Data sheet I Technical Description and Installation Instructions

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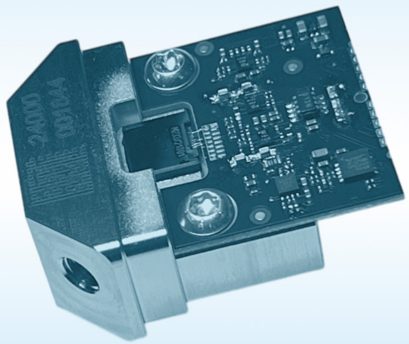


DML03 version:
Density sensor DLO-C3

Rethink Sensing

Contents

Notes about the data sheet

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.

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 was designed for measuring the density of fluids. This takes place using a microelectromechanical system (MEMS) with a microchannel shaped liked the Greek letter omega (omega chip), which is built into an internal bypass.

When the medium flows through the density sensor, the bypass arrangement generates a pressure gradient via the microchannel, which allows the medium to reach the omega chip. The medium influences the physical properties of the excited sensor (resonance frequency and quality), and these are digitised and evaluated in the microcontroller. The measured values can be read out via the serial interface.

Thus, density measurements in the range of 0...1600 kg/m3 at a flow rate of 0...10 l/h can be realised.

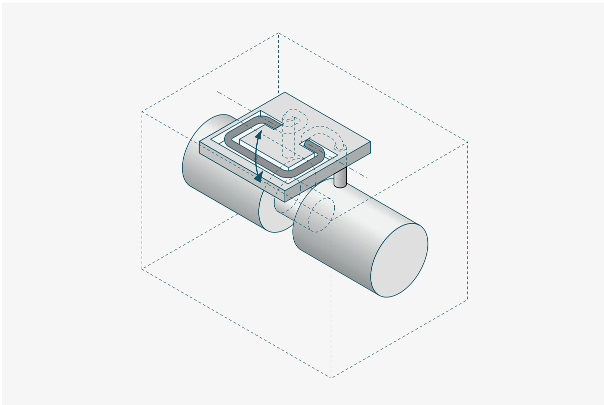
Further options are available regarding an extended density range, viscosity measurement and density measurement of gases. The specifications can be found in the corresponding documentation.

Omega chip

The omega chip, a vibronic microsystem, is the heart of the measuring system and is used for sensor signal generation in the overall system. An essential component of this microsystem is a silicon tube (microchannel), which is electrostatically set into oscillation in a vacuum atmosphere. To compensate for temperature effects, a platinum resistor is integrated, which allows local real-time temperature measurement. The omega chip essentially consists of crystalline silicon and glass.

Density measurement

The density sensor uses the omega chip for density measurement. For this purpose, the filled microchannel is brought to resonant oscillation and analysed.



Measuring principle (omega chip)

The resulting resonant frequency of the microchannel depends on the mass and thus on the density of the medium in the microchannel: The greater the density of the medium, the lower the resonant frequency. Thus the resonant frequency is a function of the medium density.

$$f \propto \sqrt{\frac{E \cdot I}{\rho_{Tube} \cdot A_{Tube} + \rho_{Fluid} \cdot A_{Fluid}}}$$

f = resonant frequency, $E \cdot I$ = stiffness of the tube, ρ_{Tube} = tube density, A_{Tube} = tube cross-section, ρ_{Fluid} = medium density, A_{Fluid} = medium cross-section

Possible applications

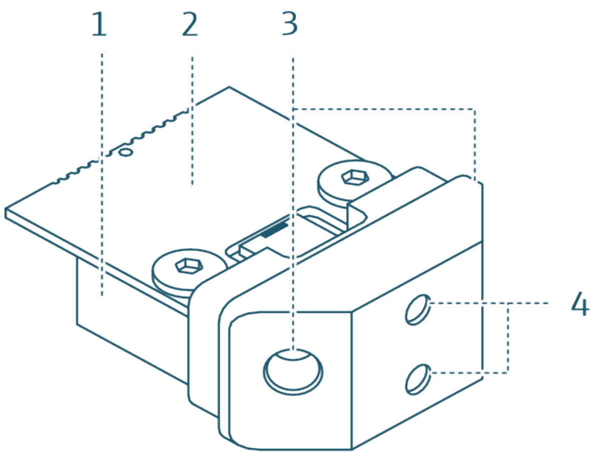
The density sensor can be used for direct and indirect density measurements. While a product property or quality can be determined with the direct density measurement, an indirect density measurement using tables and calculation algorithms makes it possible to determine the concentration of fluid mixtures.

The density sensor can be used in the following applications, for example:

- Supplement volumetric flow measurement in orifice plates, turbines or displacement devices to enable mass measurement. The density sensor takes into account temperature changes and thereby takes temperature measurements into account. It is also possible to write the externally measured pressure into the density sensor (see special documentation for gas measurement).

- Monitoring and controlling the quality of fuel mixtures such as E10 or biodiesel.

Product design



Product design of density sensor DLO-C3

1 Density sensor DLO-C3
2 Mounting holes for mechanical fastening (6 x M3 threaded holes)
3 Fluid interface (2 x M5 threaded holes)
4 PCB incl. plug sockets (back side, see page 10)

Scope of delivery

- Density sensor (including transport safety devices)

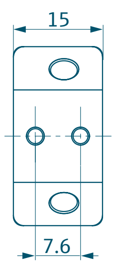
Product identification

The density sensor is identified by a consecutive, eleven-digit serial number. This is installed on the outside of the housing and can also be viewed via Modbus.

Installation, start-up and uninstallation

Fastening the density sensor mechanically

▶ Fix the density sensor with M3 screws using the provided mounting holes (4 mm depth). Maximal tightening torque 30 cNm (typically 15 to 20 cNm)



Dimensions in mm for mechanical fastening

Making the fluid connections for the density sensor

- With a flow rate >10 l/h, installation in a bypass line is recommended to limit the flow rate through the density sensor to <10 l/h.
- The bypass line can be led to a collecting tank or back to the main line.

⚠ WARNING

Danger of injury due to dangerous process conditions and pipe break

▶ Empty and depressurize the pipeline before installing the density sensor.
▶ Take high temperatures into account.
▶ If necessary, fasten the density sensor mechanically.

NOTICE

Clogging of the microchannel

▶ If necessary, install a filter upstream of the density sensor to prevent the microchannel from clogging.

NOTICE

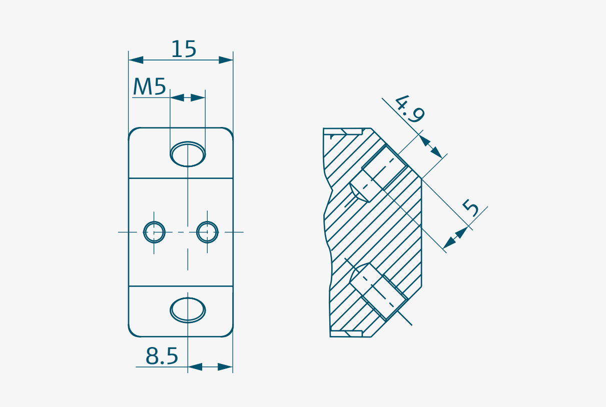
Delayed measurement signal for installation in bypass

▶ Note the time delay, for example for open-loop process control.

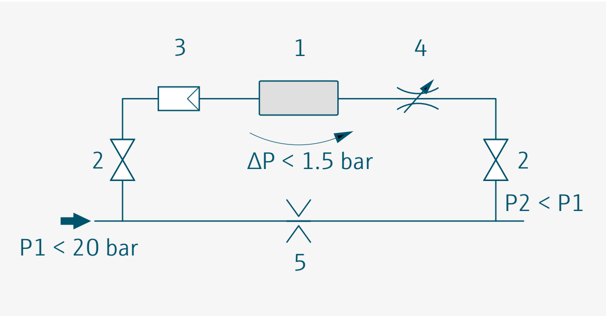
1. Remove all remaining packaging materials.

2. Remove transportation safety devices on fluid connections.

3. Install the density sensor at fluid connections with M5 connectors (thread depth 5 mm) in the pipeline, whereby flow and installation direction are not relevant. Also follow the instructions in the operating manual of the connector used.



Dimensions in mm for fluid installation



Installation example: 1 = Density sensor; 2 = Valve; 3 = Filter; 4 = Flow restrictor; 5 = Orifice

Making the electrical connections for the density sensor

⚠ WARNING

Death or severe injury due to incorrect connection

- Electrical connection work may be carried out by correspondingly trained specialist personnel only.
- Observe installation codes and requirements valid in the respective country.
- Comply with local occupational safety requirements.

⚠ WARNING

No current-limiting fuse

- Ensure overcurrent protection (I_{max} = 500 mA) through external circuit.

⚠ WARNING

Use in areas with an explosion hazard

The density sensor DLO-C3 has no approval for use in hazardous areas.

- When operating in areas with an explosion hazard, ensure explosion protection.

- Connect the density sensor to the higher-level system. Observe the cable assignment, see "Cable assignment" on page 11.

HINWEIS

UART TTL 3.3 V point-to-point connection

- The serial interface is based on the "Modbus over serial line" specification.

Integrating the density sensor into the system

The density sensor sends the measured data to the readout system via the data line in Modbus RTU transmission mode. General settings of the serial Modbus RTU interface:

NOTICE

- Modbus RTU protocol implemented according to specification V1.1b3
- Modbus registers refer to the start value 0
- For the sensor the typical response time is 10...20 ms
- For further Modbus information see section Modbus

NOTICE

The density sensor does not include a pressure sensor. However, it is possible to write the externally measured pressure into the density sensor (see special documentation for gas measurement).

Switching on the density sensor

- Switch on the power supply. After the power supply is switched on, the density sensor starts automatically after an initialization routine.

Uninstalling the density sensor

⚠ WARNING

Danger to personnel and environment from media that are hazardous to health

▶ Ensure that no media hazardous to health or the environment can escape when loosening the fluid connection.

▶ Ensure that no residues of hazardous substances can escape from the density sensor when the mechanical fastenings are loosened by changing their position.

1. Disconnect the cable connections of the electrical connections from the density sensor.
2. Disconnect the fluid connections.
3. Undo the mechanical fastening.

Cleaning and repair

Carrying out cleaning of the housing

NOTICE

Cleaning agents may cause damage to the housing

▶ Do not use high-pressure steam.

▶ Use only permitted cleaning agents.

▶ Permitted cleaning agents:
- Somat Intensive Machine Cleaner
- Methyl or isopropyl alcohol
- Water

Carrying out cleaning of the microchannel

NOTICE

Damage to the microchannel possible

▶ Use only permitted cleaning agents.

1. Flush with permitted cleaning agents.
   Permitted cleaning agents:
   - isopropanol (IPA), ethanol, petroleum ether (e.g. petroleum 80 to 110), acetone and hexane
2. Then, flush with dry air until there is no more cleaning agent in the microchannel.
3. Fill the density sensor with fluid with a known density value. Deviations from the nominal density value that are greater than the specified maximum measuring deviation indicate residues in the microchannel.

Disposal

Disposing of the density sensor

⚠ WARNING

Danger to personnel and environment from media that are hazardous to health

▶ Ensure that the density sensor and all cavities are free of any residues of the measuring medium that are hazardous to health or the environment.

▶ Send density sensor components for recycling. Observe codes and requirements valid in the respective country.

Product specification

General

Measured variable	Density and variables derived from it (e.g. standard density, concentration, etc.)
Permitted media	NOTICE **Damage to the microchannel possible.** ▶ Do not use helium or strong bases. Particulate free (<30 µm) media such as: ▪ Gasoline, diesel, kerosene ▪ OME (synthetic materials) ▪ Oils and lubricants ▪ Water-based media ▪ Methanol, ethanol, isopropanol ▪ LPG* ▪ AdBlue®* ▪ Glycol mixtures* Concentration packages: ▪ Various sugars in water ▪ Invert sugar in water ▪ High fructose corn syrup ▪ Methanol in water ▪ Ethanol in water ▪ Salt in water ▪ Minerals in water ▪ Hydrogen peroxide in water ▪ Ethylene glycol in water ▪ Butane in propane

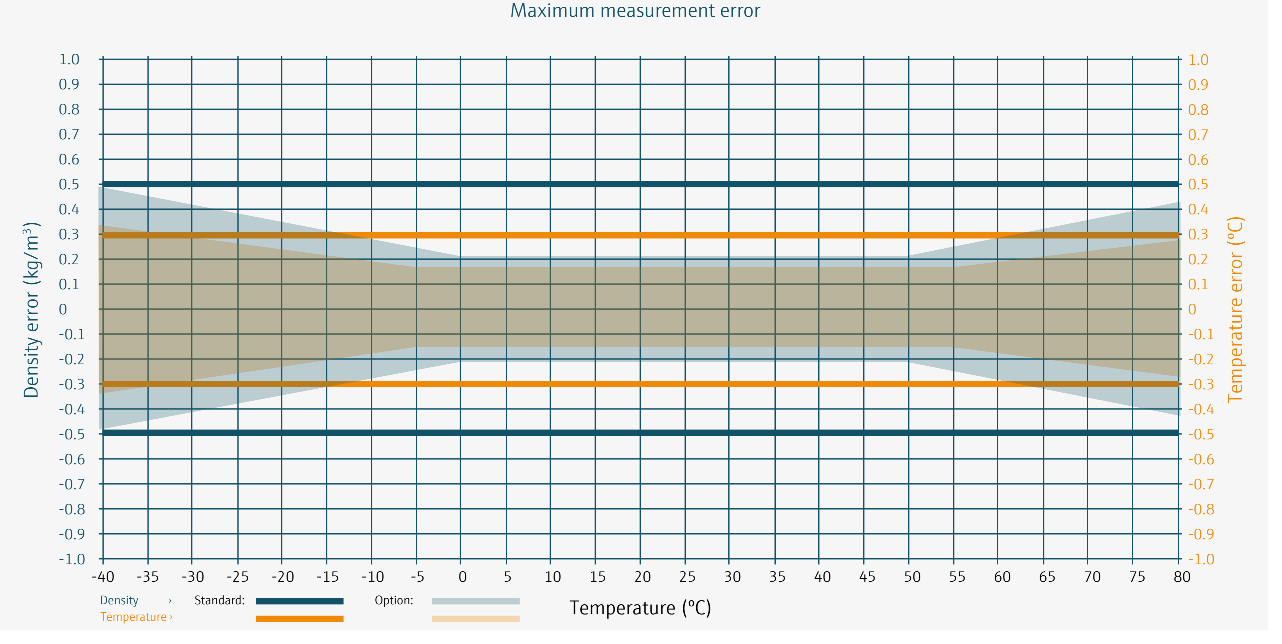
- User-specific concentration packages upon request

Other media can be used after individual clarification can be used. *Optional

For information on gas density measurement, see special documentation: Density sensor for gases.

Measurement performance

Max. measurement deviation for liquids **(For gases, see special documentation for gases.)**	■ Density: ±0.5 kg/m³ ■ Temperature: ±0.3 °C Option: ■ Density: ±0,2 kg/m³ or 0,0075 x abs (T-25 °C)] kg/m³ if the value is >0,2 kg/m³ ■ Temperature: ±0,15 °C or ±[0,005 x abs(T-25 °C)] °C if the value is >0,15 °C



NOTICE

Pressure-dependent density measurement accuracy

These specifications are in relation to measurements of liquids. For gas measurements see special documentation. The measured values are referred to 1.01325 bar (abs) as standard. A parameterisation to another pressure by order or by own parameterisation is also possible. At higher pressure, the density sensor indicates a too low density. The density deviation Δp with pressure change is:

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

- ▶ Note pressure-dependent density measurement accuracy.
- ▶ If necessary, correct the measured density value due to the influence of pressure:

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

  Here, ρ_{Fluid} is the actual density at process pressure and ρ_{meas} is the density measured by the density sensor.
- ▶ Order option: Calibration to desired pressure (1 to 20 bar (abs)).

Repeatability	■ Density: ±0.25 kg/m³ ■ Temperature: ±0.05 °C

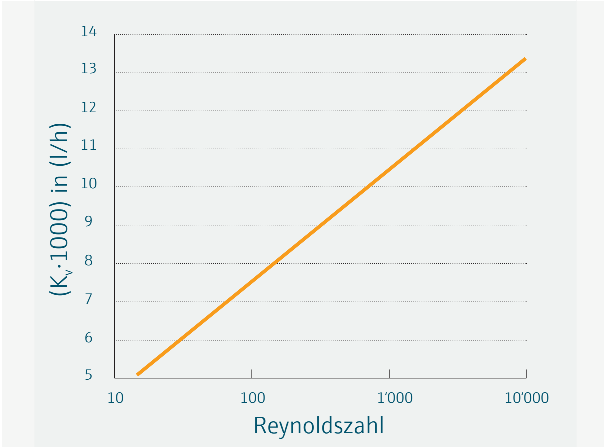
Temperature conditions

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

Area of application

Permitted measured density value	0 to 1600 kg/m³
Permitted viscosity range	0,1 to 5 mPa s (Optionally 0,1 to 50 mPa s)
Permitted medium pressure	0 to 20 bar (abs) Burst pressure 80 bar (abs)
Permitted particle size	Max. 30 µm
Permitted flow range	0 to 10 l/h 0 to 1 l/min for gases
	NOTICE Permitted means that the measuring accuracy of the sensor is within the given specifications.
Vibrations	Vibrations (<20 kHz) have no influence on the measuring accuracy due to the high working frequency of the microchannel.
Inlet and outlet runs	Inlet and outlet runs have no influence on the measuring accuracy.
Flow/pressure loss conditions	**NOTICE** To ensure proper operation, the flow rate (Q) must not exceed 10 l/h. For gas measurements, the upper limit is is 1 l/min.
Units	$[K_v]$= m³/h, $[Q]$=l/h, $[\Delta p]$=bar, $[\rho]$=kg/m³, $[\eta]$= mPa s

Flow/pressure loss conditions



Flow factor versus Reynolds number (K_v (Re) = [1.28 ln (Re) + 1.60] ± 10%)

Determining the flow factor (K_v·1000 l/m³)	The flow factor can be read by means of the Reynolds number (*Re*) via the figure Flow / pressure loss conditions.
Determination of *Re* via *Q*, *ρ* and *η*	$Re \cong \frac{Q \cdot \rho}{2 \cdot \eta}$
Determination of *Q* via Δ*p*	$Q = K_v \cdot 1000\ l/m^3 \sqrt{\frac{\Delta p}{1\ bar} \cdot \frac{1000\ kg/m^3}{\rho}}$
Determination of Δ*p* via *Q*	$\Delta p = \left(\frac{Q}{K_v \cdot 1000\ l/m^3}\right)^2 \cdot \frac{\rho}{1000}$

Calculation	If one of the needed factors such as *Q* is not available, several iteration steps are needed.
Response time	▪ The density is recorded with a measuring rate of at least 30 Hz. As a result of internal processing and filtering, the maximum group delay is 1 s. ▪ The temperature is recorded with a measuring rate of 2 Hz. As a result of internal processing and filtering, the maximum group delay is 2.5 s.

Ambient conditions

Climate class	Under clarification
Electromagnetic compatibility	Prepared for: EMV2014/30/EU (EN 61326-1)
Vibration and shock resistance	Under clarification
Protection class	No protection class defined

Materials

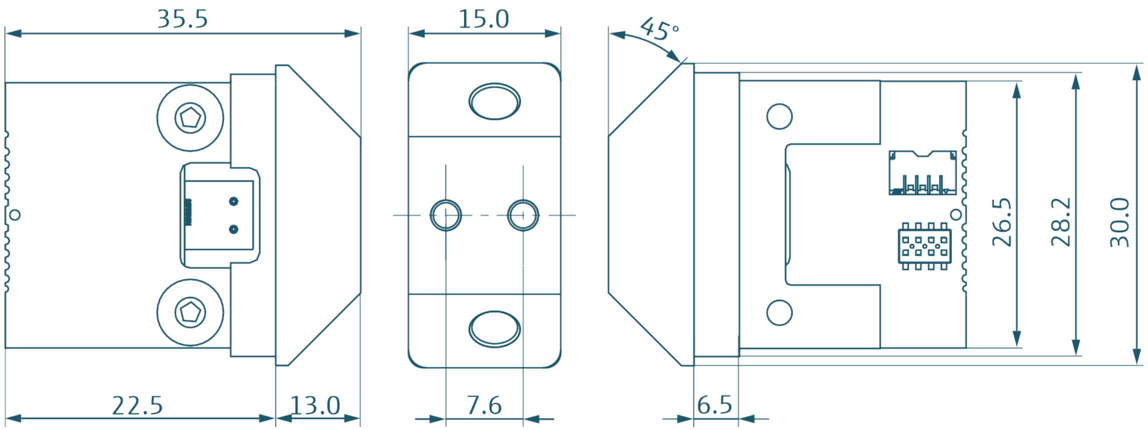
Wetted parts	▪ BOROFLOAT® 33 glass ▪ Silicon ▪ Epoxy resin ▪ Stainless steel: – 1.4542 (AISI/SUS 630 ▪ Alternative to stainless steel: - 2.4605 (Alloy 59)

Dimensions

Housing	30 x 66 x 15 mm³ (without cable, cable gland and connection for protective ground)
Weight	<50 g
Dimensions of measurement channel	160 x 200 µm (500 nl)

Fluid interface

Fluid interfaces	2 x M5 threaded holes at a 45° angle to the side and front surface



Design, dimensions in mm

Electrical interface

Pin assignment

4-Pin Socket

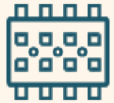
Identification no.:

JST BM04B-ACHSS

Pin assignment		
1	V+	Supply voltage
2	GND	Signal ground
3	RX	UART Receive
4	TX	UART Transmit

Pin assignment

8-Pin Socket



Identification no.:

Samtec

FLE-104-01-G-DV

Pin assignment		
1		Reserved
2	V+	Supply voltage
3	I2C	SCL
4	GND	Signal ground
5	I2C	SDA
6	RX	UART Receive
7	DE	UART
8	TX	UART Transmit

Level control	The UART interface is connected directly to the internal microcontroller pins. These are 5 V tolerant I/O pins. The interface operates with 3.3 V TTL level. Please refer to the STM32L431KCU6 data sheet.
Energy supply	Maximum current draw 20mA at 5 V, maximum power consumption 100 mW. **NOTICE** ▶ Supply: 3.5 V ... 5.5 V
Dielectric strength	The reference potential (GND) is connected to the housing and the ground connection (see product design). There is no galvanic isolation between the supply circuits, the communication interface and GND.

Certificates and approvals

CE marking	The density sensor meets the legal requirements of the EC directives. TrueDyne Sensors AG confirms the successful testing of the density sensor with the attachment of the CE mark.

Depending on the version, the product complies with the following directives:

		DLO-C3
LVD	2014/35/EU(L96/357)	✔
EMC	See environmental conditions	
RoHS	2011/65EU(L174/88)	✔

The following standards are complied with:

	DLO-C3
EN 61010-1: 2010	✔
EN 61326-1: 2013	✔
EN 61326-2-3: 2013	✔
EN 50581: 2012	✔

Legal restrictions

Fields of industry

For legal reasons, the sensor may not be used in the following industries in the USA:

- Military (any applications in the military field whatsoever, including airplanes, vehicles or military structures. This does not include fuel delivery and fuel dispensing when rrefuelling on the ground)
- Aerospace (applications in flying objects of any kind. Excluded from this is fuel delivery and fuel dispensing when refuelling on the ground)
- Fuel cells (use in stationary or mobile fuel cells)
- Medical devices (objects or substances used for medical purposes for human beings - the pharmaceutical industry is not affected)

Modbus

Default settings:

Baud rate	19200 BAUD
Data bits	8
Parity	Even
Byte order	1-0-3-2
Stop bits	1 bit
Modbus address	247
FlowControl	None (0)
Transmission type	Modbus RTU (protocol)
Temperature unit	°C
Pressure unit	bar abs
Pressure Value	1.01325 [bar]
Density unit	kg/m³

The following Modbus RTU functions are supported:

Code	Name	Description
0x03	Read Holding Registers	Read a consecutive holding register block
0x04	Read Input Registers	Read one or more successive registers
0x06	Write Single Register	Write one single register
0x10	Write Multiple Registers	Write multiple successive registers

NOTICE

The following Modbus RTU functions are not supported

- 0x02 Read Discrete Inputs
- 0x07 Read Exception Status
- 0x08 Diagnostics
- 0x0B Get Comm Event Counter
- 0x0C Get Comm Event Log

When addressing the devices, it is essential to ensure that there are not two devices with the same address. In such a case an abnormal behaviour of the whole serial bus can occur, because the master is then no longer able to communicate with all existing slaves on the bus.

Compared to the "Modbus over serial line V1.02" protocol, the following differences exist:

- 3.6 Cables - The cable strands are not twisted together.
- 3.7 Visual Diagnostics - There is no LED display on the sensor.
- "Line Polarisation" is not necessary for the sensor and is not provided.

Min. 32 sensors are supported in the bus system.

Modbus Register Information

Info

The following access code must be written into register 2176 (parameter: enter access code) to enable the maintenance access: 8646 (UINT16).

Name	Address	Data type	Selection/input	Operator	Mainte-nance
PIN (Product identi-fication number)	110 ...117	STRING16		r	r
Serial number	101 ...107	STRING14		r	r
Firmware version	7276 ...7279	STRING8		r	r
Build number	109	UINT16		r	r
Device name	7262 ...7269	STRING16		r	r
Device tag	4900 ...4907	STRING16		r	r
Access level	2177	UINT16	0: Operator 1: Maintenance 2: Service (only TrueDyne)	r	r
Start up counter	118 ...119	UINT32		r	r
SW option	2794	UINT16	0: Density 1: Viscosity 2: Concentration & Density 3: Concentration & viscosity 4: Viscosity compensated density 5: Concentration & visco-sity compensated density	r	r

Config

Modbus

Name	Address	Data type	Selection/input	Operator	Mainte-nance
Modbus address	4909	UINT16	1 ...247	r	r/w
Baud rate	4911	UINT16	3: 9600 4: 19200 5: 38400 6: 57600 7: 115200	r	r/w
Parity	4913	UINT16	0: None / 2 stop bits 1: Even / 1 stop bit 2: Odd / 1 stop bit 3: None / 1 stop bit	r	r/w

r = read / w = write / Modbus registers refer to the start value 0

Byte order	4914	UINT16	0 : 0-1-2-3 1: 3-2-1-0 2: 2-3-0-1 3: 1-0-3-2	r	r/w

Device

Name	Address	Data type	Selection/input	Operator	Mainte-nance
Restart Device	6816	UINT16	0: False 1: True	r/w	r/w
Device Tag	4900 ...4907	STRING16	Freely selectable	r	r/w
Enter Access code	2176	UINT16	0...65535 For maintenance 8646	r/w	r/w
Set Access Level	2179	UINT16	0: Operator 1: Maintenance 2: Service (TrueDyne only)	r	r/w
Reset Device	201	UINT16	0: Off 1: Reset to SW-defaults	r	r/w

Sensor

Name	Address	Data type	Selection/input	Operator	Mainte-nance
Pressure compensation mode	5183	UINT16	0: Off (internal pressure = 1.01325 bar) 1: Fixed Value 2: External Value	r	r/w
Fixed pressure value	5184 ...5185	FLOAT32		r	r/w
External pressure Value	2439 ...2440	FLOAT32		r	r/w

NOTICE

- For pressure compensation, the pressure can be written as a fixed parameter. By default, the pressure value is 1.01325 bar abs.
- The density sensor does not include a pressure sensor. However, it is possible to write the externally measured pressure into the density sensor (see special documentation for gas measurement).
- For frequent writing of the pressure value, please set the "Pressure compensation mode" to "External value" and use the "External pressure value" parameter. This value is not stored in the EEPROM. Frequent writing of the "Fixed pressure" parameter can lead to a memory violation in the EEPROM.

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
Density unit	2106	UINT16	0: g/cm³ 1: g/cc 2: kg/l 3: kg/m³ 4: lb/ft³ 5: lb/gal 6: SG liquid 7: SG gas	r	r/w

NOTICE

- Specific gravity (SG Liquid) is calculated with the current temperature (T) in relation to water, SG Gas in relation to air.

$$SG = \frac{\rho_{medium}(T)}{\rho_{water}(T)} \qquad SG = \frac{\rho(T)}{\rho_{air}(T)}$$

r = read / w = write / Modbus registers refer to the start value 0

Temperature unit	2108	UINT16	0: °C 1: K 2: °F 3: °R	r	r/w
[2]Dynamic viscosity unit	2110	UINT16	0: cP 1: P 2: Pa s 3: mPa s	r	r/w
[2]Kinematic viscosity unit	2111	UINT16	0: m^2/s 1: mm^2/s 2: cSt 3: St	r	r/w
Enter density single point	205 ...206	FLOAT32	enter density of the known media to perform a single point adjustment	r	r/w
[1]Set density single point adjustment (using a predefined media)	2510	UINT16	0: Off 1: Water 2: Air 3: Hydrogen 4: Nitrogen 5: Methane 6: CO_2 7: Argon	r	r/w
Enter density offset	5528 ...5529	FLOAT32	manually enter density offset	r	r/w
Reset density offset	207	UINT16	0: Off 1: Reset	r	r/w
[2]Enter viscosity single point	208 ...209	FLOAT32	enter viscosity of the known media to perform a single point adjustment	r	r/w
[2]Set viscosity single point adjustment (using a predefined media)	2511	UINT16	0: Off 1: Water 2: Ethanol 3: Isopropanol	r	r/w
[2]Enter viscosity offset	5530 ...5531	FLOAT32	manually enter viscosity offset	r	r/w
[2]Reset viscosity offset	210	UINT16	0: Off 1: Reset	r	r/w

MinMaxValues

Name	Address	Data type	Selection/input	Operator	Mainte-nance
Density min	2600 ...2601	FLOAT32		r	r/w
Density max	2604 ...2605	FLOAT32		r	r/w
Temperature min	2608 ...2609	FLOAT32		r	r/w
Temperature max	2612 ...2613	FLOAT32		r	r/w
Pressure min	2616 ...2617	FLOAT32		r	r/w
Pressure max	2620 ...2621	FLOAT32		r	r/w
Concentration min	2624 ...2625	FLOAT32		r	r/w
Concentration max	2628 ..2629	FLOAT32		r	r/w

r = read / w = write / Modbus registers refer to the start value 0

[2]Viscosity min	2632 ...2633	FLOAT32		r	r/w
[2]Viscosity max	2636 ...2637	FLOAT32		r	r/w

NOTICE

- [1]For in-field adjustment with gases: see special documentation for gases.
- [2]Optional: see product viscosity sensor VLO-C3

Concentration

Name	Address	Data type	Selection/input	Operator	Mainte-nance
Concentration model liquid For gas concent-ration models, see "Special documenta-tion density sensor DLO-M2 | DLO-M2_ex for gases".	26491	UINT16	0: Off 1: User coeffs 2: Fructose in water 3: Glucose in water 4: Sucrose in water 5: Invert sugar in water 6: Hydrogen peroxide in water 7: Ethanol in water (OIML) 8: Methanol in water 9: Ethyleneglycol in water 10: HFCS42 11: HFCS55 12: HFCS90 13: Sodium chloride in water 14: Total dissolved solids in water 15: Butane in Propane	r	r/w
Concentration unit	2438	UINT16	0: Reserved 1: °Brix 2: °Balling 3: Reserved 4: Reserved 5: %Vol@20°C 6: °Plato 7: Reserved 8: %ABV@20°C 9: %mass 10: mg/l 11: Reserved 12: User conc. 13: %mol 14: mol/l@20°C	r	r/w
Custom concentration model name	2584 ...2588	STRING10	Description of the cus-tomised concentration model	r	r/w

NOTICE

- Desired liquid and gas types can be specified when ordering.
- Customer-specific concentration models can be parameterised by TrueDyne on request.

Process Variable

Name	Address	Data type	Selection/input	Operator	Mainte-nance
Density	2012 ...2013	FLOAT32		r	r
[2] Viscosity compen-sated density	2030 ...2031	FLOAT32		r	r
Temperature	2016 ...2017	FLOAT32		r	r

r = read / w = write / Modbus registers refer to the start value 0

Pressure	2088 ...2089	FLOAT32		r	r
[2] **Dynamic viscosity**	2018 ...2019	FLOAT32		r	r
[2] **Kinematic viscosity**	2082 ...2083	FLOAT32		r	r
Concentration	2597 ...2598	FLOAT32		r	r

Status

Name	Address	Data type	Selection/input	Operator	Mainte-nance
ControlState	2650	UINT16	0: Error 1: Unstable 2: Disabled 4: Running 5: Locked 6: Emergency Shutoff	r	r
Diagnostics	8000	UINT16 ENUM	0: OK 1: Unknown Error 2: HEAP Error 3: Storage Error	r	r
Error Code	8003	UINT16		r	r
Event 1	8004 ... 8011	STRING16		r	r
Event 2	8012 ... 8019	STRING16		r	r
Event 3	8020 ... 8027	STRING16		r	r
Event 4	8028 ... 8043	STRING16		r	r
Event 5	8044 ... 8051	STRING16		r	r
Event 6	8052 .. 8059	STRING16		r	r
Event 7	8060 .. 8067	STRING16		r	r
Event 8	8068 .. 8075	STRING16		r	r
Event 9	8076 .. 8083	STRING16		r	r
Event 10	8084 .. 8091	STRING16		r	r

NOTICE

- [2]Only available with viscosity sensor VLO-C3
- Control State: The status of the sensor is continuously monitored internally. In normal operation, the measuring system oscillates, in which case the status is “Locked”. In the “Running” state, the system attempts to return to normal operation.
- The event list (Event 1 - Event 10) describes an internal ring buffer, whereby the latest event is always assigned to “Event 1” and the oldest event to “Event 10”.

These event messages are output as a “string” and categorized into “information messages” (I) and “error messages” (E). Two messages are given as examples:

- I-01 Start 03: Information about the third start of the sensor.
- E-02 Storage: Error 02, memory error.

For error messages, please contact the customer service of TrueDyne Sensors AG.

r = read / w = write / Modbus registers refer to the start value 0

Download area

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

https://www.truedyne.com/dichtesensoren_fuer_fluessig-keiten_und_gase/fluessigkeiten-dlo-c3/download-dlo-c3/

Documents and files

Product information

- Data sheet
- STEP file
- 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

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.

- *www.truedyne.com*

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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