Special documentation I density sensor DLO-M2 I DLO-M2_ex for gases

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From firmware version: V2.03.00
From serial number: xxx1318

DML02 | DML02_ex version

Density sensor DLO-M2 | DLO-M2_ex for gases

Rethink Sensing

Contents

Notes about the special documentation

Use and safekeeping

- This data sheet is an integral component of the density sensor
- Keep the data sheet in the immediate vicinity of the place of use.
- In case of transfer to third parties, pass on the data sheet or relevant content to them.
- Read the data sheet carefully.
- We reserve the right to make changes.

⚠ WARNING

Use of the DLO-M2_ex version

This document is only valid in connection with the DLOM2_ex with the safety instructions DB-KU-100206-*. The asterisk (*) stands for the version.

Function

The data sheet provides information for safe use and installation of the density sensor.

Symbols used

The following symbols are used in the data sheet to draw attention to dangerous situations and to indicate instructions for action:

Symbol	Description
⚠ WARNING	Leads to death or serious injury if not avoided.
NOTICE	Information on facts that do not involve physical injury.
▶	Single-step handling instruction
1. / **2.** / **3.**	Multi-step handling instruction

Safety notes

Intended use

- Depending on the ordered version, the measuring instrument can also measure explosive and inflammable media.
- Measuring instruments for use in hazardous areas are specially marked on the type plate.
- The density sensor is to be used exclusively for measuring the density of fluids. Only permitted media may be used.
- Check by means of the type plate whether the ordered measuring instrument can be used for its intended purpose in the area relevant for approval (e.g. explosion protection).
- Failure to observe the area of application can impair safety. The manufacturer shall not be held liable for damage arising from improper use.

Qualification of personnel

- The density sensor may be installed by specialist personnel only.

Operating safety

- The owner/operator is responsible for interference-free operation of the density sensor.
- Only operate the density sensor in a technically perfect and safe operating condition.
- In case of increased medium temperature, ensure protection against accidental contact to avoid burns.
- Unauthorised modifications or repairs to the density sensor are not permitted and can lead to unforeseeable dangers.

Product safety

- The density sensor complies with the guidelines listed in the EU Declaration of Conformity. By affixing the CE mark, TrueDyne Sensors AG confirms this fact.

Product description

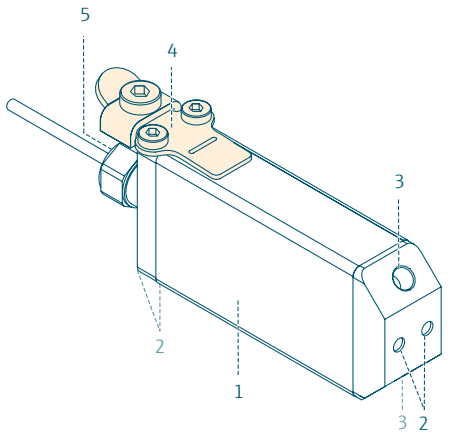
Overview

The density sensor DLO-M2 can be used for gas density measurement directly in the process.

The measuring principle works in the pressure range of 0 to 20 bar abs, whereby the pressure can be measured externally and written to the density sensor via Modbus RTU (see page 6).

With the density sensor DLO-M2 a highly accurate density and concentration measurement of non-corrosive gases and gas mixtures is thus possible.

Product design



Product design of density sensor DLO-M2 | DLO-M2_ex

1 Density sensor DLO-M2(_ex)
2 Mounting holes for mechanical fastening (6 x M3 threaded holes)
3 Fluid interface (2 x M5 threaded holes)
4 Clamp on grounding plate with screws M3×6 TORX
5 Electronic interface for communication and power supply

NOTICE

For the DLO-M2 (non-ex), item 4 (clamp on grounding plate with screws M3×6 TORX) is not applicable. Marked orange in the graphic.

Product specification

General

Measured variable	Density and variables derived from it (e.g. standard density, concentration, etc.)
Permissible gases and their mixtures	**NOTICE** **Damage to the microchannel possible.** ▶ Do not use helium. ▪ N_2 ▪ H_2 ▪ Air ▪ Ar ▪ CO_2 ▪ O_2 ▪ CH_4 ▪ CO ▪ Propane ▪ Butane Other media can be used if necessary after individual clarification.

Measurement performance

Reference conditions	▪ Gases with density <30 kg/m³ ▪ Temperature -40 to +60 °C ▪ Pressure 0 to 20 bar (Burst pressure: 80 bar abs.) ▪ Pressure sensor with a basic accuracy under reference conditions of ± 0.05 bar and a repeatability of ±0.02 bar. ▪ Correct mounting of the pressure sensor according to description (see picture page 6) . ▪ Recommended max. flow rate for full measuring accuracy: 1 l/min ▪ Vibrations (<20 kHz) have no influence on the measurement accuracy due to the high operating frequency of the microchannel.
Max. measurement deviation **Basic accuracy under reference conditions**	▪ Density: ±0.1 kg/m³ ▪ Temperature: ±0.3 °C Option ▪ Temperature: ±0.15 °C resp. ±[0.005 x abs (T-25 °C)] °C if the value is >0.15 °C
Max. measurement deviation with field calibration	▪ Density: ±0.05 kg/m³
Repeatability **Basic repeatability under reference conditions**	▪ Density: ±0.05 kg/m³ ▪ Temperature ±0.05 °C

Pressure dependent density measurement accuracy

The density sensor is calibrated to 1 bar (abs) as standard. At higher pressure, the density sensor indicates too low a density.

Influence factor 1: Compressibility of the fluid

Gases are compressible and according to the ideal gas law the pressure-dependent density change is:

$$\Delta\rho = \Delta p/(R \cdot T)$$

Therefore, when feeding in an external pressure value, it is also important to minimise the pressure difference between the sensor element and the pressure sensor.

For example, at a process pressure of 1 bar and a pressure drop between sensor element and pressure sensor of 100 mbar, the pressure-related density error would already be >0.1 kg/m³ for air at room temperature, which is greater than the maximum measurement error of the sensor itself.

Influence factor 2: Pressure dependence of the properties of the measuring tube

The density deviation Δρ due to the change in the mechanical properties of the measuring tube is Δp with pressure change:

$$\Delta\rho = (0.07 \pm 0.02)\ \frac{kg}{m^3 \cdot bar} \cdot \Delta p$$

NOTICE

Pressure dependent density measurement accuracy

- Observe pressure-dependent density measurement accuracy.
- If necessary, correct density reading due to pressure influence:

$$\rho_{Fluid} = \rho_{mess} + \Delta\rho$$

Here *ρFluid* is the actual density at process pressure and *ρmess* is the density measured by the density sensor.

- Order option: Calibration to desired pressure (1 to 20 bar (abs)).

NOTICE

- When the system pressure is increased, the relative density measurement accuracy increases.
- If the medium temperature changes rapidly (>2 °C/min), the measurement deviation may be greater than specified under reference conditions.
- For the derived measurands (concentration, standard density and molar mass), the measurement accuracy can be affected during a rapid change in the medium pressure (>0.1 bar/s).

Temperature conditions

Permissible medium temperature	-40 to +60 °C
Permissible ambient temperature	-40 to +60 °C
Permissible storage temperature	-40 to +60 °C

Mounting

Mounting location

The meter is usually installed in a bypass line. For low flow rates, installation in the main line is also possible.

Installation in a bypass line is recommended in the following cases:

- Flow rate >1 l/min
- Pipeline diameter >6 mm

Mounting position

The mounting position has no influence on the measuring accuracy.

Flow direction:

- The flow direction has no influence on the measuring accuracy.

Inlet and outlet sections:

- Run-in and run-out distances have no influence on the measuring accuracy.

Installation in bypass

Observe the following when installing in the bypass line:

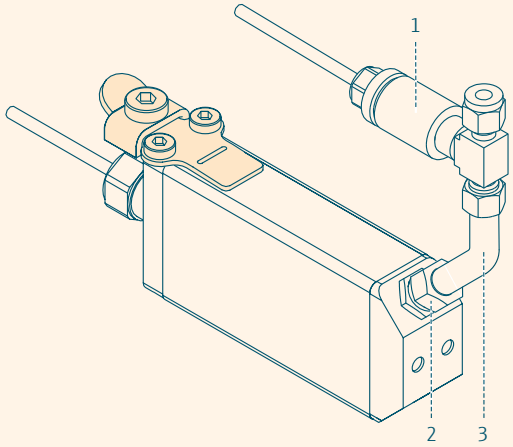
- A pressure gradient must be built up so that the medium flows through the measuring device.
- The max. permissible pressure drop of 0.1 bar (1.45 psi) across the gauge must not be exceeded.
- The bypass line can be routed to atmosphere or back to the process line.

Filter

To avoid clogging of the microchannel, it is recommended to install a filter upstream of the meter.

Recommended filter pore size:
15 µm

Pressure sensor



Installation pressure sensor

1 Pressure sensor with fluidic connection
2 Adapter pipe fitting to M5 thread
3 Fluid carrying connector

NOTICE

The components 1 to 3 shown here are for illustrative purposes only and are not included in the scope of delivery of the sensor.

Modbus

Config

Sensor

Name	Address	Data type	Selection/input	Operator	Maintenance
Pressure compensation	5183	UINT16	0: Off 1: Fixed Value 2: External Value	r	r/w
Fixed pressure	5184 ...5185	FLOAT32		r	r/w
External pressure	2439	FLOAT32		r	r/w

NOTICE

- The density sensor does not include a pressure sensor.
- For pressure compensation, the pressure can be written as a parameter.
- Frequent writing of the "Fixed pressure" parameter can lead to memory corruption in the EEPROM.
- For frequent writing of the pressure value please set the "Pressure compensation" to "External value" and use the parameter "External pressure". This value is not stored in the EEPROM.

Name	Address	Data type	Selection/input	Operator	Maintenance
Pressure unit	2129	UINT16	0: bar abs 1: bar gauge 2: psi abs 3: psi gauge 4: kPa abs 5: kPa gauge	r	r/w

Name	Address	Data type	Selection/input	Operator	Maintenance
Density unit	2106	UINT16	0: g/cm³ 1: g/cc 2: kg/l 3: kg/m³ 4: lb/ft³ 5: lb/gal 6: Specific gravity	r	r/w
Temperature unit	2108	UINT16	0: °C 1: K 2: °F 3: °R	r	r/w
Density single point	205 ...206	FLOAT32		r	r/w
Density offset	5528 ...5529	FLOAT32		r	r/w
Reset density offset	207	UINT16	0: Off 1: Reset	r	r/w
Single point adjustment	2510	UINT16	0: Off 1: Water 2: Air 3: Hydrogen 4: Nitrogen 5: Methane 6: CO_2 7: Argon	-	r/w

Concentration

Name	Address	Data type	Selection/input	Operator	Maintenance
GasType	26493	UINT16	0: Off 1: UseUserCoeffs 2: N_2/H_2 3: Air/H_2 4: Ar/H_2 5: N_2/Ar 6: Reserved 7: Reserved 8: N_2/CO_2 9: Air/CO_2 10: O_2/CO_2 11: CO_2/CH_4 12: H_2/CO 13: Air/O_2 14: CH_4/H_2 15: Ar/CO_2 16: Propane/Butane 17: O_2/H_2	r	r/w
*Selected carrier gas	211	UINT16	0: Gas1 1: Gas2	r	r/w
Custom mixture name	2584 ...2588	STRING10		r	r

NOTICE

- *The carrier gas can be defined by means of the "Selected carrier gas" parameter. Example: For the gas mixture N_2/H_2 the selection of gas1 defines N_2 as cthe carrier gas, whereas the selection of gas2 defines H_2.as the carrier gas.
- Desired parameterisation can be specified when ordering.
- Custom gas mixtures can be stored by TrueDyne upon request.

Process Variable

Name	Address	Data type	Selection/input	Operator	Maintenance
Density	2012 ...2013	FLOAT32		r	r
Temperature	2016 ...2017	FLOAT32		r	r
Pressure	2088 ...2089	FLOAT32		r	r
Concentration	2597 ...2598	FLOAT32		r	r

Download area

On our website www.truedyne.com you will find this document and other useful documents in our download area.

Documents and files

Product information
- Data sheet
- Safety notes
- STEP file
- Special documentation density sensor DLO-M2 | DLO-M2_ex for gases
- Calibration certificate (optional)

Declarations of conformity
- CE marking EU declaration of conformity
- RoHS III EU declaration of conformity

Training courses
- Basics of density measurement training

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Website

Are you looking for more innovative sensors for density and viscosity? Visit our website www.truedyne.com and learn more about our current product portfolio.

Product portfolio

Sensors for measuring fluids
For example:
- DLO-M2 density sensor
- VLO-M2 viscosity and density sensor
- FLT-M1 flow sensor

Sensors for measuring gases
- DGF-I1 density sensor
- Nanomass density sensor

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