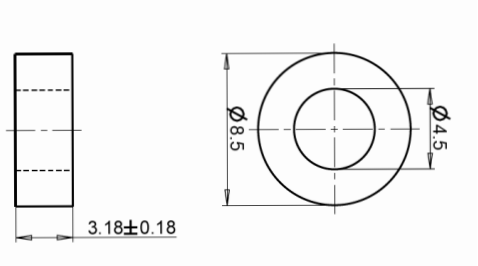


Fig. 34: *Dimensions of sensor*

Appendix B Process adapters

Material number	23483
G 1/8" THREAD x 1/8" PIPE SWAGELOK, SST	
	
Material	Stainless steel 316/1.4401
Connection	for 1/8" tube

Material number	23484
G 1/8" THREAD x HOSE BARB ADAPTER, PTFE FOR HOSE d=4MM PMAX= 6 BAR AT 20°C"	
	
Material	PCTFE
Max. pressure (depending on the fluid temperature)	-10 °C = 6.0 bar 5 °C = 6.0 bar 20 °C = 6.0 bar 30 °C = 4.8 bar 40 °C = 4.2 bar 50 °C = 3.6 bar 60 °C = 3.0 bar
Connection	for hose with DI = 4 mm

Material number	191117
GASKET 8.5 x 4.5x 3.18 FFKM	
	
Material	FFKM

Material number	254233
Straight screw connection G 1/8" PVDF, compression type for 6x4 mm hose	
	
Material	PVDF
Connection type 1	male thread ISO 228-1 G 1/8"
Connection type 2	compression type fitting for 6x4 mm hose Not suitable for PTFE and PFA hoses.
Process temperature	-40 °C to 140 °C
Process pressure absolute	max. 10 bar (at 20 °C)

Appendix C Declaration of conformity

EU Declaration of Conformity

(original)

Anton Paar

The Manufacturer **Anton Paar GmbH,** Anton-Paar-Str. 20, A-8054 Graz, Austria – Europe hereby declares that the products listed below

Product designation:	**L-Dens 3300 Process Density Sensor**
Model:	**L-Dens 3300 SST with HMI, L-Dens 3300 GLS with HMI** **L-Dens 3300 SST w/o HMI, L-Dens 3300 GLS w/o HMI**
Material number:	184123, 184124 245840, 246092

is in conformity with the relevant European Union harmonisation legislation. This declaration of conformity is issued under the sole responsibility of the manufacturer.

Electromagnetic Compatibility (2014/30/EU, OJ L 96/79 of 29.3.2014)

Applied standards:

▪ EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
▪ EN 61326-2-3:2013	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-3: Particular requirements – Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning

Low Voltage Directive (2014/35/EU, OJ L 96/357 of 29.3.2014)

Applied standards:

▪ EN 61010-1:2010 + A1:2019 + A1:2019/AC:2019	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
▪ EN IEC 61010-2-201:2018	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-201: Particular requirements for control equipment

RoHS Directive (2011/65/EU, OJ L 174/88 of 1.7.2011)

Place and date of issue: Graz, 19 April 2024

DocuSigned by:
4C1800E6A5304C2...
DI Dr. Christopher Fradler, MBA
Executive Director
Business Unit Solutions

DocuSigned by:
Christoph Ebner
C4B0FF0B8EFF4AD...
Dr. Christoph Ebner
Head of Process Instrumentation
Business Unit Solutions

E12IB003EN-J

www.anton-paar.com