Bopp & Reuther
Messtechnik GmbH

# Density Transducer DIMF 2.0 TVS

for continuous measurement of density and concentration of liquids

## with HART® Communication

## Operating Instructions


Bopp & Reuther Messtechnik GmbH
Am Neuen Rheinhafen 4 - 67346 Speyer
Postfach 1709 - 67327 Speyer
Phone +49(0)6232/657-0
Fax +49(0)6232/657-505
http://www.burmt.de
info@burmt.de





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## Foreword

## I. Transport, delievery, storage

**Storage and transport:**

Protect the devices against humidity, soiling, impact, and damage.

**Inspection of the delivery:**

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

Report any transport damage immediately after delivery. Damage reported later cannot be recognized.

## II. Warranty

For the scope and period of warranty, please refer to the contractual terms of delievery. Claims under warranty shall be conditional to expert installation and startup in compliance with the operating instructions for the device.

The electronics contains electrostatically sensitive parts. Therefore, electrostatic discharges must be avoided when the electronics housing is open.

## III. General safety information

***Read and observe these Operating Instructions thoroughly and keep them available for reference.***

***Installation must be carried out by qualified personnel.***

***For the installation and operation of the device, the regulations of ElexV, the generally recognized rules of engineering practice and the Operating Instructions must be observed.***

***We do not assume liability for the improper handling, use, installation, operation, or maintenance of the device.***

***In the case of corrosive media, resistance of the oscillating tube must be checked.***

***Damaged devices must be shut down.***

# 1 Technical data

## 1.1 Density transducer type DIMF 2.0

| | | |
|---|---|---|
| Density range | 0 to 5000 kg/m³ | |
| Calibration range | 400 to 2000 kg/m³<br>see Configuration Data Sheet supplied | (Standard) |
| Accuracy | better than ±0.02 % (±0.2 kg/m³)<br>(under reference condition)<br>see Configuration Data Sheet supplied | (Standard) |
| Repeatability | better than ± 0.005 % (± 0.05 kg/m³) | |
| Temperature range of liquid | - 40°C to + 150°C<br>see Configuration Data Sheet supplied | (Standard) |
| Temperature influence without compensation | approx. 2,8 kg/m³/°C | |
| Temperature compensation | via integral Pt1000<br>in acc. with DIN Class A<br>directly in the transmitter | |
| Pressure influence | less than 0.02 kg/m³/bar | |
| Operating pressure | 100 bar<br>see Configuration Data Sheet supplied | (Standard) |
| Liquid | pumpable liquids<br>see Configuration Data Sheet supplied | |
| Material: wetted parts | 1.4571<br>see Configuration Data Sheet supplied | (Standard) |
| Material: transmitter housing | made of 1.4571 | |
| Smallest inside diameter | ∅ 10 mm | |
| Specialties | Gasket-free construction<br>on request. Material certificates<br>in acc. with DIN ISO10204-3.1B;<br>see Configuration Data Sheet supplied | |
| Weight | approx. 4.2 kg | |
| Process connections | Swagelok fittings for<br>outer pipe diameter 12 mm<br>see Configuration Data Sheet supplied | (Standard) |

All percentages are referenced to a density of 1000 kg/m³.

**For the exact specification of the device version, see the Configuration Data Sheet of the device supplied.**

## 1.2 Evaluation electronics of transmitter type TR

| | |
|---|---|
| Functions | Excites the oscillating element of the density transducer to its natural frequency.<br>Equipped with a two-line display and four keys for displaying data and configuring the on-site transmitter.<br>HART® communication<br>When the process data are changed, the user can perform a simple modification of the set parameters. |
| Display parameters | Density, concentration, operating temperature, etc. |
| Programmable parameters | Lower range and upper range value of the output signal (smallest measuring span approx. 5 kg/m³)<br>Calibration constants, constants of liquid, reference temperature, etc. |
| HART® protocol | Operation using a PC or laptop equipped with the SensorPort 2 configuration software together with the HART® interface or operation using a HART® hand-held terminal 2.3 HC-275 of Rosemount |
| Output signal | 4-20 mA, linearized and temperature-corrected, can be assigned to any display parameter (e.g. operating density, reference density, concentration, °Brix, °Plato or other magnitudes derived from density) |
| Power supply | 24 V DC (min. 14 V DC / max. 30 V DC) |
| Connection | 2-wire technique via screw terminals;<br>cable enters via cable gland with M 20 x 1.5<br>or ½“ NPT thread for pipe installation (conduit system) |
| Cable specification | 2 wires, twisted and shielded |
| Ambient temperature | -10°C to +58°C<br>- 40°C to +70°C on request |
| Storage temperature | -40°C to +70°C |
| Safety classes | Exi (standard version):<br>EEx ia IIC T4 ZELM 99 ATEX 0008 X<br>Device group II<br>Category 1/2 G<br>Measuring tube designed for Zone 0<br><br>Exi (Tantalum version):<br>EEx ia IIC T4 ZELM 99 ATEX 0008 X<br>Device group II<br>Category 2 G<br><br>Exd:<br>see individual approval<br>94/9/EG, FM, CSA in preparation |
| Degree of protection (housing) | IP 65 |
| Dimensions (housing) | ø100 (D) x 155 (L) x 120 (H) mm |
| Material (housing) | Cast aluminum |
| Weight | 1.2 kg |
| Calibration and configuration | According to customer data at<br>Bopp & Reuther Messtechnik GmbH factory |

### 1.3 Required differential pressure

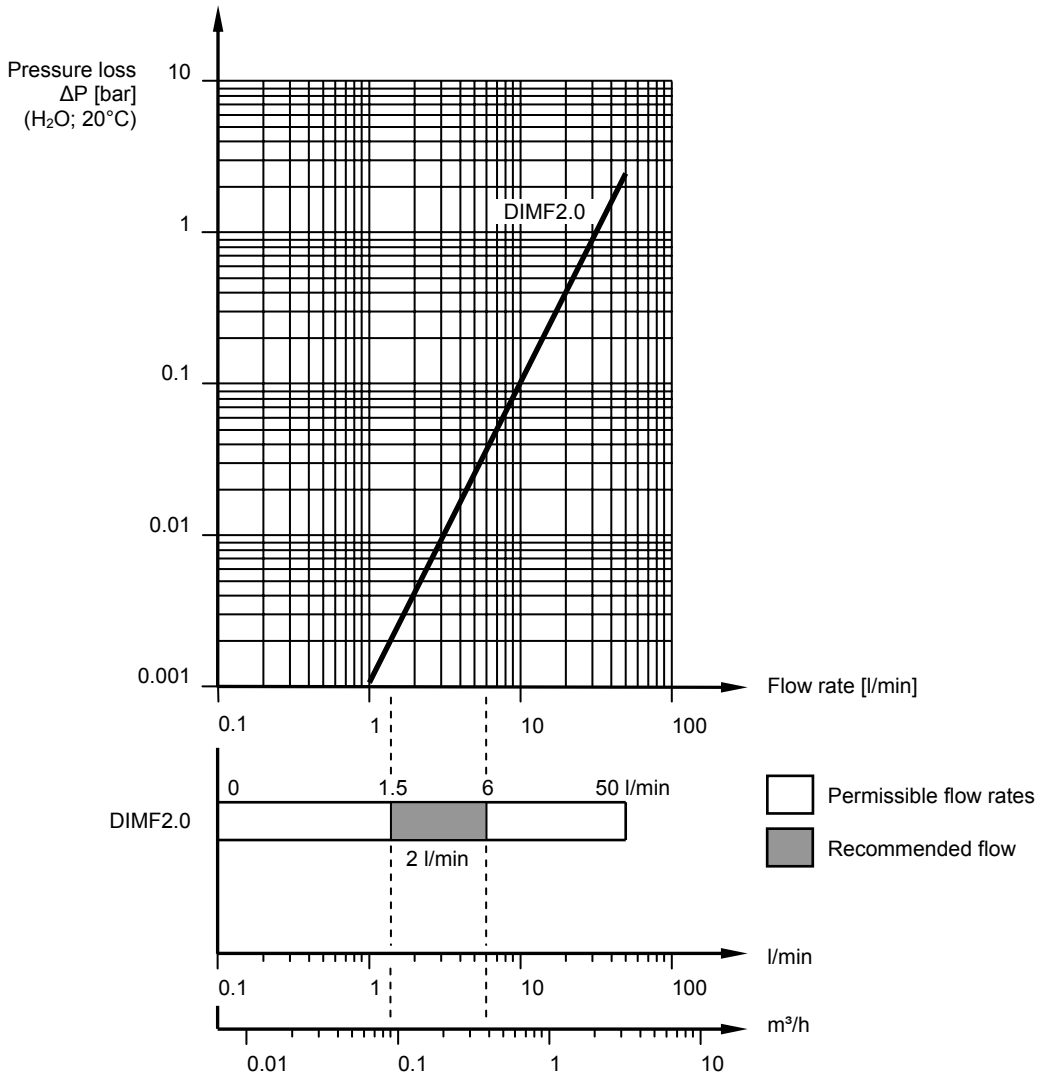
Density transducers of the DIMF series measure independently of flow rate and also at flow rate zero. Their application is therefore normally problem-free. Care must, however, be taken to ensure that the operating flow rate in the transducer

- updates the sample fast enough
- equalizes the temperature in the tranducer
- avoids air or gas bubbles or deposits in the oscillating tube
- does not cause cavitation in the oscillating tube
- does not cause wear through abrasives

Recommended operating flow rate through the density transducer:

DIMF 2.0: approx. 2.0 l/m.

**Pressure loss diagram**



# 2 Intended use

The density transducer type DIMF allows the continuous measurement of the density of liquids and liquid mixtures. The proven oscillating element principle ensures great accuracy in combination with outstanding long-term stability. The easy-to-get-on-with-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 equalize the temperature influence in the transducer.

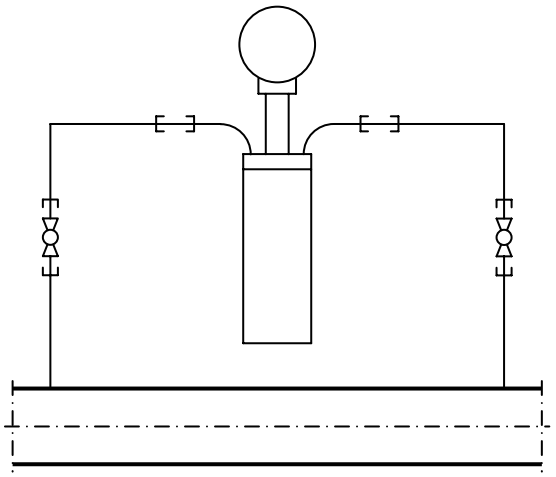
Each density transducer is calibrated with different liquids of different densities. The transducer constants for the calculation of the density from the frequency, the calibration temperature and the correction coefficients for temperature influence are given under section 16.4 *Example of configuration log*.

# 4 Installation examples

In principle, the density transducer can be installed directly into the product line (for permissible flow rates, see section 1.3). For higher flow rates or measurements at containers, installation in a by-pass is recommended.

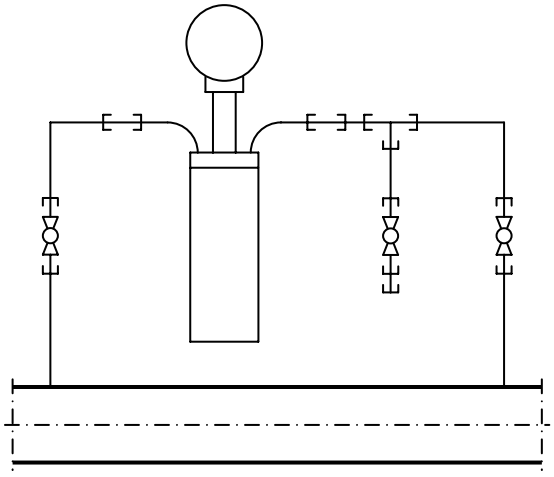
## 4.1 By-pass installation

### 4.1.1 Standard configuration



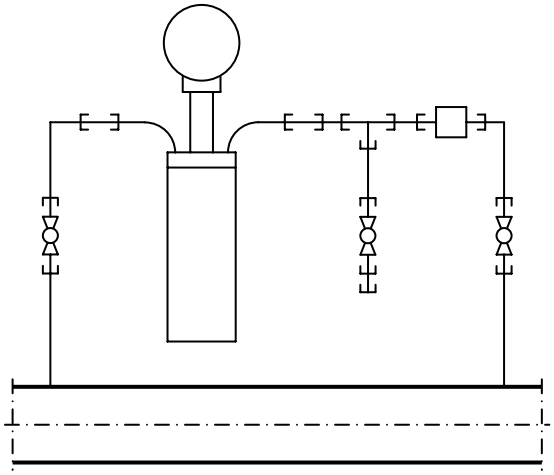
| Part | Qty. |
|---|---|
| Shut-off valve ø12 | 2 |
| Straight tube fitting | 2 |

### 4.1.2 with sampling



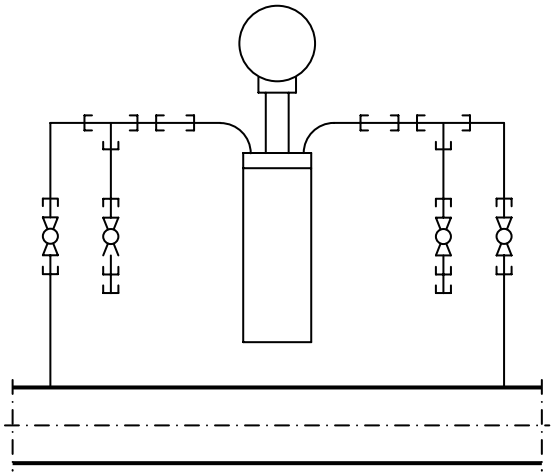
| Part | Qty. |
|---|---|
| Shut-off valve ø12 | 3 |
| Straight tube fitting ø12 | 2 |
| T-type connector ø12 | 1 |
| Screw cap ø12 | 1 |

### 4.1.3 with sampling and sight glass



| Part | Qty. |
|---|---|
| Sight glass R3/8“ | 1 |
| Shut-off valve ø12 | 3 |
| Straight tube fitting ø12 | 2 |
| Male connector R3/8“- ø12 | 2 |
| T-type connector ø12 | 1 |
| Screw cap ø12 | 1 |

### 4.1.4 with sampling and calibration or flushing connection



| Part | Qty. |
|---|---|
| Shut-off valve ø12 | 4 |
| Straight tube fitting ø12 | 2 |
| T-type connector ø12 | 2 |
| Screw cap ø12 | 2 |

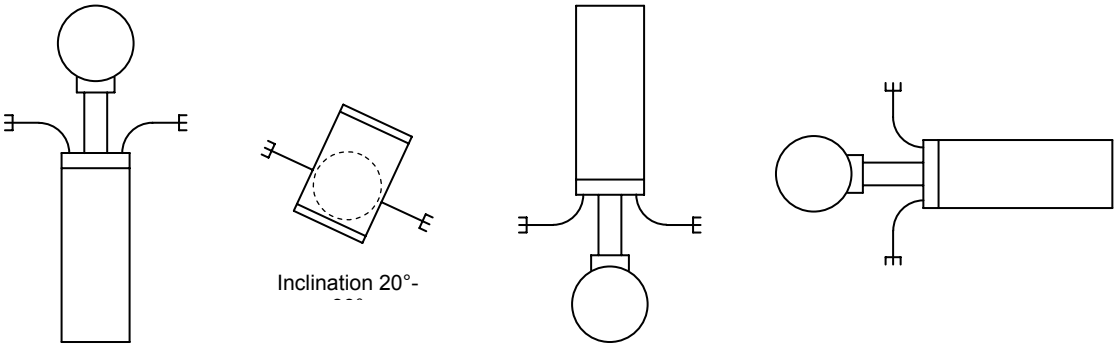
### 4.2 Installation into the product line

Installation into the product line is possible up to a flow rate of 50 l/min (using $H_2O$ as an example). For other viscosities, differing pressure losses must be considered.

**Caution!**
The pressure in the product line must never fall below the vapor pressure. Direct solar irradiation of the density transducer must be avoided. If necessary, heat insulation must be provided.

### 4.3 Examples for installation positions

The device may be mounted in any position. However, depending on the properties of the liquid and the flow velocity, the following positions are recommended:




A B C D

Mounting position A: standard mounting position, e.g. for clean liquids at low flow velocities

Mounting position B: self-draining position

Mounting positions C or D: for liquids with solids

## 5 Mounting

### 5.1 Density transducer

- Handle with care: do not knock the density transducer.
- Install density transducer into by-pass or directly into the product line.
- Deaerate the device before putting it into operation.
- Provide a constant flow through the density transducer.
- Any flow direction is possible.
- Normal flow rate to be approx. 1.5 to 6 l/min, max. 50 l/min (provides current liquid sample, avoids deposits)
- Avoid generation of steam bubbles.
- The use of a clamp or a bracket is recommended (e.g. mounting plate, pipe or wall clamp).
- If mounting position is "self-draining", a clamp or a bracket must be used.
- The pipe bends of the density transducer must not be bent during mounting.

### 5.2 Piping

- Inner diameter of connecting pipe: min. ø12
- Sampling connection to be fitted laterally when product line is in horizontal position.
- By-pass pipes should be as short as possible.
- If necessary, provide both heat insulation and flushing connections (the latter close to the density transducer).

### 5.3 Process connections

Ensure that the density transducer connection is compatible with the by-pass connections.
For the connection type of your density transducer, see the Configuration Data Sheet supplied.

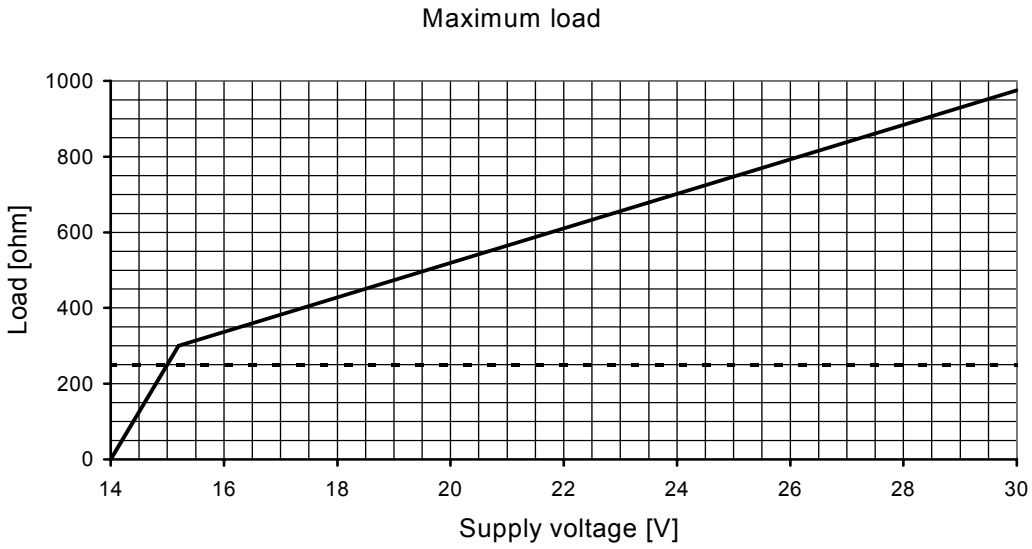
### 5.4 Relationship between permissible ambient temperature and temperature of liquid

| **DIMF ... (interconnected version)** | | | |
|---|---|---|---|
| Class | Ambient temperature | Temperature of liquid | Type |
| T2<br>T3<br>T3 | 46<br>46<br>49 | 210<br>200<br>170 | **H** High temperature |
| T3<br>T4<br>T4<br>T4 | 50<br>52<br>54<br>58 | 150<br>135<br>110<br>60 | **S+H** Standard temperature and high temperature |

# 6 Electrical connection

## 6.1 Power supply voltage

- The transmitter type TR must be supplied with 24 V DC, 2-wire technique.
- Terminal voltage 14 to 30 V DC (terminals 1 and 2)
- Recommendation: 2-wire cables, twisted and shielded (cable diameter 6-12 mm)
- Ground cable shield according to section 16.1 *Wiring diagram.*
- In order to ensure safe HART® communication, the limits for the minimum load with $R_L \geq 250\ \Omega$ must be observed.
- For the maximum amount of line and load resistance, see diagram below. The maximum load depends on the supply voltage.




$$For \quad U_B < 15.2V: \qquad R = \frac{(U_B - 14V)}{0.004A}$$

$$For \quad U_B \geq 15.2V: \qquad R = \frac{(U_B - 8.5V)}{0.022A}$$

### 6.2 Additional requirements in hazardous area for intrinsically safe operation

- Observe installation requirement in accordance with DIN EN 60079-14 / VDE 0165, Part 1.
- Connected loads power supply voltage
  Umax = 30 V  Imax = 110 mA  Pmax = 825 mW
  Ci  ≤ 34 nF  Li  ≤ 0.6 mH
- Power supply must be provided by a certified, intrinsically safe supply unit or by safety barriers.
- In order to connect the bonding conductor safely, use the internal and external bonding connector terminals, which have been designed for a wire range of 1.5 mm² (inside) or 4 mm² (outside).
- If barriers are part of the supply circuit, they must also be connected to the common bonding conductor.

## 7 Commissioning

- Flush product lines before connecting the density transducer
- Ensure that all connections are tight
- Deaerate density transducer
- Switch on power supply

## 8 Factory setting

The density transducer DIMF 2.0 TR has been parameterized according to customer specifications. After switching on the power supply, the specified parameters (e.g. density, reference density or concentration) and the operating temperature will be shown on the display.
If these parameters have changed since the order was placed, the setting can be modified (see section 10 *Configuration, operation*).

# 9 On-site adjustment

An on-site adjustment is carried out if an error has been confirmed due to certain on-site conditions after the reasons according to section 13.1 have been checked. By changing the transducer constant $K_0$, a simple adjustment can be performed.

Example: Measurement condition Temperature must be relatively stable

**Rho (measured density) = 996.6 Kg/m³**
**Rho (setpoint value) = 996.0 Kg/m³ (e.g. value stated in table)**

difference (misalignment) = +0.6 Kg/m³
current $K_0$ value = -7360.708 Kg/m³

| **setpoint $K_0$ value = $K_0$ (current) – misalignment** |
|---|

correct $K_0$ value = - 7360.708 Kg/m³ - 0.6 Kg/m³
= -7361.308 Kg/m³

Now this value must be entered into the transmitter type TR.

If possible, the constants $K_1$ and $K_2$ should not be modified by the user.

Depending on the operating mode or application and the reason for the error, the adjustment can also be carried out via the concentration coefficient $K_{X0}$. Here the same procedure is applied.

# 10 Configuration, operation

The transmitter can be configured (operated) in two different ways:

1. HART® communication
2. On-site operation with keys and display

## 10.1 Operation via HART® communication

The device can be operated using a PC or laptop and the SensorPort 2 configuration software in connection with a HART® interface.

A HART® Communicator is another operating element which can be used (e.g. model HC-275 of Rosemount). The operating functions of the HC-275 are defined in the HART "Device Description Language" (DDL). Using the HC-275 the DIMF can be operated or configured on site. For the electrical connection, see section 16.1.

### 10.1.1 Process variable

| | |
|---|---|
| Measured value: | The current measured value is displayed. The measured value can be selected from a list with density or concentration operating modes. The units are defined in this list. The measured value is firmly assigned to the HART® primary variable and thus also to the current output. |
| Operating density, reference density, frequency, temperature: | The uncorrected or the temperature-corrected operating density, the reference density, the oscillation frequency and the medium temperature can also be displayed in the concentration operating mode and transmitted via HART® variables 2 to 4. The assignment is free. |
| Measured value current %: | The measured value is displayed as a percentage of the measuring range span. |
| Display current: | The setpoint value of the present current output is displayed in mA. |

### 10.1.2 Diagnosis

**Communication status**

| | |
|---|---|
| Device address: | The device address for polling operation can be assigned a value between 1 and 15. Address = 0 means analog operation, address > 0 means polling operation. If the DIMF is to be installed in a multidrop system, the address must be between 1 and 15. For this, the DIMF must first be configured with the desired address in a point-to-point connection. |
| Number of preambles: | The read value indicates how many preambles the master has to send to the slave in its inquiry. The written value indicates how many preambles the DIMF has to send to the master. |

**Device status**

| | |
|---|---|
| Configuration changed: | If the configuration is changed during operation, the "configuration changed" flag will be set and displayed. |
| Reset "configuration changed" flag: | The "configuration changed" flag can be removed. |
| Error codes: | The error codes of the DIMF are displayed. The most recent error is displayed. All previous error messages are no longer available. |

**Limiting values**

| | |
|---|---|
| Temperatures: | The DIMF measures the product temperature and the temperature in the electronics housing. The min. and max. limiting values are stored and displayed. |

### 10.1.3 Basic settings

**Device information**

| | |
|---|---|
| Model code: | The model code of the device is displayed. |
| Device identification: | The serial number of the electronics is displayed. |
| Device type: | The device type is displayed. |
| Sensor type: | Defaults to 0. |
| Manufacturer code: | The manufacturer's name is displayed. |
| Distributor code: | The distributor's name is displayed. |
| TAG: | The TAG address (measuring point number) is displayed. |
| Date: | The date of the most recent configuration change will be displayed. (must be overwritten manually). |
| Descriptor: | A short text of 16 characters can be entered by the user or be read. |
| Message: | A short text of 32 characters can be entered by the user or be read. |
| Write protection: | The DIMF does not support write protection. |
| Manufacturing no. sensor: | The manufacturing number of the sensor can be read. |
| Manufacturing no. device: | The manufacturing number of the device can be read. It is identical with the sensor manufacturing number. |
| Revision levels, universal, standard, software, hardware: | The revision numbers are read. |

**Tranducer data**

| | |
|---|---|
| Transducer factors: | The factors $K_0$, $K_1$, $K_2$, $K_{T0}$, $K_{T1}$, $K_{T2}$ and $T_{kal}$ can be read and changed. |

**Medium data**

| | |
|---|---|
| Medium factors: | The factors α, $K_{C0}$, $K_{C1}$, $K_{X0}$, $K_{X1}$, $K_{X2}$ and $T_{ref}$ can be read and changed. |

**Process data**

| | |
|---|---|
| Damping: | Damping affects the display and the output current. A value between 0 to 5 can be set. The increment is approx. 0.25 s. |
| Upper/lower range value: | The meter range is factory-set for each application. |
| Minimum measuring range span: | The measuring range span can be freely defined within the meter range. However, the set values must not be below the minimum measuring span range, as this may lead to step changes of the output current. |
| Upper range value | Characteristic value for the 20-mA point. |
| Lower range value: | Characteristic value for the 4-mA point. |

### 10.1.4 Operating modes

**Simulation**

Current simulation: In order to test the devices connected in series, a fixed output current of 3.9 to 22 mA can be set. After the test, the current value 0 mA must be entered to end simulation.

Alarm 21.8 mA: An alarm signal can be transmitted via the current loop. The current then rises to 21.8 mA. This alarm is generated due to a maloperation of the DIMF. The alarm function can be switched off.

Selection of measured variable: The measured variable has been assigned to the HART® primary variable and thus to the current output. When displaying density, the user can change between operating or reference density. When calculating the concentration, the user can select between the two different methods.

### 10.1.5 Special settings

**Electronic adjustment**

Calibrate current output: The characteristic of the analog current output can be calibrated in its zero point at 4 mA and in its slope at 20 mA. It must be observed that the zero point will be calibrated before the upper range value.

Reset device: With this command, the device can be restored to a defined operating state present after the supply voltage was applied.

## 10.2 Operation with the keys (configuration via the control unit)

To access the keys, the screw cover of the longer end of the housing must be opened. When the housing cover has been opened, the degree of protection of the housing is not ensured.
After the configuration has been completed, the housing cover must be remounted and the screws must be fastened fingertight (be careful not to damage the sealing ring).

***For the Exd version the housing may only be removed after it has been ensured that there is no explosive atmosphere.***

The covers of the Exd version are secured against opening. In order to open the cover, the locking bar must be swiveled sideways and clamped in this position. After closing the covers, they must be resecured.

### 10.2.1 Display

The transmitter type TR has a two-line display with 8 digits for each line. Each line is subdivided into two fields:

- in the 1st field the channel no. is displayed (1 digit)
- in the 2nd field the corresponding measured values or the constants are displayed (7 digits).

The values displayed in the upper line cannot be changed. The values displayed in the lower line (programming line) can be changed.
The activated line is marked with a triangle behind the channel number. By pressing the ENTER key, you can toggle between the lines.

### 10.2.2 Keys

The transmitter type TR has four operating keys:

▲ and ▼
- increases or decreases the channel no. in operating mode
- increases or decreases the digits in the programming mode

↵
- moves to the next input position (the corresponding digit blinks)
- accepts the current channel contents when shifting to the very right and leaving the display
- toggles between the lower and the upper line (only in operating mode)

P
- changes from the operating to the programming mode
- in programming mode: places the comma next to the entry position (blinking digit)
- deletes error message on channel "]"
- pressing this key for a couple of seconds resets the entry position (blinking digit)

### 10.2.3 Operating mode

In the operating mode, the measured values and constants displayed cannot be changed. When the transmitter type TR is switched on,

- a display test is carried out
- the operating mode is activated automatically
- the current measured variable, density (kg/m³) or concentration (%), depending on the operating mode, is displayed in the upper line
- the current temperature (°C) is displayed in the lower line
- the upper line is activated

If a different value is to be displayed in the lower line, the lower line must be activated by pressing "↵". Then you select the corresponding channel no. (see table in section 10.3) by pressing "▲" or "▼" . Once the last channel number has been reached the display moves back to the first channel. Once the first channel number has been reached, the display moves to the highest channel no.

### 10.2.4 Programming mode

Depending on the operating mode, in programming mode, the device parameters and the medium constants can be programmed or modified on site. The constants can only be programmed in the lower line. For this, the "P" key must be actuated until the first digit blinks in the display field. This digit can then be changed with the keys "▲" or "▼". Pressing the ↵ key moves you to the next entry position (corresponding digit blinks). To place a comma, you press the P key for a short moment. After leaving the last position, the channel is accepted with the current contents. By pressing the P key for approx. 3 seconds the current input position can be reset to the previous position.

- while programming the $K_0$ and $K_{X0}$ values all measured and calculated values are frozen; the upper display line will not be activated.
- if the "programming" function has been initiated but not terminated, it will be terminated automatically after approx. 2 minutes; the old value will be restored.
- channel no. "]“ is used for displaying error codes; these can be deleted by pressing the "P" key (see error code table in section 13.2.1).

### 10.2.5 Operating mode

By selecting the operating mode (channel E) you define the calculation method according to which the measured variable is to be acquired and the output signal is to be represented.
By selecting the operating mode you define

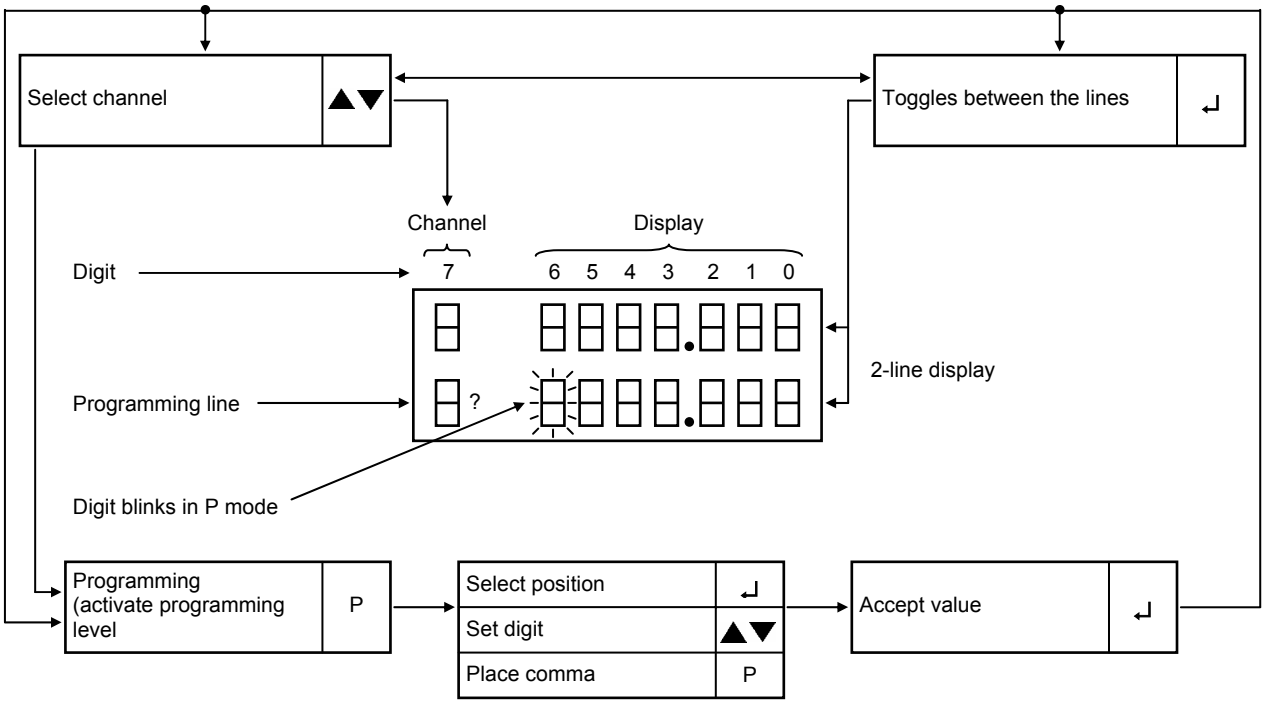
- the assignment of the primary HART® variables (current output signal)
- the measured value in "channel 4".

The following operating modes are available:

- density in kg/m³ (for equation 1, 2 and 3, see section 11)
  (there is a choice between operating density or reference density, depending on the $\alpha$ value)
- concentration in % (for equation 1, 2, 4 and 5, see section

The analog output signal (4 to 20 mA) can be freely assigned to the desired measuring range (lower range value: channel 5, upper range value: channel 6) within the meter range.
The minimum measuring range span should not be below a density range of 5 kg/m³.

### 10.2.6 Short description of the control unit




| | Key | | | |
|---|---|---|---|---|
| | **P** | ▲ | ▼ | ↵ |
| Operating mode | Activate programming mode | Channel selection | | Toggle between lines |
| | | Increase channel no. | Decrease channel no. | Prolonged pressing: Display test |
| Programming mode | Set decimal point | Set parameters | | Move to next digit or accept value |
| | Prolonged pressing resets entry position | Increase digit | Decrease digit | Exit programming mode |

### 10.3 Channel overview / channel assignment

| | Channel no. | Operating mode | | Unit | Limiting values | |
|---|---|---|---|---|---|---|
| | | Density (ρ) | Concentration (%) | | min. | max. |
| | E | 0 | 1 | - | 0 | 1 (2) |
| Display parameters | 0 | Operating density ($\alpha$=0) / Reference density ($\alpha \neq 0$) | Reference density | kg/m³ | 0 | 10000 |
| | 1 | Current output Proportional to density | Current output Proportional to concentration | mA | 4 | 20 |
| | 2 | Oscillating frequency | Oscillating frequency | Hz | 0.5 | 10000 |
| | 3 | Temperature | Temperature | °C | -50 | +210 |
| | 4 | Density a percentag of measuring range span | Concentration (C) | %, # | 0 | 10000 |
| Measuring range | 5 | $\rho_{min}$ | $C_{min}$ | kg/m³ or # | 0.0 | 10000 |
| | 6 | $\rho_{max}$ | $C_{max}$ | kg/m³ or # | 0.1 | 10000 |
| Transducer constants | 7 | $K_0$ | | kg/m³ | -100000 | 100000 |
| | 8 | $K_1$ | | kg/m³ • s | -100000 | 100000 |
| | 9 | $K_2$ | | kg/m³ • $s^2$ | -100000 | 100000 |
| | A | $K_{T0}$ | | kg/m³ • k | -10 | 10 |
| | b | $K_{T1}$ | | $10^{-6}$ • $k^{-1}$ | -100 | 0 |
| | C | dedicated | | - | - | - |
| | F | $t_{Kal}$ | | °C | -50 | +210 |
| System constants | H | 20mA corr. | | mA | 18 | 22 |
| | I | Pt corr. (offset) | | - | 0.5 | 1.5 |
| | J | Pt corr. (slope) | | - | 0.5 | 1.5 |
| | L | 4mA-Korr | | mA | 3.8 | 4.2 |
| Medium constants | n | - | $K_{C0}$ | kg/m³ • k | 999999.9 | 999999.9 |
| | o | - | $K_{C1}$ | $k^{-1}$ | 999999.9 | 999999.9 |
| | P | - | $K_{X0}$ | # | 999999.9 | 999999.9 |
| | r | - | $K_{X1}$ | # / kg/m³ | 999999.9 | 999999.9 |
| | U | - | $K_{X2}$ | $10^{-5}$ • # / ( )$^2$ | 999999.9 | 999999.9 |
| | d | $t_{Ref}$ | | °C | -50 | +210 |
| | Y | $\alpha$ | - | kg/m³ • k | -10 | 10 |
| | ] | Errors (see section 13.2.1) | | | | |

# In operating mode 1, the measured value can be displayed in any unit by configuring the parameters accordingly.

## 11 Equations

Equation no. **1** **Linearization frequency ⇒ density**

$$\rho_B = K_0 + K_1 \bullet \tau + K_2 \bullet \tau^2$$

| | |
|---|---|
| $\rho_B$ | Uncorrected operating density |
| $K_0$, $K_1$, $K_2$ | Transducer constants (programmable) |
| $\tau$ = 10000/frequency | Period (measured) |

Equation no. **2** **Temperature correction**

$$\rho_{BT} = \rho_B + (K_{T0} + K_{T1} \bullet 10^{-6} \bullet \rho_B) \bullet (t - t_{Kal})$$

| | |
|---|---|
| $\rho_{BT}$ | Temperature-corrected operating density |
| $\rho_B$ | Uncorrected operating density |
| $K_{T0}$, $K_{T1}$ | Transducer constants (programmable) |
| t | Operating temperature (°C, measured using Pt 1000) |
| $t_{Kal}$ | Calibration temperature |

Equation no. **3** **Calculation on reference temperature** (for density operating mode)

$$\rho_{Ref} = \rho_{BT} + \alpha \bullet (t - t_{Ref})$$

| | |
|---|---|
| $\rho_{Ref}$ | Reference density |
| $\rho_{BT}$ | Temperature-corrected operating density |
| $\alpha$ | Expansion coefficient of the liquid (programmable) |
| t | Operating temperature (°C, measured using Pt 1000) |
| $t_{Ref}$ | Reference temperature (°C, programmable) |

Equation no. **4** **Calculation on reference temperature** (for concentration operating mode)

$$\rho_{Ref} = \rho_{BT} + (K_{C0} + K_{C1} \bullet \rho_{BT}) \bullet (t - t_{Ref})$$

| | |
|---|---|
| $\rho_{Ref}$ | Reference density |
| $\rho_{BT}$ | Temperature corrected operating density |
| $K_{C0}$, $K_{C1}$ | Constants of liquid (programmable) |
| t | Operating temperature (°C, measure using Pt 1000) |
| $t_{Ref}$ | Reference temperature (°C, programmable) |

Equation no. **5** **Converting density into concentration (#) at reference temperature**

$$C = K_{X0} + K_{X1} \bullet \rho_{Ref} + K_{X2} \bullet 10^{-5} \bullet \rho_{Ref}^2$$

| | |
|---|---|
| C | Concentration at reference temperature (#) |
| $\rho_{Ref}$ | Reference density |
| $K_{X0}$, $K_{X1}$, $K_{X2}$ | Concentration coefficients (programmable) |

## 12 Maintenance

Two measures are recommended: cleaning and zero point adjustment.

**Cleaning**

The density transducer should be cleaned when, for example, liquids tending to sedimentation are measured. The easiest method is to increase the flow velocity through the density transducer to the maximum permissible value for some minutes to flush away sediments and solids. If this measure does not prove successful, the density transducer should be cleaned with a special detergent if flushing connections are provided. In this case the corrosion resistance of the wetted parts of the density transducer must be observed.

**Zero point adjustment**

Abrasion, sedimentation or corrosion may shift the zero point of the density transducer. The zero point shift can be established by a comparison measurement and rectified by an on-site adjustment (see sections 9 and 13.1).

## 13 Error detection/troubleshooting

Periodical checks of the density transducer facilitate error detection and may provide information about possible error sources.
These checks can normally be limited to a comparison between the measured value and a reference measurement, using either lab equipment or a density transducer as a master.
For this purpose it is essential that the test equipment is of sufficient reliability and accuracy (e.g. test equipment approved by the Weights and Measurement Authorities) to ensure correct results. During the test, the conditions must be comparable to the actual operating conditions; if necessary, the temperature coefficient of the liquid must be taken into consideration.
If the measured value does not match the result of the reference measurement, the following measures should be taken:

- Check the evaluation electronis (transmitter):
  electrical connection, power supply, cabling to the transducer.
- Ensure that the data of the calibration log or the
  service list and the programmed parameters of the evaluation electronics are identical.
- Inspect the density transducer for damage
  (temper colors on the transducer housing caused by high temperature and other mechanical defects such as damaged transmitter housing, damaged gaskets or terminals).
- Look for disturbances from process side (e.g. empty product lines or gas bubbles).

A seriously damaged density transducer should be dismounted and returned to the service department of Bopp & Reuther Messtechnik (see section 15).

Otherwise, additional inspections should be performed. In general, there are three types of error sources:

- errors/defects caused by the liquid
- errors/defects caused by the transmitter
- errors/defects caused by the density transducer

### 13.1 Errors/defects caused by the liquid

| Symptom | Possible reason | Remedy |
|---|---|---|
| Negative measuring error<br>Unstable indication | Gas or air bubbles in the liquid or inside the density transducer | Increase pressure in product line |
| | | Deaerate product line |
| | | Increase flow velocity in the transducer |
| Positive measuring error<br>Long-term drift | Deposits inside the transducer | Increase flow velocity to approx. 5 m/sec., for example |
| | | Flush away sediments inside the density transducer with detergent (ensure that wetted parts are corrosion-resistant) |
| | | Clean transducer pipe various times with a sphere and by applying the appropriate pressure |
| Negative measuring error<br>Long-term drift | Corrosion | Check material resistance of the density transducer |
| | Abrasion | Reduce flow velocity in the transducer (recommende value < 1 m/s) |
| Indication does not change or is moving too slow | Flow velocity too low or zero | Open all shut-off valves |
| | | Increase flow velocity in the transducer |

Defects caused by sedimentation, corrosion or abrasion can often be seen after the density transducer has been dismounted.
If necessary, the density transducer should be returned to the service department of Bopp & Reuther Messtechnik for recalibration or an on-site adjustment (see section 9) should be performed using the offset value $K_0$.

### 13.2 Errors/defects caused by the transmitter

| Symptom | Possible reason | Remedy |
|---|---|---|
| Current output does not react or reacts incorrectly | Power supply voltage too low | Check power supply voltage (> 14 V DC, < 30 V DC) |
| | Cable resistance too high | Larger cable cross section |
| | Transmitter is defective | Check current output (see section 14 *Self-monitoring functions*) Replace transmitter if necessary |
| | Upper range value has been reached | Expand measuring range (channels 5 and 6) |
| Current output is unsteady | Shield not grounded or bonding conductor not connected | Ground cable shield or connect bonding conductor in cable gland |
| Display blinks constantly | Power supply voltage too low | Supply voltage must be > 14 V DC at the terminal |
| Empty display | Power supply voltage too low | Check supply voltage |
| | Transmitter is defective | Replace transmitter |
| Channel ] shows error number | see error code table, section 13.2.1 | |
| Wrong density or concentration is displayed or temperature is "not" compensated | Wrong parameterization (e.g. wrong unit for temperature coefficient alpha) | Check the programmed log data and their signs (equations in section 11 might be helpful) |
| | Specified measuring range has been exceeded | Requires new programming data |
| No frequency signal or senseless frequency between test terminals on display board | Air or gas bubble in the liquid | see section 13.1 *Errors/defects caused by the liquid* |
| | Transmitter is incorrectly connected to transducer | Check sensor connections |
| | Defective transducer | Check transducer coils if necessary (see section 13.3) |
| | Transmitter is defective | Replace transmitter |
| Displayed temperature is wrong | Transmitter is incorrectly connected to transducer | Check Pt1000 connections |
| | Defective transducer | Check temperature sensor (see section 13.3) |

### 13.2.1 Error code table

| No. | Description | Remedy |
|---|---|---|
| 0 | No error occurred | |
| 1 | Watchdog reset or interruption of power supply | Check power supply voltage |
| 2 | P1000 line short-circuited | Resolve short-circuit, return device to Bopp & Reuther Messtechnik, if necessary |
| 3 | P1000 line interrupted | Re-establish connection, return device to Bopp & Reuther Messtechnik, if necessary |
| 33 | Error in HART® protocol | Contact Bopp & Reuther Messtechnik |
| 42 | Data error in the A/D converter | Contact Bopp & Reuther Messtechnik |
| 75 | Device temperature exceeds quartz calibration interval | Control device environment |

All error messages can be deleted by pressing the "P" key when the programming line is activated in channel "]". If the error number re-appears on the display, the error source has not been resolved.

### 13.3 Errors/defects caused by the density transducer

Disconnect the device, open the screw-down cover, loosen the two fastening screws of the electronics and carefully remove the electronics. For the version with control unit, the digital display must be screwed off first. Disconnect all coil and temperature sensor cables from the transducer in order to check the resistances in accordance with the following data:

- Resistance of the transducer coil at 20°C between blue (BU) and yellow (YE) 60 Ω
- Resistance of the excitation coil at 20°C between black (BK) and white (WH) 125 Ω
- Resistance against mass > 100 MΩ

The wires of the temperature transducer are marked with a black shrinkdown sleeve.

Resistance levels PT1000 between blue (BU) and yellow (YE)

| Temperature (°C) | -20 | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 |
|---|---|---|---|---|---|---|---|---|---|
| Resistance (Ω) | 922 | 1000 | 1078 | 1155 | 1232 | 1309 | 1385 | 1460 | 1536 |

| Symptom | Possible reason | Remedy |
|---|---|---|
| Coil resistance is zero or infinite | Coil is defective | Return density with transmitter to Bopp & Reuther Messtechnik |
| Resistance of Pt1000 is zero or infinite | Pt1000 is defective | Return density with transmitter to Bopp & Reuther Messtechnik |
| Short circuit between cable and housing | Frame connection | Return density with transmitter to Bopp & Reuther Messtechnik |

# 14 Self-monitoring functions

## 14.1 Monitoring supply voltage

After a power failure a power-ON reset will be carried out, and the error code 1 will be displayed in channel "[" or the error will be reported via HART®.

## 14.2 Error message

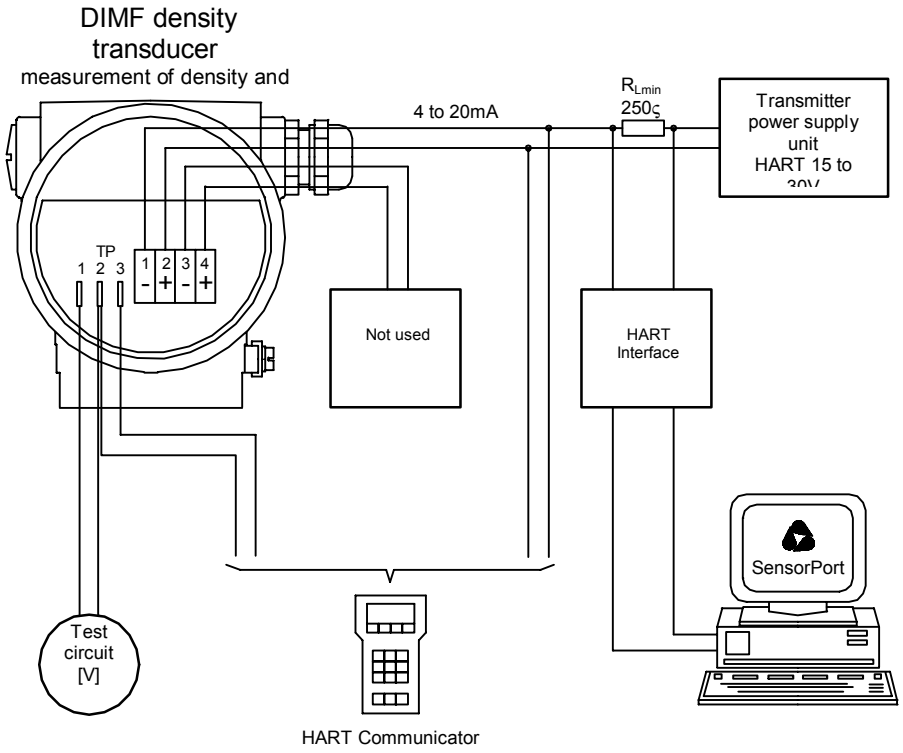
An error code will be displayed on channel "]". The error that was reported last will be displayed. For the corresponding error description, see section 13.2.1 *Error code table*.

# 15 Service

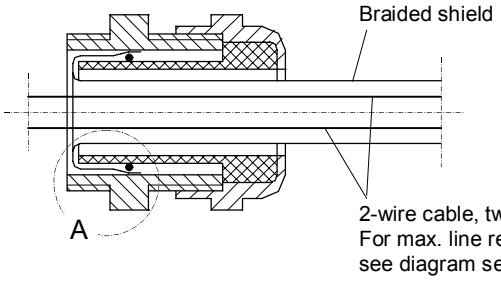
Bopp & Reuther
Messtechik GmbH
Service Abt. MRV-S
Am Neuen Rheinhafen 4
67346 Speyer
Phone: +49 (0) 6232 657-0
Fax: +49 (0) 6232 657-505

# 16 Appendix

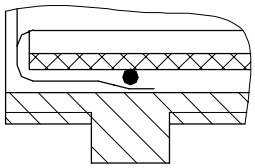
## 16.1 Wiring diagram




Grounding the cable shield

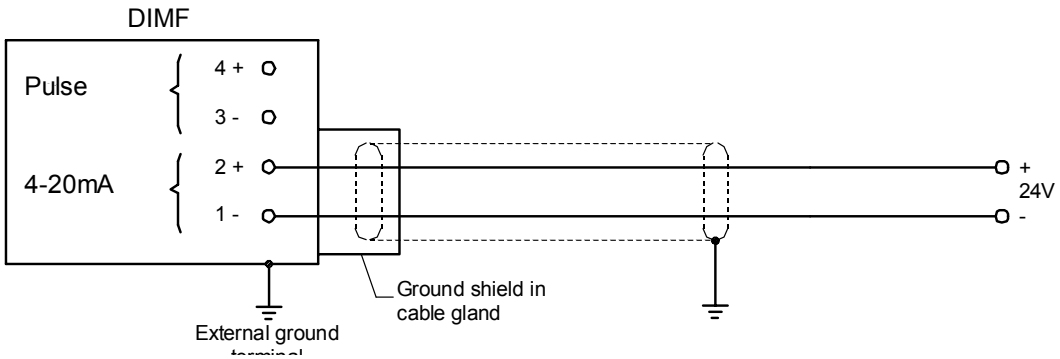



Detail A

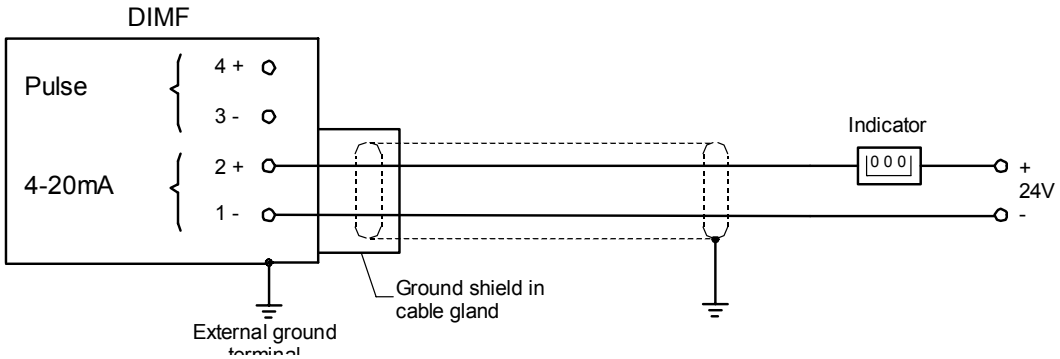


## 16.2 Application examples for safe areas

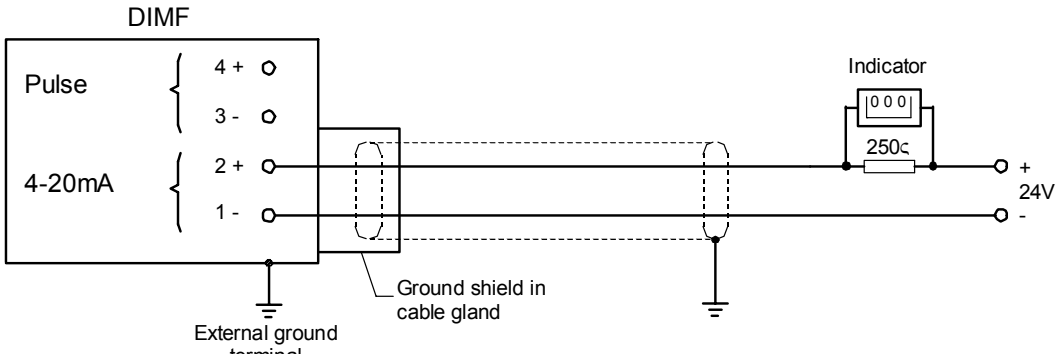
Local indication without signal transmission




Analog transmission 4 to 20mA to indicator or recorder

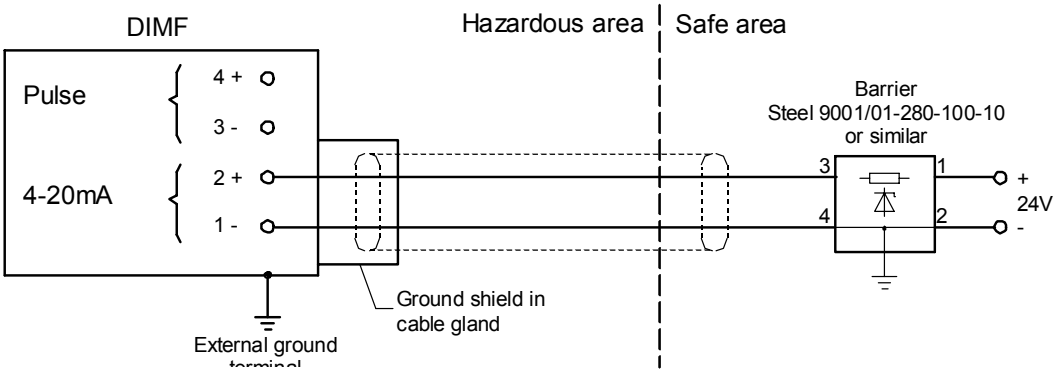



Analog transmission 1 to 5V to indicator or recorder

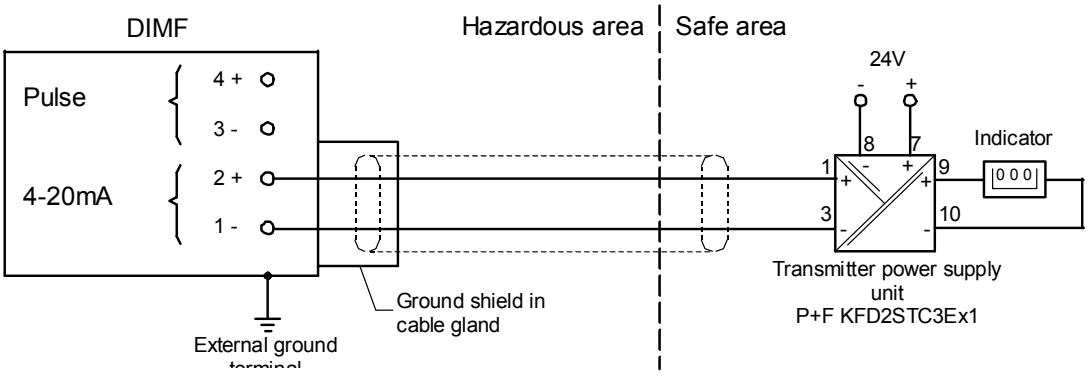


## 16.3 Application examples for hazardous areas

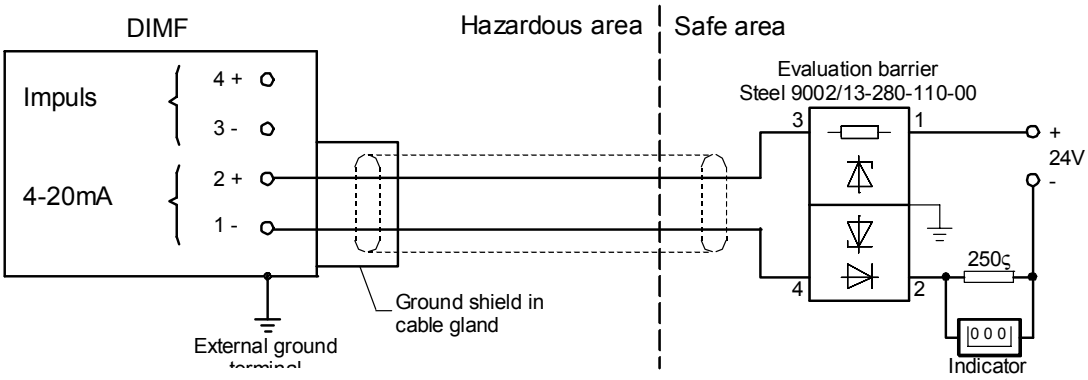
Local indication without signal transmission




Analog transmission 4 to 20mA, electrically isolated,
to indicator or recorder




Analog transmission 1 to 5V to indicator or recorder



## 16.4 Example of configuration log

| Pag 1/1<br>4/11/99<br>9:21:04 | **Dichte/Konz. Transmitter DIMF**<br>(Bopp & Reuther Messtechnik GmbH)<br>Configuration file: | Bopp & Reuther<br>Messtechnik GmbH |
|---|---|---|

### Measuring point

| | | | |
|---|---|---|---|
| Denominator | ***TEST*** | Date | ***23/06/1999*** |
| TAG no. | ***TEST*** | | |
| Production no. | ***33105*** | | |
| Message for user | ***WITH TRANSDUCER COIL CONNECTION*** | | |

### Manufacturer information

| | | | |
|---|---|---|---|
| Type name | ***DIMF*** | Universal command | ***5*** |
| Manufacturer | ***Bopp & Reuther Messtechnik GmbH*** | Device-spec. command rev. | ***7*** |
| Device type | ***Typ 238*** | Software revision | ***1*** |
| Device identification | ***14*** | Hardware re[illegible]n | ***2.0*** |

### Measuring range

| | | | | |
|---|---|---|---|---|
| Upper range value | ***10000.00*** | % | Pr[illegible]ion r | ***33105*** |
| Lower range value | ***0.00*** | % | | |
| Minimum meas. range | ***0.00*** | % | | |

### Output (PV)

| | |
|---|---|
| Upper range va[illegible] | ***1.20*** |
| Lower range[illegible]ue | ***70*** |
| Dimension[illegible] | ***%*** |
| Transfer fu[illegible] | ***Li*** |
| Damping in seconds[illegible] | ***3.*** |

### Model code

***DIMF2.0-TRv-EXI-71-S12-M-1-H***

### Operation

| | |
|---|---|
| Alarm code | *off* |
| Operating mode | ***1:concentration f(t)*** |

### Transducer constants

| | | |
|---|---|---|
| $K_0$ | ***-5806.77002*** | (-100000...100000) |
| $K_1$ | ***16.19601*** | (-100000...100000) |
| $K_2$ | ***41.28275*** | (-100000...100000) |
| $K_{T0}$ | ***-2.65598*** | (-10...10) |
| $K_{T1}$ | ***-5806.77002*** | (-100...0) |
| $K_{T2}$ | ***-5806.77002*** | (-10...10) |

### Constants of liquid

| | | |
|---|---|---|
| $K_{C0}$ | ***0.00000*** | (-100000...100000) |
| $K_{C1}$ | ***0.00000*** | (-100000...100000) |
| $K_{C2}$ | ***0.00000*** | (-100000...100000) |
| $K_{X0}$ | ***0.00000*** | (-100000...100000) |
| $K_{X1}$ | ***0.00000*** | (-100000...100000) |
| $K_{X2}$ | ***0.00000*** | (-100000...100000) |
| $K_{X3}$ | ***0.00000*** | (-100000...100000) |
| alpha | ***0.00000*** | (0.0...10) |
| Tref | ***20.00*** | (-50...210) |
| Tkal | ***20.10*** | (-50...210) |



## 16.5 EC prototype test certificate

# Prüf- und Zertifizierungsstelle

# ZELM Ex

(1) # EC-TYPE-EXAMINATION CERTIFICATE

**(Translation)**

(2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres - **Directive 94/9/EC**

(3) EC-TYPE-EXAMINATION CERTIFICATE Number:

## ZELM 99 ATEX 0008 X

(4) Equipment: **Density Meter DIMF *.* T** ...**

(5) Manufacturer: **Bopp & Reuther Messtechnik GmbH**

(6) Address: **D-68305 Mannheim**

(7) This equipment and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The Prüf- und Zertifizierungsstelle ZELM Ex, notified body No. 0820 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.

The examination and test results are recorded in the confidential report ZELM Ex 0569815009.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

**EN 50 014: 1997** **EN 50 020: 1994** **EN 50 284: 1997**

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type-examination Certificate relates only to the design and construction of the specified equipment in accordance with Directive 94/9/EC. Further requirements of this Directive apply to the manufacture and supply of this equipment.

(12) The marking of the equipment shall include the following:

Ex **II 1/2 G EEx ia IIC T4**

Zertifizierungsstelle **ZELM Ex**

Braunschweig, October 29, 1999

Dipl.-Ing. Harald Zelm

Zertifizierungsstelle ZELM Ex

(13) # SCHEDULE

(14) **EC-TYPE-EXAMINATION CERTIFICATE ZELM 99 ATEX 0008 X**

(15) Description of equipment

The density meter is made for continuous measuring of density or concentration of liquids, liquid mixtures or multi-phase fluids.
Essentially it consists of the fork enclosure, made of stainless steel containing the pipe fork or the vibration fork with the measured fluid inside, and the electronical transmitter within a housing of cast aluminium alloy. Variation of the natural frequency of the fork due to density variation of the fluid is measured by the sensor coil and transformed by the transmitter into a density-proportional signal. The transmitter housing is mounted on the fork enclosure with an extension tube or separated as wall mounting. In this case there is a terminal box mounted on the extension tube.
The model DIMF *.* T** ... density meter is intended for use in potentially explosive atmospheres. Its supply circuit must be a certified intrinsically safe supply and signal circuit
The density meter permits bidirectional communication by HART protocol.
Dependent on the measured fluid the fork may be assessed as category 1G. Also a flammeble non-explosive medium is possible.

Electrical data

supply- / signal circuit (KL 1.1 and KL1.2)

type of protection Intrinsic Safety EEx ia IIC

only for connection to certified intrinsically safe circuits with the following max. values:

$U_o$ = 30 V
$I_o$ = 110 mA
$P_o$ = 825 mW

effective internal capacitance and inductance:

$C_i$ ≤ 34 nF
$L_i$ ≤ 0,6 mH

(16) Report No. ZELM Ex 0569815009

(17) Special conditions for safe use

The equipment is fit for an ambient temperature of -40 °C up to +58 °C related to transmitter electronics. Temperature of the measured fluid may come up to +210 °C.
The assignment of temperature class and maximum medium and ambient temperature is shown as follows:

Optional heat insulation may cover the half of the extension tube.
Ambient temperature has to be met just beyond the electronics or terminal housing.
Minimum medium and ambient temperature is –40 °C.

| **DIMF *.* TV* (Extension tube)** | | | |
|---|---|---|---|
| Class | T ambient [°C] electronics | T medium [°C] | Type |
| T2 | 46 | 210 | **H** |
| T3 | 46 | 200 | High temperature |
| T3 | 49 | 170 | |
| T3 | 50 | 150 | **S+H** |
| T4 | 52 | 135 | Standard temperature |
| T4 | 54 | 110 | and |
| T4 | 58 | 60 | High temperature |
| **DIMF *.* TW* (Wall mounting)** | | | |
| Electronics Ambient temp.: | | 58 °C | |
| Class | T ambient [°C] terminal box | T medium [°C] | Type |
| T2 | 67 | 210 | **H** |
| T3 | 68 | 200 | High temperature |
| T3 | 71 | 170 | |
| T3 | 73 | 150 | **S+H** |
| T4 | 74 | 135 | Standard temperature |
| T4 | 77 | 110 | and |
| T4 | 80 | 80 | High temperature |

Due to these limits the maximum temperature of electronic parts will meet the amount of 60 °C.

(18) Essential Health and Safety Requirements

met by standards

Zertifizierungsstelle **ZELM Ex** Braunschweig, October 29, 1999

Dipl.-Ing. Harald Zelm

Zertifizierungs- und Prüf- stelle Zelm Ex ZELM Ex

# Prüf- und Zertifizierungsstelle

# ZELM Ex

# 1. Supplement

(Supplement according to EC-Directive 94/9 Annex III letter 6)

## to EC-type-examination Certificate

## ZELM 99 ATEX 0008 X

| | |
|---|---|
| Equipment: | **Density Meter DIMF *.* T**...** |
| Manufacturer: | **Bopp & Reuther Messtechnik GmbH** |
| Address: | **D-68305 Mannheim** |

Description of supplement

The address is changed to: **D-67346 Speyer**

The Density Meter DIMF *.* T**... will be supplemented by an alternative version with an increased pipe diameter. The type designation of this new version is DIMF 2.1 T**....

The modifications concern to the construction and the type designation of the equipment.

The "Special conditions for safe use" are supplemented.

All further data remain unchanged and are valid also for this 1. Supplement.

Report No.

ZELM Ex 1160415273

Special conditions for safe use

The special conditions of the EC-type-examination Certificate ZELM 99 ATEX 0008 X are valid further on. The following is additionally applied:

For the operation with mediums which require the category 1, impact and friction - for instance by solid parts in the medium - must be safely avoided.

Essential Health and Safety Requirements

The Essential Health and Safety Requirements are further met by adherence to the standards which are given in the EC-type-examination Certificate.

Zertifizierungsstelle **ZELM Ex**

Zertifizierungsstelle und Prüfstelle ZELM Ex

Braunschweig, October 18, 2004

Adolf Gruber

EXAM
BBG Prüf- und Zertifizier GmbH

**Translation**

(1) # EC-Type Examination Certificate

(2) **- Directive 94/9/EC -**
**Equipment and protective systems intended for use in potentially explosive atmospheres**

(3) ## BVS 04 ATEX E 020 X

(4) **Equipment:** **Liquid density meter type DIMF*.**** ...**

(5) **Manufacturer:** **Bopp & Reuther Messtechnik GmbH**

(6) **Address:** **D - 67346 Speyer**

(7) The design and construction of this equipment and any acceptable variation thereto are specified in the schedule to this type examination certificate.

(8) The certification body of EXAM BBG Prüf- und Zertifizier GmbH, notified body no. 0158 in accordance with Article 9 of the Directive 94/9/EC of the European Parliament and the Council of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.
The examination and test results are recorded in the test and assessment report BVS PP 04.2031 EG.

(9) The Essential Health and Safety Requirements are assured by compliance with:

| | |
|---|---|
| EN 50014:1997+A1-A2 | General requirements |
| EN 50018:2000 +A1 | Flameproof enclosure ´d´ |
| EN 50020:2002 | Intrinsic safety ´i´ |

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-Type Examination Certificate relates only to the design, examination and tests of the specified equipment in accordance to Directive 94/9/EC.
Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate

(12) The marking of the equipment shall include the following:

**II 2G EEx d [ib] IIC T4**

**EXAM BBG Prüf- und Zertifizier GmbH**
Bochum, dated 25. Februar 2004

Signed: Jockers
Certification body

Signed: Eickhoff
Special services



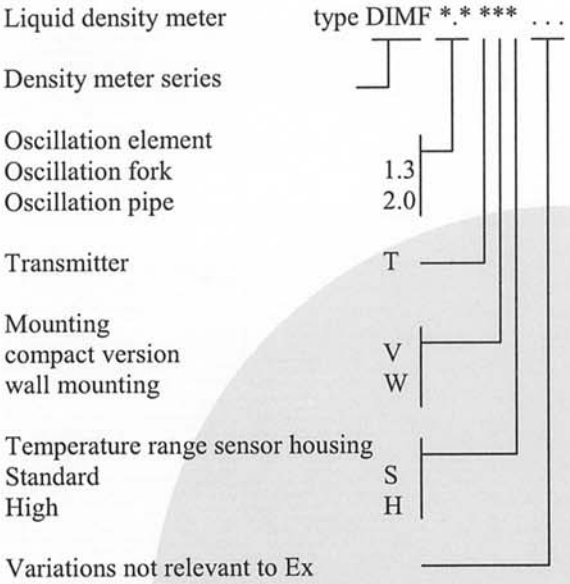
Dinnendahlstrasse 9 44809 Bochum Germany Phone +49 201 172-3947 Fax +49 201 172-3948
(until 31.05.2003: Deutsche Montan Technologie GmbH Am Technologiepark 1 45307 Essen Germany)

(13) Appendix to

(14) # EC-Type Examination Certificate

## BVS 04 ATEX E 020 X

(15) 15.1 Subject and type




15.2 Description

The liquid density meter type DIMF*.**** ... consists of a electronic housing according to EC Type Examination Certificate DMT 00 ATEX E 010 U closed with threaded covers. The electronic housing provides two compartments of different size, one designed as flameproof terminal compartment the other one designed as electronic compartment fitted with intrinsically safe electronic modules.

For mounting purposes of an associated sensor, the housing is fitted with an adapter. The intrinsically safe sensor may be separated from or directly combined with the enclosure. The adapter is related to the electronic compartment.

The terminal compartment - type of protection flameproof enclosure "d" - is equipped with a combined current limiting and safety shunt assembly module, providing terminals for interconnection of the non intrinsically safe 4 - 20 mA supply and signal circuit. A cable entry certified for this purpose is used to lead the non-intrinsically safe circuit into the terminal compartment.

The intrinsically safe output circuit of the current limiting and safety shunt assembly module is led into the electronic compartment via feed-through capacitors.

The electronic compartment of the liquid density meter only contains intrinsically safe electronic modules (according to EC Type Examination Certificate ZELM 99 ATEX 0008 X) transferring measuring data from an intrinsically safe sensor circuit into the non intrinsically safe 4 - 20 mA supply and signal circuit.



Dinnendahlstrasse 9 44809 Bochum Germany Phone +49 201 172-3947 Fax +49 201 172-3948
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The threaded cover of the electronic compartment is equipped alternatively with a glass window for inspection purposes of the LCD display below.

The intrinsically safe sensor - directly combined with the housing or installed separately - consists of a stainless steel sensor housing fitted with an oscillation fork / oscillation pipe passed by the measured medium.

With regard to construction, the sensor of the liquid density meter type DIMF*.**** ... is identical with the sensor of the intrinsically safe liquid density meter type DIMF *.*T**... according to EC Type Examination Certificate ZELM 99 ATEX 0008 X.

15.3 Parameters

15.3.1 Non intrinsically safe supply and signal circuit (4 - 20 mA current loop)

| | | | | |
|---|---|---|---|---|
| Rated voltage | $U_N$ | DC | 24 | V |
| Maximum permitted voltage for normal operation | | DC | 28,5 | V |
| | $U_m$ | AC | 250 | V |
| Power consumption | $P_N$ | | 1 | W |

15.3.2 Internal intrinsically safe supply and signal circuit
(internal safety shunt assembly providing current limitation; level of protection EEx ib IIC

| | | | | |
|---|---|---|---|---|
| Voltage | $U_o$ | DC | 30 | V |
| Short circuit current | $I_o$ | | 26,6 | mA |
| Power | $P_o$ | | 798 | mW |

15.3.3 Ambient temperature range
Flameproof electronic housing: $-40\ °C \le T_a \le +60\ °C$
and directly combined or separated intrinsically safe sensor
according to ZELM 99 ATEX 0008 X: $-40\ °C \le T_a \le +58\ °C$

(16) Test and assessment report
BVS PP 04.2031 EG as of 25.02.2004

(17) Special conditions for safe use

17.1 The "-" - terminal of the non intrinsically safe supply and signal circuit is interconnected to the housing. Grounding of the non intrinsically safe supply and signal circuit / of the housing shall comply with clause 6.6 of EN 50020:2002.

17.2 The liquid density meter type DIMF*.**** ... is designed for use in an ambient temperature range $-40\ °C \le T_a \le +60\ °C$, related to the electronic assembly within the flameproof electronic housing.
A temperature of the measured medium up to 210 °C is permitted.
Temperature class grouping in relation to maximum ambient / medium temperature is listed in the table below.

An insulation versus excessive heat - installed additionally - may cover half of the spacing-tube as a maximum. The permitted ambient temperature shall be met in the environment directly aside the flameproof electronic housing.



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| **DIMF *.* TV * (compact version)** | | | |
|---|---|---|---|
| temperature class | T Ambient [°C] electronic assembly | T medium [°C] | type |
| T2 | 46 | 210 | H |
| T3 | 46 | 200 | High temperature |
| T3 | 49 | 170 | |
| T3 | 50 | 150 | S+H |
| T4 | 52 | 135 | Standard temperature |
| T4 | 54 | 110 | and |
| T4 | 58 | 60 | High temperature |

**DIMF *.* TW (wall mounting)**

ambient temperature- electronic assembly: 58°C

| temperature class | T ambient [°C] terminal compartment | T medium [°C] | type |
|---|---|---|---|
| T2 | 67 | 210 | H |
| T3 | 68 | 200 | High temperature |
| T3 | 71 | 170 | |
| T3 | 73 | 150 | S+H |
| T4 | 74 | 135 | Standard temperature |
| T4 | 77 | 110 | and |
| T4 | 80 | 80 | High temperature |

We confirm the correctness of the translation from the German original.
In the case of arbitration only the German wording shall be valid and binding.

44809 Bochum, 25. February 2004
BVS-Schä/Kw A 20020701

**EXAM BBG Prüf- und Zertifizier GmbH**

Certification body

Special services



Dinnendahlstrasse 9 44809 Bochum Germany Phone +49 201 172-3947 Fax +49 201 172-3948
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