BOPP & REUTHER MESSTECHNIK

Density and Concentration Meter DIMF-Compact

For continuously measuring the density and concentration of liquids

Operating Instructions

Contents

Introduction

I. Transport, Delivery, Storage

Storage and transport:
Protect devices against humidity, soiling, impacts and damage.

Delivery inspection
Upon receipt, check the delivery for completeness. Compare the device data with the data on the delivery note and in the order records.

Report any in-transit damage immediately upon delivery. Damages reported at a later date shall not be recognised.

II. Warranty

Please refer to the contractual terms and conditions relating to delivery for the scope and period of warranty. Warranty claims shall be conditional to correct installation and commissioning in accordance with the operating instructions of the device.

III. General Safety Information

Read and observe these operating instructions thoroughly and keep them available for reference.

Installation has to be carried out by qualified personnel.

Always observe the generally acknowledged rules of technology and these operating instructions during installation and operation of the device

We shall accept no liability for improper handling, use, installation, operation and maintenance of the device.

In the case of corrosive media, the material resistance of the oscillating pipe has to be checked.

Damaged devices must be shut down.

1. Technical Data

1.1 Density transducer

Density range	500 to 1500 kg/m³
Calibration range	800 to 1200 kg/m³
Measuring accuracy	Up to ± 0.1% (± 1 kg/m³) depending on the model
Repeatability	better than ± 0.02 % (± 0.2 kg/m³)
Medium temperature*	0°C to + 80°C
Ambient temperature*	0°C to + 60°C
Temperature compensation	Via integrated Pt1000 in accordance with DIN Class A directly in the transmitter
Operating pressure	6 bar depending on the type of connection
Liquid	Pumpable liquids
Material: wetted parts	Stainless steel 1.4571 (others on request)
Material: Transmitter housing	stainless steel 1.4571
Smallest inside diameter	2 x 7 mm parallel
Weight	approx. 1.2 kg
Process connections	Internal thread G ¼“

All percentages refer to a density of 1000 kg/m³ at 20°C.
For exact specifications of the device model, see the configuration data sheet of the supplied device.

* In the welded version, the device can be used at any temperatures within the ranges specified above.

1.2 Evaluation electronics

Functions	The electronics integrated in the sensor housing ensures the oscillating element in the density transducer is excited at its natural frequency, compensates temperature influences and provides the operator with measuring results via an RS232 data interface
Output signal	Operating density, temperature Through specific programming of reference density, concentration, °Brix or other parameters derived from density Measured values are transferred to a PC via the RS232 interface
Communication protocol	Communication with the module occurs via a customary terminal program, e.g. Windows® terminal, Hyper terminal…
Power supply	15 – 24 V DC < 20 mA
Electrical connection	Via connector
Cable specification	(Four core) cable length max. 30 m
Ambient temperature	0°C to + 80°C
Storage temperature	-20°C to + 80°C
Degree of housing protection	IP65
Housing dimensions	50 (D) x 175 (L) x 60 (H) mm

Calibration and configuration	According to ordering data at Bopp & Reuther Messtechnik GmbH

1.3 Factory setting

The density transducers of the DIMF-Compact series have been parameterised according to your specifications. After switching on the power supply, DIMF-Compact outputs measured values once a second.

1.4 Output log

Communication process between DIMF compact and a connected PC

Output format:

```
 -  -  -  _  _  _  2  4  .  6  _  _  0  .  8  6  1  8  _  _  0  0 \n \  \0  (ASCII)
2D 2D 2D 20 20 20 32 34 2E 36 20 20 30 2E 38 36 31 38 20 20 30 30 0A 1A 00  (HEX)
```

24.6
Temperature measuring value in °C: 2 integer places, 1 x decimal places
At measuring values < 0°C the output "00.0" and error code = 02
At measuring values < *-10°C* the output „00.0“ and error code = 16
At measuring values > 70°C the output of the real temperature and error code = 02
At measuring values > *99,9°C* the output is „99.9“ and error code = 16

0.8618
Density measuring value in g/cm³: 1 integer place, 4 decimal places
At measuring values < 0.500 g/cm³ the output of the density and error code 04 *
At measuring values < 0 g/cm³ the output: „0.0000“ and the error code 04 **
At measuring values *>1500 kg/m³* the output of the density and error code 08

* This value occurs, when air exists in the device.
** This value could occur, when air exists in the device.

00
Status info (optional display)

00	No error,
01	Density measuring value is not stable ***
02	Medium temperature outside of 0-70°
04	Density below 500 kg = air detection
08	Density above 1500 kg = device error
16	Error temperature sensor (break/short circuit) = device error
32	Error electronic (e.g. error pickup system) = device error

*** To determine the status a delay of 5 measured values is necessary. If the error code "reading unstable" disappears then the correct value exists since 5 seconds.
In the event of two faults, the status values will add: "06" = error 02 + 04
Error codes are set back to 0 automatically when the fault is no longer present.

To complete the transfer, the character "CR" and "LF" must be sent in order to reach a linefeed for e.g. hyper terminal

Wechsel des Ausgabeformates:
Das Gerät kann die Messdaten auf verschiedene Arten ausgeben.

Change output format:
You can choose different types of output formats.

Send the letter "T" to the DIMF by RS232.
You will receive the temperature and density as RS232 output. 9600 baud, 1 start bit, 7 data bits, 1 stop bit, EVEN parity. Example values at 24.6°C and 861.8 kg/m³:

```
                    Temperature        Density kg/liter
-  -  -             2  4  .  6        0  .  8  6  1  8 \n \  \0  (ASCII)
2D 2D 2D 20 20 20 32 34 2E 36 20 20 30 2E 38 36 31 38 0A 1A 00  (HEX)
```

Send the letter "C" to the DIMF by RS232.
You will receive the temperature and density and Status-Value as RS232 output. 9600Baud, 1 Startbit, 8 Databits, 1 Stopbit, NO Parity. Example values at 24,6°C and 861,8 kg/m³:

```
                  Temperature      Density kg/liter      Status
-  -  -            2  4  .  6       0  .  8  6  1  8       0  0  \n \  \0  (ASCII)
2D 2D 2D 20 20 20 32 34 2E 36 20 20 30 2E 38 36 31 38 20 20 30 30 0A 1A 00  (HEX)
```

- ➔ To change the output format to a new format, the letter has to be sent with the actual (old) format. After sending, the device will restart and send in the new format. (check the data bits and parity).
- ➔ Attention: Don´t send any random commands to the device. This can lead to malfunction of the device, if internal settings are modified accidentally. In this case, the device needs to be recalibrated in the factory.

2. Intended Use

The DIMF density transducer allows the continuous measurement of the density or concentration of liquids and liquid mixtures.
The proven oscillating element principle ensures a high-degree of accuracy in combination with outstanding long-term stability. The simple construction assures reliable operation even under tough process conditions.

3. Measuring Principle

The real sensor of the density transducer is an oscillating element in the form of a tube bent into a tuning fork. The liquid to be measured passes continuously through this element. Excited electromagnetically by an excitation coil, it will oscillate at its natural frequency. Changes in the density of the liquid lead to changes in the natural frequency. This change in frequency, sensed by a pick-up

coil, represents the measurement effect. An additional built-in resistance thermometer measures the process temperature, which can also be used to equalise the temperature influence in the transducer. Each density transducer is calibrated with various liquids of different densities. The transducer constants for calculating the density from the frequency, the calibration temperature and the correction coefficients for the temperature influence can be seen in the configuration data protocol (see section 13.3 for example).

4. Installation

4.1 Installing the device

The device can be installed directly in the main product line for a flow rate of up to 10 ℓ/min. Installation in a by-pass is recommended for higher flow rates or measurements at containers. For other viscosities, differing pressure losses have to be considered (see details in section 4.2).

Density transducers of the DIMF series measure independent of the flow rate and also at zero flow rate. Their application is, therefore, normally problem-free. However, it has to be ensured that the operating flow rate in the transducer

- updates the sample fast enough
- equalises the temperature in the transducer
- prevents gas bubbles or any sediment collecting in the oscillating tube
- does not cause cavitation in the oscillating tube
- does not cause wear through abrasives

CAUTION:
The pressure in the product line should never fall below the vapour pressure. Keep the density transducer out of direct sunlight. If necessary, heat insulation has to be provided.

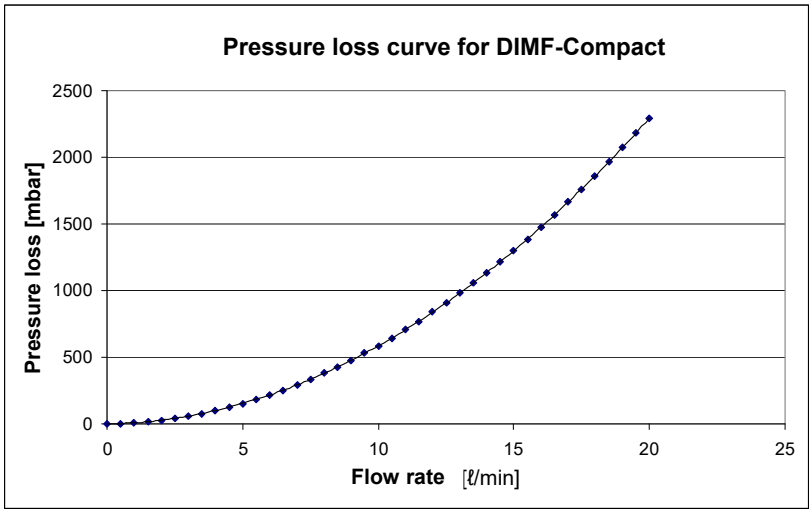
With higher medium temperatures, make sure the integrated electronics is not exposed to temperatures above 80°C.

4.2 Required differential pressure

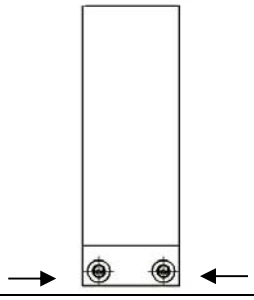
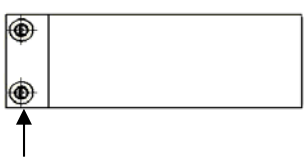
From experience, a flow rate of 1 to 6 ℓ/min is recommended to ensure a sufficiently fast sample update.
Max. flow rate: 0 to 10 ℓ/min

Pressure loss curve

Pressure loss for water 20°C



4.3 Examples of installation positions

Standard installation position • Clean liquids • Also lower flow rates • Without gas admixtures	Any
Installation position for liquids which are subject to sedimentation.	
Installation position for liquids in which gas bubbles can occur.	

The arrow indicates the possible direction of flow.

5. Assembly

5.1 Density transducer

- Handle with care; do not knock
- Install in the by-pass or directly in the product line
- De-aerate before commissioning
- Provide a constant flow through the density transducer
- Any flow direction is possible, see section 4.3
- For the flow rate, see details in section 4.2
  (provides current liquid sample, prevents sedimentation)
  Prevent generation of vapour bubbles

5.2 Piping

- Minimum diameter of the connecting pipe: 6 mm
- Fit sampling connection laterally if the main line is horizontal
- Supply pipe should be as short as possible
- If necessary, provide heat insulation for supply pipe
- If necessary, provide flushing connections close to the density transducer

5.3 Process connections

Ensure that the transducer connection is compatible with the piping connections.
See the supplied configuration data sheet for the type of connection of your density transducer.

Model
with quick assembly block

6. Electrical Connection

6.1 Connection

- The power supply and the data lines are connected by the customer
  in the connector (see section 13.1)
- For the connector type, see Appendix

7. Commissioning

- Flush pipes before connecting the density transducer
- Ensure that all connections are tight
- De-aerate the density transducer
- Switch on the power supply

8. On-Site Adjustment

8.1 Zero adjustment with water

Fill the device with distilled water. Make sure there are no gas bubbles in the device. The density output must be similar to the water density. Send the letter "W" via the RS232 interface. The device measures the density and calculates the water density relating to the current temperature. The K0 value is corrected using these two values and saved again in the device. After adjustment, the device displays the water density.

8.2 Adjustment with any density

Fill the device with the medium. Make sure there are no gas bubbles in the device. The medium density for the current temperature must be known. Adjustment takes place until the operating density has been reached. Send the letter "A" and the density via the RS232 interface, e.g. 998.12 kg/m³, as follows: "A0998.120". Pay particular attention to the number of characters and the decimal point!
The device measures the current density and calculates the offset for the density received. The adjustment value is corrected and saved in the device. After adjustment, the device displays the exact transferred density.

If problems occur after the on-site adjustment, the factory calibration data can be reset by sending the letter "B" to the device via the RS232 interface.

9. Configuration, Operation

Operation at the device itself is not possible. Only the on-site adjustment is available for the configuration (see chapter 8)

10. Maintenance

Maintenance work involves cleaning and zero point adjustment.

10.1 Cleaning

The density transducer should be cleaned according to the sedimentation tendencies of the measured liquid. The simplest cleaning method is to increase the flow velocity through the density transducer to the maximum permissible value for a few minutes in order to flush away any sediment and solids. If this measure is not successful, the density transducer should be cleaned with special detergent if flushing connections are provided. Always observe the corrosion resistance of the density transducer material.

10.2 Zero point adjustment

Abrasion, sedimentation or corrosion can cause the zero point of the density transducer to shift. The zero point shift can be established via a comparison measurement and rectified by an on-site adjustment (see chapter 8 and 11).

11. Error Detection / Troubleshooting

Periodical inspections of the density transducer facilitate error detection and can provide information about possible error sources.
The inspection can usually be limited to a comparison between the value measured by the density transducer and a reference measurement (e.g. sampling with laboratory measurement or a comparison density meter connected in series).
It is essential that the reference measurement is sufficiently reliable and accurate (if necessary, calibratable) to ensure correct results. During this comparison, ensure that the reference conditions are comparable to actual operating conditions (if necessary, take the temperature coefficient of the used liquid into consideration).
If the value measured by the density transducer does not match the result of the reference measurement, carry out the following measures:

- Inspect the density transducer for serious damages
  (temper colours on the housing due to high temperature as well as obvious mechanical damage, e.g. connector, etc.)

- Look for process-related malfunctioning (e.g. empty product line, gas bubbles)

A seriously damaged density transducer must be disassembled and returned to Bopp & Reuther Messtechnik GmbH (see chapter 12).
Otherwise, troubleshooting should be carried out as described below. There are three general sources of error:

- Errors caused by the liquid (see section 11.1)
- Errors caused by the connection provided by the customer (see section 11.2)
- Errors caused by the electronics (see section 11.3)

11.1 Errors caused by the liquid

Error	Possible reason	Remedy
Negative measuring error Unstable display	Air locks or gas bubbles in the product or inside the transducer	Increase pressure in the product line
		De-aerate the product line
		Increase the flow velocity in the transducer
Positive measuring error Long-term drift	Sedimentation in the transducer	Increase the flow velocity in the transducer (recommended value, e.g. 6 ℓ/min)
		Remove any sediments in the transducer using an appropriate solvent (observe the corrosion resistance of the transducer)
Negative measuring error Long-term drift	Corrosion	Inspect the material resistance of the transducer
	Abrasion	Reduce the flow velocity in the transducer (recommended value, e.g. 1 ℓ/min see section 4.2)
The display does not change or is too slow The displayed temperature is too low	Flow in the transducer is too low or zero	Open all shut-off valves
		Increase the flow velocity in the transducer

11.2 Errors caused by the connection provided by the customer

- Check the power supply connection and the communication lines (see section 13.1). After switching on the power supply, a sound is audible in the device at a pitch of approx. 400 Hz. If this sound is not audible, the power supply has most probably been connected incorrectly
- Measured values are not output via the RS232 line -> check correct connection of the communication lines
- Check the protocol settings in the terminal program (see communication
- protocol, see section 1.2)

11.3 Errors caused by the electronics

- No oscillating noise audible at a pitch of approx. 400 Hz -> see chapter 12
- Device oscillates but measured values are not output -> see chapter 12
- Unrealistic measured values are output that deviate from the actually measured value by hundreds of kg/m³
- Air / Sediment in the device, see section 11.1
- Possibly failed on-site adjustment -> reset factory calibration data (see section 8.2)
- Measured values still deviate significantly after resetting the factory calibration data -> see chapter 12

12. Service

Please contact our Service Department with regard to the density and concentration meter:

Bopp & Reuther Messtechnik GmbH
Dept. MRV-S Service
Am Neuen Rheinhafen 4
67346 Speyer, Germany

Phone: +49 6232 657 – 420
Fax: +49 6232 657 – 561

13. Appendix

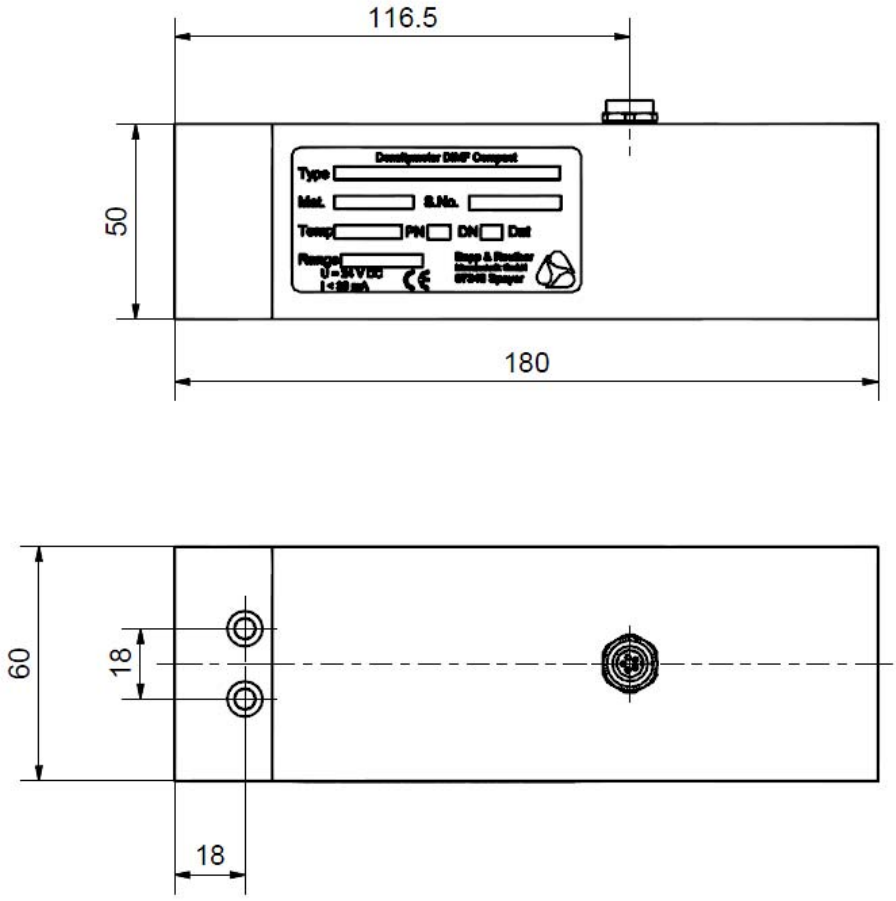
13.1 Wiring diagram

Pin 1 15 – 24V
Pin 2 GND
Pin 3 RS232 control commands from PC to DIMF
Pin 4 RS232 measured values from DIMF to PC
Pin 5 Leave unconnected

The following connector must be used by the customer:
Binder cable connector round series 712 5-pole
e.g. Bopp & Reuther Messtechnik, item no.: 2-08-45001-020
e.g. manufacturer no.: 99-0413-00-05
e.g. purchase via RS: RS order no.: 115-2764
Purchase via R.E.D.: Order no. 99-0413-00-05

13.2 Dimensions

All dimensions in mm



13.3 Example of configuration data log

Kalibrierzertifikat DIMF-Compact

Calibration certificate DIMF-Compact

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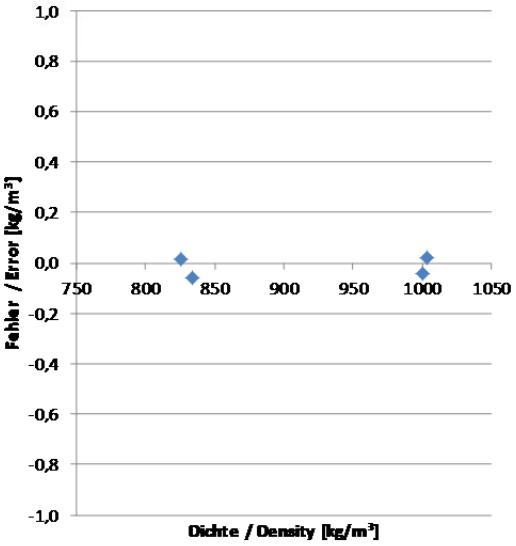
Kunde / Customer: Musterfirma
Prüfmedien / Calibration liquids: Alkohol - Wasser / Alcohol - Water
Seriennummer / Serial No.: 10037350
Aufnehmertyp / Test item: DIMF Compact
Prüfdatum / Test date: 09.09.2010
Prüfer / Tester: Schmidt

Kalibrierungstabelle / Calibration table

Prüfmedien Calibration liquids	Frequenz Prüfling [Hz] Frequency	Dichte Referenz Sollwert [kg/m³] Density of ref.	Dichte Prüfling Istwert [kg/m³] Density Test item	Temperatur [°C] Temperature	Fehler [%] Error	Fehler [kg/m³] Error
Medium / Liquid 1	*371,417*	*1003,376*	**1003,355**	*15,87*	*-0,0021*	*0,0210*
Medium / Liquid 2	*370,784*	*1000,433*	**1000,474**	*25,69*	*0,0041*	*-0,0408*
Medium / Liquid 3	*377,337*	*834,462*	**834,522**	*34,99*	*0,0071*	*-0,0597*
Medium / Liquid 4	*376,964*	*825,884*	**825,869**	*44,71*	*-0,0018*	*0,0150*

Aufnehmerkonstanten / Calibration constan

K0: *-3354,333984* kg/m³
K2: *6,050909* kg/(m³•s²)
KT1: *-0,002517* 1/K
Lambda: *16,500000* kg/(m³•K)



Messverfahren / measurement method:

Master 1 *Serialnr. 38400*
Kalibrierung gegen Mastergerät
Calibration against reference

Kalibrierung der Master gültig bis
Calibration master valid until 02.2011

Umgebungstemperatur Kalibrierraum 20°C
Ambient temperature calibration laboratory

Dieses Protokoll wurde automatisiert erstellt und ist ohne Unterschrift gültig. Druckdatum / printed: 9.9.2010
This protocol was created automatically and is valid without signature

13.4 EC Declaration of Conformity

BOPP & REUTHER MESSTECHNIK

EU - Konformitätserklärung
EU - Declaration of conformity
UE - Déclaration de conformité

Hiermit erklärt der Hersteller in alleiniger Verantwortung, dass die nachfolgend bezeichnete Baueinheit den Anforderungen der zutreffenden EU-Richtlinien entspricht. Bei nicht mit uns abgestimmten Änderungen verliert diese Erklärung ihre Gültigkeit.

The manufacturer herewith declares under sole responsibility that the unit mentioned below complies with the requirements of the relevant EU directives. This declaration is no longer valid if the unit is modified without our agreement.

Par la présente, le fabricant déclare que les appareils décrits ci-dessous, correspondent aux exigences de la réglementation UE qui les concerne. Toute modification des appareils sans notre accord entraine la perte de validité de cette déclaration de conformité

Hersteller *Manufacture* Fabricant	Bopp & Reuther Messtechnik GmbH Am Neuen Rheinhafen 4 D-67346 Speyer
Bezeichnung *Description* Description	Dichtemesser *Density meter* Capteur de masse volumique
Typ, Modell *Type, model* Type, modèle	DIMF Compact

Richtlinie *Directive* Directive	2014/30/EU /UE L 96/79 Elektromagnetische Verträglichkeit *Electromagnetic interference* Compatibilité électromagnétique
Normen und normative Dokumente *Standards and normative documents* Normes et documents normatifs	EN 55011, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8

Richtlinie *Directive* Directive	2011/65/EU /UE L 174/88 Beschränkung gefährlicher Stoffe *Restriction of hazardous substances* Limitation de substances dangereuses
Normen und normative Dokumente *Standards and normative documents* Normes et documents normatifs	EN 50581:2012

Ort, Datum / *Place, Date* / Lieu, Date: **Speyer, 2018-07-04**

Dr. J. Ph. Herzog
Geschäftsführer / *Managing director* / Gérant

i. A. B. Bähr
QS Leiter / *QA Manager* / Responsable qualité

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