

## Service Handbook

# Universal 3-Beam ultrasonic flowmeter

**UFM 3030 K/...EEx compact ultrasonic flowmeter**  
**UFC 030 F/...EEx ultrasonic flow converter**  
**UFS 3000 F/...EEx ultrasonic flow sensor**




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Electromagnetic flowmeters

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Variable area flowmeters

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Mass flowmeters

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**Ultrasonic flowmeters**

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Vortex flowmeters

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Flow controllers

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Level measuring instruments

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Pressure and temperature

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Heat metering

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Communications technology

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Switches, counters, displays and recorders

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Engineering systems & solutions

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## General advice on safety

- Do not install, operate or maintain this flow meter without reading, understanding and following the factory-supplied instructions, otherwise injury or damage may result.
- Read these instructions carefully before starting installation and save them for future reference.
- Observe all warnings and instructions marked on the product.
- Use only mains supply with protective earthing connected.
- Do not use the product with removed covers under wet conditions.
- Consider handling and lifting instructions to avoid damage.
- Install the product securely and stable.
- Install and connect cabling proper to exclude damage or harmful situations.
- If the product does not operate normally, refer to the service instructions or refer to qualified KROHNE service engineers.
- There are no operator-serviceable parts inside the product.

The following symbols may appear in this manual or on the product



ATTENTION: refer to operating and installation instructions!



DANGER: risk of electric shock!



PROTECTIVE conductor terminal!

These terms may appear in this manual or on the product:

WARNING statement: identify conditions or practice that could result in injury or loss of life.



CAUTION statement: identify conditions or practice that could result in damage to the product or other property.



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## Disclaimer

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- This document contains important information on the product. KROHNE attempts to be as accurate and up-to-date as possible but assumes no responsibility for errors or omissions. Nor does KROHNE make any commitment to update the information contained herein. This manual and all other documents are subject to change without prior notice.
- KROHNE will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect, incidental, punitive and consequential damages.
- This disclaimer does not apply in case KROHNE has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.
- Any product purchased from KROHNE is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.
- KROHNE reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

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## Product liability and warranty

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- Responsibility for suitability and intended use of this ultrasonic flow meter rests solely with the user. Improper installation and operation of the flow meter (system) may lead to loss of warranty.
- In addition, the Terms and Conditions of Sale are applicable and are the basis for the purchase contract.
- If flow meters need to be returned to KROHNE, please note the information given on the last pages of the installation and operating instructions. KROHNE regrets that they cannot repair or check flow meter(s) unless accompanied by the completed form (see last pages of the installation and operating instructions).

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## Items included with order

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- UFM 3030 ultrasonic flow meter, comprising of a flow sensor, UFS 3000 and a signal converter, UFC 030 either built together as a compact system or supplied as two separate pieces, in the size as indicated on the packaging box
- Signal cable (only in case of a separate system)
- Special tool for opening the converter housing

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## Documentation supplied

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- Condensed installation and operating manual
- For Ex-units: installation and operating instructions for use in hazardous areas
- Instruction card: overview of the configuration menu and display markers
- Product information CD
- Approval documents, unless reproduced in the installation and operating instructions
- Certificate of system calibration data

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This instrument is developed and manufactured by:

KROHNE Altometer  
Kerkeplaat 12  
3313 LC Dordrecht  
The Netherlands

For information, maintenance or service please contact your nearest local KROHNE representative.

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## **Notes on the service handbook**

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This service handbook is divided into four parts for easy use. All ultrasonic flow meters are factory-set to your order specifications. Therefore, no further adjustments are necessary prior to initial start-up. Condensed installation and operating instructions are available for installation and initial start-up.

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|--------|--|
| Part A | Chapters 1, 2 and 3; System installation and start-up. Installation, connecting and powering the flow meter. |
| Part B | Chapters 4 and 5; The signal converter. Operator control and functioning of the signal converter.            |
| Part C | Chapters 6 and 7; Functional checks and service. Servicing the flow meter.                                   |
| Part D | Chapters 8, 9 and 10; Technical data. dimensions, block diagram and ultrasonic measuring principle.          |

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## Part A System Installation and Start-up

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### 1 Introduction

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#### 1.1 Cautions

Only for flow meters supplied with a voltage over 50 VAC.



**Refer all maintenance or service to trained KROHNE service engineers.**

Mains power shall be disconnected from the product before performing any maintenance.

This product is prepared for and can only function with the rated AC mains voltage as indicated on the nameplate.

This product is a Class 1 device (earthed) and requires a correct connection to protective earth. The protective earth conductor of the main power shall be properly connected to the marked protective earth terminal to ensure safety from electric shock for the operator and its environment. For detail refer to this service handbook.

#### 1.2 Unpacking and inspection

- This product has been thoroughly inspected and tested before shipment and is ready for operation.
- After carefully unpacking, inspect for shipping damage before attempting to operate. If any indication of mechanical damage is found contact immediately the responsible transport service and your local KROHNE representative.
- A simple operating check of the electronics after unpacking and before permanent installation is advisable to ascertain whether it has suffered damage during shipment. Confirm for the correct mains voltage printed on the nameplate. If it differs from the ordered product please contact your local KROHNE representative.
- After connecting to the mains, check if there is any indication on the display and if the backlight of the display is lighted. If not, contact your local KROHNE representative for advice.

#### 1.3 System description

The UFM 3030 ultrasonic flow meter is a precision instrument designed for linear, bi/directional flow measurement of liquids. Flow measurement values can be output via the standard analog and-or pulse/frequency outputs. Via a user friendly operator interface (HMI) the unit can be set up for a wide range of applications. Next to actual volumetric flow measurement the unit can be configured to perform flow totalization (plus, minus and sum). Also measurement and output of the liquid sonic velocity can be configured. Optionally the unit can be set to perform one of the following additional functions:

- Calculate and output corrected standard volumetric or mass flow using the external pressure and temperature inputs
- Batch function
- Heat function, combining T1, T2 and volume

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## 1.4 Available versions

The UFM 3030 consists of a flow sensor (UFS 3000) and a signal converter (UFC 030), which can be built into a compact flow meter, UFM 3030 K or a separate flow meter, UFM 3030 F. Both flow sensor and signal converter are available with an approval for use in hazardous areas. Special codes and regulations apply in these areas and are referred to in the instructions for hazardous area versions, supplied as a separate manual.



UFS 3000



UFC 030



UFM 3030 K

## 1.5 CE Approvals

### EMC, Electromagnetic Compatibility Directive

The product complies with the requirements of the harmonised standards under the EMC directive 89/336/EEC.

### Low Voltage Directive

The product complies with the requirements of the Low Voltage Directive 73/23/EEC and is designed in accordance with EN IEC 61010-1 first and second edition. (safety requirements for electrical equipment for measurement, control and laboratory use part 1)

Local safety regulations shall be observed in combination with the measures special to this product to avoid dangerous situations.

### Pressure Equipment Directive

The KROHNE organisation complies with the requirements of Module H of the Pressure Equipment Directive 97/23/EC (full quality assurance).

Please refer to the CE declaration for more detailed information.



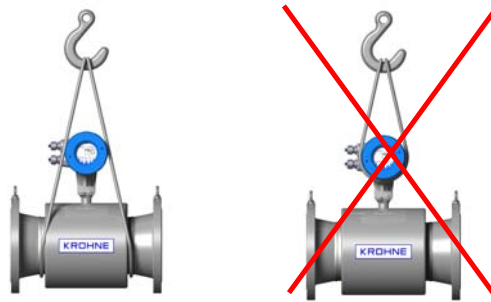
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## 2 Mechanical installation

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### 2.1 Handling the flowmeter

Important: Do not lift the compact flowmeter by the signal converter housing or the terminal box. Check the weight of the flowmeter as indicated on the type plate before handling the unit. When handling the flowmeter avoid hard blows, jolts or impacts.

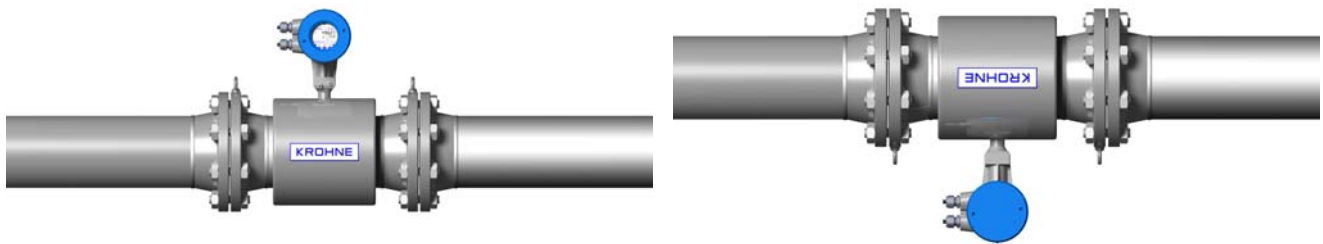


Do not place the flowmeter on the signal converter housing.

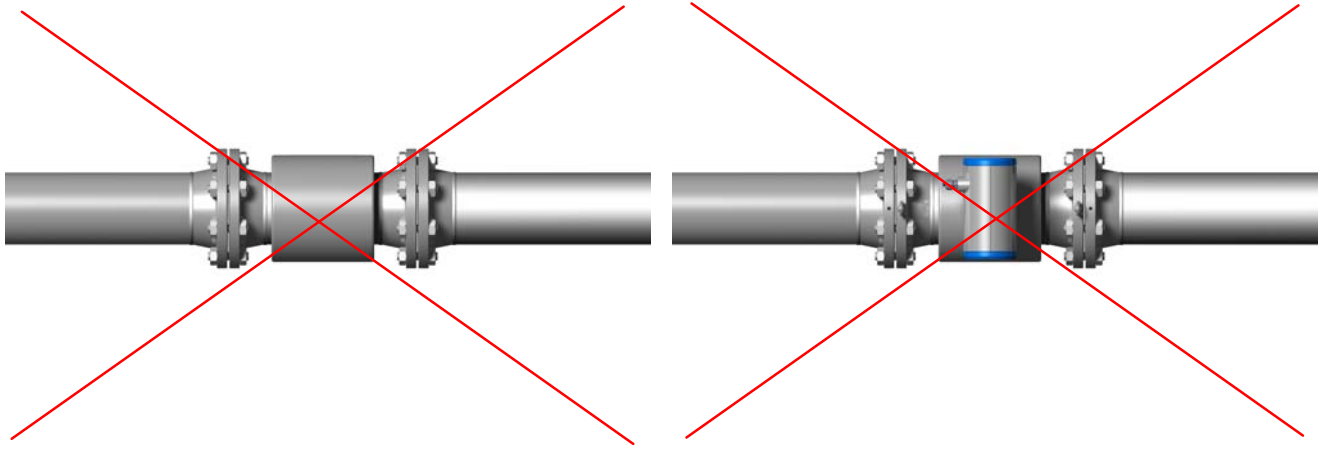


### 2.2 Installation location and position

The UFM 3030 flow meter can be installed in horizontal, slightly ascending or vertical pipelines. If installed in a horizontal or slightly ascending pipeline, always install the converter or terminal box in vertical position opposite the flow sensor either with the converter up or down, but never in horizontal position.







If required the position of the signal converter can be modified by turning the display circuit board through 90° or 180° to achieve a horizontal position of the display. In addition the signal converter housing may be turned through 90° opposite the flow sensor. For an exact description of this procedure, refer to chapter 8.6.

The measuring tube must be completely filled at all times for proper flow measurement, as the sensors become non-wetted, a loss of signal message will be displayed. There is no damage when this occurs.

Flow direction. The UFM 3030 is a bi-directional flow meter. Note the indicating arrow for the positive direction on the flow meter.

It is recommended to protect the signal converter from direct sunlight to prolong the life. Although no direct damage will occur, installation of a sunshield is advised. Do not expose the signal converter to excessive vibration. To protect the flow meter from excessive vibration support the pipeline on either side of the flow meter. Make sure there is sufficient room next to the pipe flanges to fit the bolts and nuts.

To achieve the specified accuracy of the flow meter, a straight inlet section of 10 × DN (DN = meter size) and an outlet section of 5 × DN should be applied.

Normally zero setting is not necessary, but if required the zero point can be checked and the meter can be re-zeroed under stationary flow conditions (see Function 1.01.03 of the converter menu). To force zero flow, a shut-off valve should be provided upstream and/or downstream of the flow sensor.

Mixing different fluid products. Install the flow meter upstream of mixing point or at minimum distance of 30× DN (DN = meter size) downstream of the mixing point, otherwise the flow measurement may be unstable.

Ambient temperature all flow meters: -40 to +65°C/ -40 to +149°F  
Product temperature compact flow meter: -25 to +140°C/ -13 F to +284°F  
Product temperature separate flow meter: -25 to +180°C/ -13 to +356°F  
Special versions are available for higher process temperatures.

In case of a pipeline running along a wall: please observe a minimum distance between pipe centreline and the wall of at least 0.5 m (1.6 ft).

### 2.3 Special installation requirements

To avoid measuring errors and malfunctioning of the flow meter due to gas or air inclusions or an empty pipe, please observe the following precautions:

Since gas will collect at the highest point of a pipe, installation of the flow meter at that location should be avoided at all times. Also installation in a down going pipe should be avoided since a completely filled pipe may not be guaranteed due to cascading affects. Additionally flow profile distortion is possible.

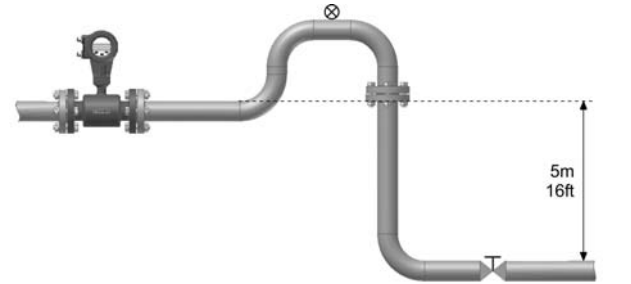
Long horizontal pipes: install in slightly ascending pipe section. If not possible, ensure adequate velocity to prevent air, gas or vapour from collecting in upper part of flow tube As a partially filled meter will report higher than actual flow rates, or not measure (as transducer pairs become non-wetted).



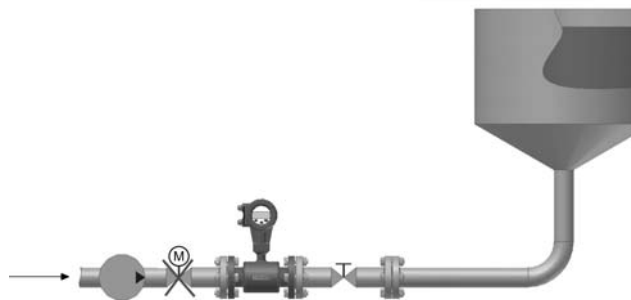
Open feed or discharge: Install meter in a lowered section of the pipe to ensure a full pipe condition through the meter.



Down going pipeline over 5 m (16 ft) length: install air vent downstream of the flow meter. To prevent vacuum. While this will not harm the meter, it may cause gases to come out of solution (cavitate) and interfere with proper measurements.



Always install control valves downstream of flow meter in order to avoid cavitation or distortion of flow profile.

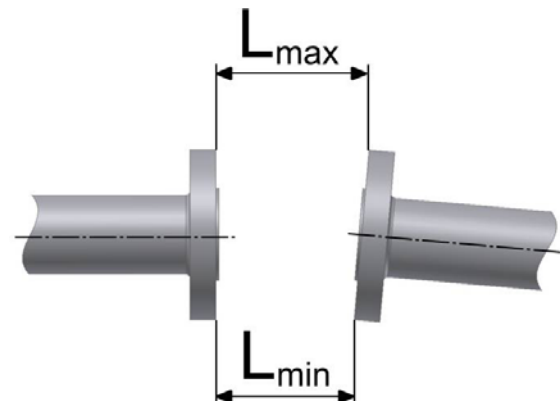


Never install flow meter on a pump suction side in order to avoid cavitation or flashing in the flow meter.



## 2.4 Pipe flanges

Refer to dimensional drawings for flange spacing and in addition allow for thickness of gaskets. Install flow meter in line with pipe axis. Pipe flange faces must be parallel to each other, max. Permissible deviation:  $L_{max} - L_{min} \leq 0.5 \text{ mm}$  (0.02").



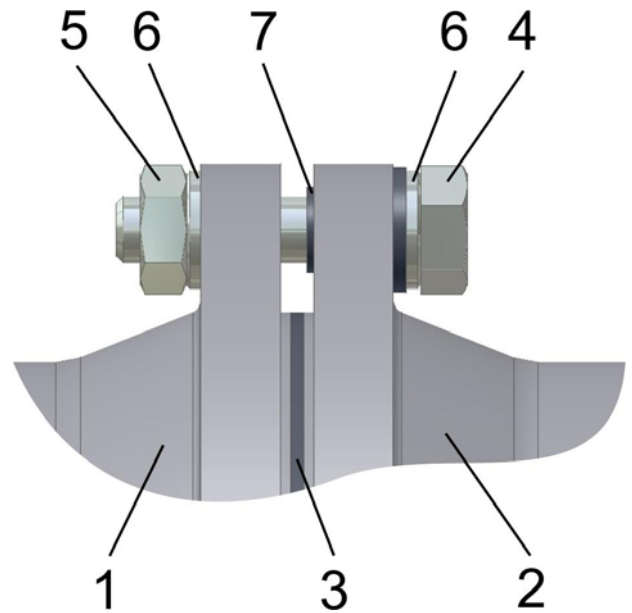
## 2.5 Pipes with cathodic protection

Pipes with electric corrosion protection are generally insulated inside and outside so that the fluid has no conductive connection to ground. The flow meter must be insulated from the pipe. Note the following when installing the flow meter:

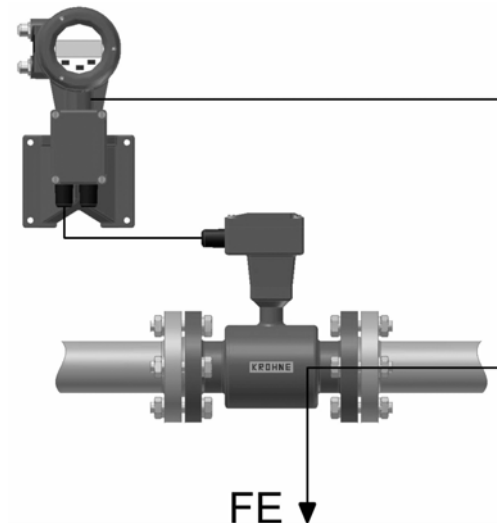
The pipe flanges must be connected to each other using a copper cable (L), but must not be connected to the flow meter.

The bolts for the flange connections and the gaskets must be insulated. Use sleeves and washers that are made of insulating material (these must be provided by customer).

1. Flange of flow sensor
2. Gasket
3. Pipe flange
4. Bolt
5. Nut
6. Washer
7. Insulating sleeve



Follow grounding instructions.  
Use  $\geq 4 \text{ mm}^2$  ( $\geq \text{AWG } 10$  cable).  
Note: No earthing cables are supplied by KROHNE.



## 3 Connecting the signal converter

### 3.1 Safety instructions

This product is designed for use in accordance with EN IEC 61010-1 for Installation Category 2 and Pollution Degree 2. Hazardous voltages are present within this product during normal operation. The product is designed for Protection Class I and should never be operated without protective earthing. The product shall also never be operated with covers removed unless equivalent protection of the operator and its environment from accidental contact with hazardous internal voltages is provided. Always follow basic and local safety precautions when using this product to reduce risk of injury from electrical shock, spread of fire or other dangerous situations.

### 3.2 Converter terminal box

- The converter terminal box is accessible after removing the rear (blind) cover of the electronics section using the special wrench supplied with the flow meter.
- Do not damage the screw thread and the gasket, never allow dirt to accumulate, and make sure that the screw thread is well greased, using Teflon grease at all times. A damaged gasket must be replaced immediately!
- Do not cross or loop the cables in the terminal box of the signal converter. Use separate cable entries for power supply and signal cables.
- Special regulations apply to installation in hazardous areas (see installation instructions for hazardous areas).

### 3.3 Power supply connection

In case of connection to the mains supply voltage:

Environmental conditions

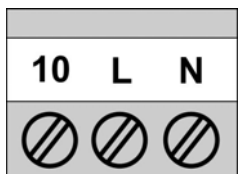
- The UFM3030 is designed to operate safe under the following conditions:
- Suitable for indoor and outdoor use, the instrument is usable up to protection category IP67 (IEC 60529)
- Use up to an altitude of 2000 m above sea level
- Suitable for an operation ambient temperature range  $-40^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$
- Suitable for an storage temperature range  $-40^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$
- Suitable for use in atmospheres with a relative humidity up to 80%
- Over voltages up to category II on the main supply voltage ( IEC 60364-4-443)
- Connected to protective earth conductor ( Protection Class I)
- Rated pollution degree 2



- This instrument is intended for permanent connection to the mains. It is required (for example for service) to mount an external switch or circuit breaker near the product for disconnection from the mains. It must be easily reachable by the operator and marked as the disconnecting device for this product. The switch or circuit breaker has to be suitable for the application and shall also be in accordance with local (safety) requirements and of the building installation. (IEC 60947-1/-3).
- The protective conductor clamp terminal size M5, press-fitted in the terminal compartment (near the main connection terminals), shall always to be connected to the protective earth conductor of the mains supply. Conductors up to  $4\text{ mm}^2$  (11 AWG) be connected to this terminal. The diameter of the conductors of the mains supply, including the protective earth conductor shall be in accordance with the general and local requirements.

- It is not allowed to use the protective conductor terminal for any other connection than the protective earth conductor.
- IP 67 is only warranted when using suitable cabling with the cable glands and covers mounted as specified.

The power supply terminals has three connections



There is a separate earthing that must be connected:

Terminal	Function
10	Reserved Ground connection
L / L1	Live power supply

**Specification**  
 Not for protective earthing  
 Mains voltage AC supply:  
 100 V AC < U < 240 V AC: -15%, +10%  
 SELV AC/DC supply:  
 DC: 18-32 V dc  
 AC: 24 V AC: -10% +15%

N / N1	Neutral power supply
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PE: Protective ground connection  
 FE: Functional ground connection

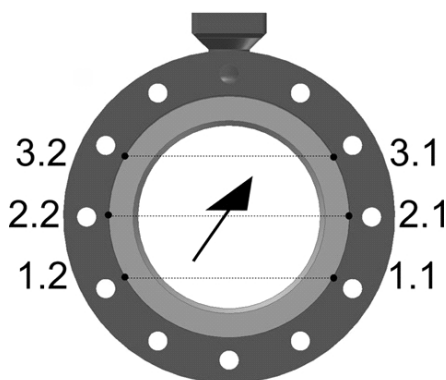
Protective conductor clamp terminal.  
 Conductors up to 4 mm<sup>2</sup> (11 AWG) need to be connected to this terminal.

### 3.4 Connection of sensor cables (UFM 3030 F only)

For the UFM 3030 F the sensors must be connected using the factory supplied MR06 cable between the flow sensor terminal box and the converter housing terminal box. For the UFM 3030C this is connected at the factory.

Both the flow sensor terminals and the converter sensor terminals should be connected using the appropriate numbers indicated on the sensor cable.)

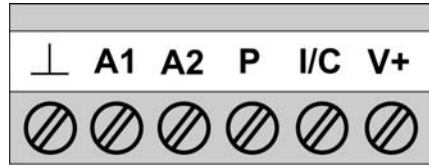
Cable diameter: 11 mm (0,433 inch), minimum bending radius: 8 x cable diameter.



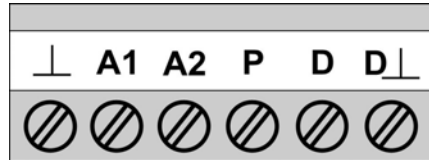
### 3.5 Electrical connection of the signal inputs and outputs

The terminal to connect the electrical signal inputs and outputs consist of 6 connections.

For standard instruments

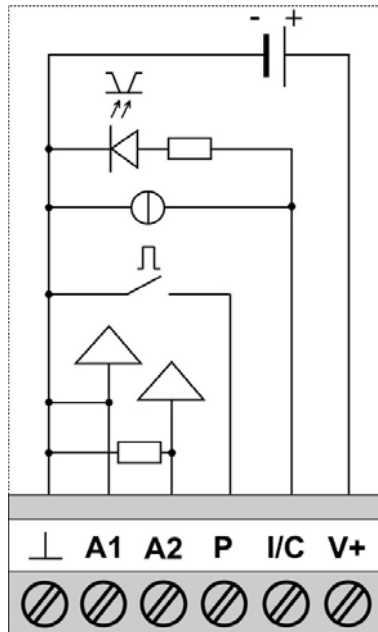


For instruments with a communication module



For wiring of the signal inputs and outputs it is advised to use unshielded twisted pairs.

Internal circuit of the signal inputs and outputs of the converter



Terminal	Function	Specification
⌊	Common ground	-
A1	Analog input 1, for temperature measurement. Configuration via menu option 3.2.2. and 3.2.3.	0(4) to 20 mA Ri = 58,2 Ω, fuse: 50 mA
A2	Analog input 2, for temperature or pressure measurement. Configuration via menu option 3.2.4. and 3.2.5.	0(4) to 20 mA Ri = 58,2 Ω, fuse: 50 mA
I/C	Combined Current output (I) and Digital input (C). Current output (I) Incl. Hart communication Function can be set via menu option 3.4.0. and 3.6.0.	Current output (I): I ≤ 22 mA, Rload ≤ 680 Ω. Umax = 15Vdc. Digital input (C): low = 0-5 VDC, high = 15-32 VDC. Will be switched off when current output activated.
P	Pulse/frequency output. Function can be set via menu option 3.5.0.	I max: 150 mA Umax: 32Vdc, 24Vac Max frequency: 2 kHz
V+	DC power supply from converter for active wiring of inputs and outputs	22 VDC at full load, 24 VDC maximum. I ≤ 100 mA.

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<b>D+</b>	Communication connection+	For fieldbus communication
<b>D-</b>	Communication connection -	For fieldbus communication
<b>P/I/C</b>	Combined current output (I) digital output (C) and pulse output (P). See individual I/C terminal and P terminal functions	See individual I/C terminal and P terminal specifications.

The electrical input and output signals can be connected either in active or in passive mode. In active mode DC supply voltage is provided from the V+ terminal. In passive mode supply voltage is provided from an external source. Please observe instrument polarity: current (I) is always flowing towards I, C, P, A1, A2 terminals (current sink).

Note! Never use the active and passive mode at the same terminal simultaneously.

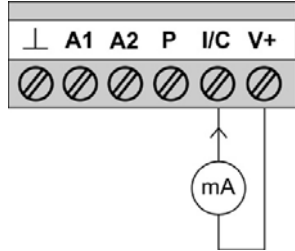
If HART communication is used, do not connect the pulse/frequency output P in active mode.

### 3.6 Connection diagram examples

In the following, some examples of how to connect the electrical input and output signals.

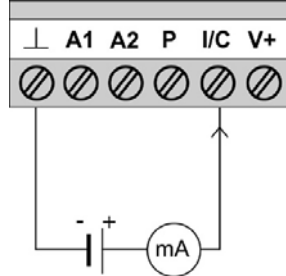
#### Current output

Active



$R_i \leq 680 \Omega$

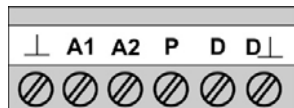
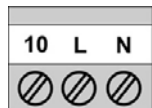
Passive



For supply:  $U = 15 - 24V_{dc}$ ,  $I \geq 22mA$

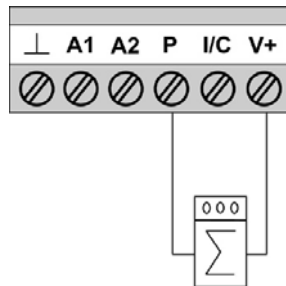
#### Pulse output

Active



$R1 \geq 470 \Omega$ ,  $R2 = U \cdot R1 / (V+ - U)$

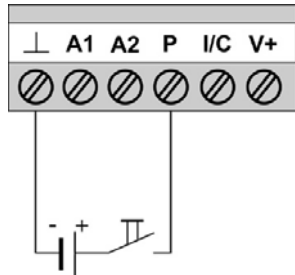
Passive



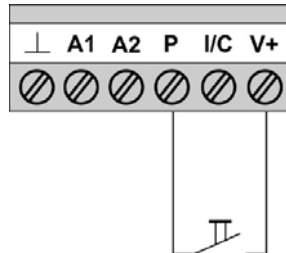
For supply:  $U \leq 32V_{dc}$ ,  $\leq 24V_{ac}$

#### Digital input

Active

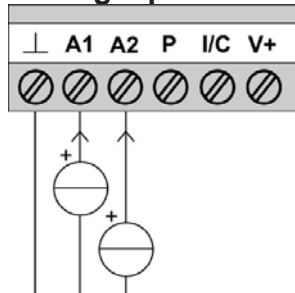


Passive



For supply:  $U = 15 - 30V_{dc}$ ,  $I \geq 1,5 mA$

#### Analog input





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## 4 Start-up

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- Check that the flow meter has been correctly installed.
- With separate systems, check before initial start-up that the correct converter (UFC 030 F) is used with the correct flow sensor (UFS 3000).
- Order No., see instrument nameplates
- Meter size (DN), Function 3.1.5
- Primary constant GK, Function 3.1.6
- Flow direction, Function 3.1.7
- When powered, the signal converter operates in the measuring mode. TEST, NO ERROR and IDENT NO. \_ \_ \_ \_ \_ of the signal converter appear in succession on the display. This is followed by display of the actual flow rate and/or the internal count on a continuous or alternating basis (depending on setting, see Function 3.03 Display or Function 1.02 Display).
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## Part B The signal converter

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### 5 Operating the signal converter

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#### 5.1 Front panel and operating keys

The front panel and its operating keys are accessible after removing the front (glass) cover of the electronics section using the special wrench supplied with the flowmeter.



When removing the cover, do not damage the screw thread and the gasket, never allow dirt to accumulate, and make sure that they are well greased using Teflon grease at all times. A damaged gasket must be replaced immediately!



1. Display 1st (top) line, measured value
2. Display 2nd (middle) line, units of measured value
3. Display 3rd (bottom) line with markers ▼ to identify actual displayed value, from left to right:  
Flow rate  
Velocity Of Sound VOS  
Total + Totalizer (forward flow)  
Total - Totalizer (reverse flow)  
Total  $\Sigma$  Totalizer sum (+ and -)
4. Compass field for error indication
5. Operating keys for programming the signal converter
6. Magnetic sensors to program the signal converter by means of a hand-held bar magnet (optional) without having to open the housing.

The function of the sensors is as follows: the left most sensor is equivalent to left key, the right most, the right key, and the top, the center key.

The converter is capable of displaying several types of measured values (depending on the programming under Submenu 1.02 or 3.03.00 DISPLAY), indicated by the markers at the display bottom line. Depending on the programming of Function 3.03.07 CYCL DISP, they can be selected manually at any time by pressing the  $\uparrow$  key or they are automatically cycled at 5 second intervals.

Depending on the programming of Function 3.03.08 ERROR MSG, errors are indicated by flashing display lines and/or by the compass field. For a description of the errors and what to do, see main menu Error/Totalizer.

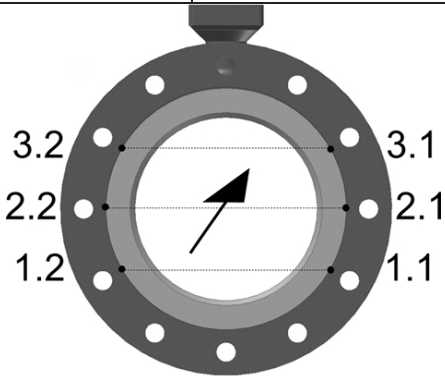


Key	Measuring mode	Menu mode	Data level
→	Go to the parameter setting mode, function 1.00.00 OPERATION. If access CODE 1 is activated, CODE 1 must be entered first. Using function 3.07.02 access CODE 1 can be activated or deactivated.	Go to the next, lower menu level.	Go to the next character or change line (only when 2 lines are displayed)
↵	Go to the error/Totalizer reset mode (via "CODE 2")	Return to the previous (higher) menu level or leave the menu mode.	Accept entered value
↑	Cycle through measured values, see Function 3.03.07 CYCL DISP	Cycle through menu options within actual menu level.	Cycle active digit up to new values

Function	Text	Description and settings
0.00.00	ERROR/TOT	Main menu 0.00.00 Error/Totalizer
0.00.01	VIEW ERR	View error messages list
0.00.02	RST ERR	Reset error messages
		NO RESET (keep error messages list) RESET (reset error messages list)
0.00.03	RST TOTAL	Reset Totalizer (option available depending on setting in 3.7.8) RESET ALL (reset all Totalizer values) NO RESET (keep Totalizer values)

1.00.00	OPERATION	Main menu 1.00.00 Operation
1.01.00	FLOW	Submenu 1.01.00 Flow
1.01.01	FULL SCALE	Full-scale value for 100% volume flow rate, see Function 3.01.01
1.01.02	ZERO VALUE	Zero value, see Function 3.01.02
1.01.03	ZERO CAL	Zero calibration, see Function 3.01.03
1.01.04	MASTER TC	Master time constant, see Function 3.01.04
1.01.05	LF CUTOFF	Low-flow cut-off, see Function 3.01.05
1.01.06	CUTOFF ON	Cut-off active, see Function 3.01.06
1.01.07	CUTOFF OFF	Cut-off de-active, see Function 3.01.07
1.02.00	DISPLAY	Submenu 1.02.00 Display
1.02.01	DISP FLOW	Display of flow, see Function 3.03.01
1.02.02	DISP TOTAL	Function of Totalizer, see Function 3.03.02
1.02.03	TOTAL VOL	Display of Totalizer, see Function 3.03.04
1.03.00	PULSE OUTP	Submenu 1.03.00 Pulse output
1.03.01	PULSE RATE	Pulse frequency value for 100 % scale, See Function 3.05.08
1.03.02	PULSE/UNIT	Pulse value per volume flow unit, see Function 3.05.09
1.03.03	PULSE/UNIT	Pulse value per energy unit, see function 3.05.10

2.00.00	TEST	Main menu 2.00.00 Test functions
2.01.00	DISPLAY	Submenu 2.01.00 Display
2.01.01	DISPLAY	Test display, lights all pixels. End with ↵ key
2.02.00	OUTPUTS	Submenu 2.02.00 Outputs
2.02.01	CURRENT	Test current output 0 mA      4 mA 12 mA     20 mA 22 mA
		Use up arrow to advance. Displayed value directly present at current output. Actual value present at output after pressing ↵

		key.
2.02.02	PULSE	Test pulse/frequency output
		1 Hz      10 Hz 100 Hz    1000 Hz 2000 Hz Use the up arrow to advance. Displayed value directly present at pulse output. Actual value present at output after pressing ↵ key
2.03.00	INPUTS	Submenu 2.03.00 Inputs
2.03.01	AN INP 1	Test analog input 1 Measure current at analog input 1. End with ↵ key.
2.03.02	AN INP 2	Test analog input 2 Measure current at analog input 2. End with ↵ key.
2.03.03	DIG INPUT	Test digital input Measure level at digital input. End with ↵ key.
2.03.04	SENSOR	Sensor status, per sensor (6 statuses in total): good, open, short Sensor coding: X.X = path.sensor Path 1 = lower path, path 2 = middle path, path 3 = upper path. X.1: upstream sensor X.2: down stream sensor
		
2.04.00	DEV INFO	Submenu 2.04.00 Device information
2.04.01	MANUFACT	Display manufacturer
2.04.02	MODEL NO	Display model number
2.04.03	SERIAL NO	Display serial number
2.04.04	UP2 HW NO	Display µP2 hardware number
2.04.05	UP2 SW NO	Display µP2 software number
2.04.06	FRNT HW NO	Display front end hardware number
2.04.07	DSP HW NO	Display D.S.P. hardware number
2.04.08	DSP SW NO	Display D.S.P. software number
2.04.09	TIME COUNT	Display time counter

3.00.00	INSTALL	Main menu 3.00.00 Installation
3.01.00	FLOW	Submenu 3.01.00 Volume flow parameters
3.01.01	FULL SCALE	Full-scale value for 100% volume and flow rate units (see Function 1.01.01). The selection of units may be limited to SI units only. m <sup>3</sup> /s, m <sup>3</sup> /min, m <sup>3</sup> /hr, L/s, L/min, L/hr, US.Gal/s, US.Gal/min, US.Gal/hr, bbls/hr, bbls/day, ***** (free user configurable unit).
3.01.02	ZERO VALUE	Zero value (see Function 1.01.02) FIXED (factory zero setting) MEASURED (zero calibration possible, see Function 3.01.03)
3.01.03	ZERO CAL	Zero calibration (see Function 1.01.03) Carry out only at “zero” flow and with completely filled

		measuring tube. Duration approximately 15s with display indicating "BUSY". STORE NO (preserve old zero value) STORE YES (store new zero value)
3.01.04	MASTER TC	Master time constant of display and current output (see Function 1.01.04) Range: 0.02 through 99.99 s
3.01.05	LF CUTOFF	Low-flow cut-off for display and outputs (see 1.01.05) NO (fixed tripping points: ON = 0.1%, OFF = 0.2%) YES (see Function 3.01.06 and 3.01.07)
3.01.06	CUTOFF ON	Cut off "active" value Range: 1 through 19% of Q100%
3.01.07	CUTOFF OFF	Cut off "de-active" value Range: 2 through 20% of Q100% Value "off" must be greater than value "on"
3.01.08	METER SIZE	Meter size Selection of size from meter size table: 25-3000 mm equivalent to 1-120 inch
3.01.09	GK VALUE	Flow sensor constant (GK) Must equal flow sensor nameplate value Range: 0.02 through 20
3.01.10	FLOW DIR	Definition of forward flow direction POSITIVE NEGATIVE Setting in accordance with direction of arrow on flow sensor
3.01.11	MIN VOS	Minimum velocity of sound (VOS) Value used for I0% or P0% when function "VOS" selected in Function 3.04.01 or 3.05.01 Unit: m/s or feet/s Range: 0 through 4999 m/s (0 through 15000 feet/s)
3.01.12	MAX VOS	Maximum velocity of sound Value used for I100% or P100% when function "VOS" selected in Function 3.04.01 or 3.05.01 Unit: m/s or feet/s Range: 1 through 4999 m/s (0 through 15000 feet/s) Maximum value must be greater than minimum value
3.02.00	VERSION	Submenu 3.02.00 Version
3.02.01	FUNCTION	Function of converter This is factory pre-set and can only be changed to standard from any setting. MODIS setting can not be altered. STANDARD CORR T (temperature correction via input 1, see also Function 3.02.08 through 3.02.11) CORR T+ P (temperature correction via input 1, pressure correction via input 2, see also Function 3.02.08 through 3.02.11) HEAT (heat measurement, see function 3.02.12) BATCH (batch volume, see Function 3.02.13) MODIS
3.02.02	INP1 4 mA	4 mA Reference for analog input 1 4 mA Temperature reference Unit: Celsius or Fahrenheit Range: -50° through 150°C
3.02.03	INP1 20 mA	20 mA Reference for analog input 1 20 mA Temperature reference

		Unit: Celsius or Fahrenheit Range: -50° through 150°C
3.02.04	INP2 4 mA	4 mA Reference for analog input 2 4 mA Temperature reference Unit: Celsius or Fahrenheit Range: -50° through 150°C
3.0205	INP2 20 mA	20 mA Reference for analog input 2 20 mA Temperature reference Unit: Celsius or Fahrenheit Range: -50° through 150°C
3.02.06	INP2 4 mA	4 mA Reference for analog input 2 4 mA Pressure reference Unit: bar(a) or psi(a) Range: 0 through 100 Bar(a)
3.02.07	INP2 20 mA	20 mA Reference for analog input 2 20 mA Pressure reference Unit: bar(a) or psi(a) Range: 0 through 100 Bar(a)
3.02.08	K0	Product constant K0 Range: 10 <sup>-9</sup> through 10 <sup>9</sup>
3.02.09	K1	Product constant K1 Range: : 10 <sup>-9</sup> through 10 <sup>9</sup>
3.02.10	K2	Product constant K2 Range: : 10 <sup>-9</sup> through 10 <sup>9</sup>
3.02.11	DENSITY 15	Product density at T = 15°C Range: 500 through 2000 kg/m <sup>3</sup>
3.02.12	FULL SCALE	Heat measurement Full scale setting and unit for Heat power. GJ/s, GJ/hr, MJ/s, MJ/hr, GCal/s, GCal/hr, MCal/s, MCal/hr
3.02.13	BATCH VOL	Batch volume Total size and units. m <sup>3</sup> , Liter, US.Gallon, Barrel or user definable unit Range: 0.025 through 100000 m <sup>3</sup>
3.03.00	DISPLAY	Submenu 3.03.00 Display (see Function 1.02.01)
3.03.01	DISP FLOW	Display of flow RATE (full-scale units) Percent (percentage of full-scale, 0% - 100%) NO DISPLAY (no flow display)
3.03.02	FUNCT TOT	Function of Totalizer ACT FLOW (actual flow units) CORR FLOW (corrected flow units) POS BOTH (both, only forward)
3.03.03	DISP TOTAL	Display of Totalizer (see Function 1.02.02) A Totalizer can be selected here for displaying. Available options are TOTAL OFF, FORWARD, REVERSE, BOTH, SUM, BOTH + SUM, NO DISPLAY
3.03.04	TOTAL VOL	Unit for volume Totalizer X10 m <sup>3</sup> , US.Gallon, m <sup>3</sup> , Barrel, liter
3.03.05	TOTAL ENER	Unit for energy Totalizer X 10 GJ, GJ, MJ, GCal, MCal
3.03.06	VOS	Unit for Velocity Of Sound NO DISPLAY, m/s, feet/s
3.03.07	CYCL DISP	Cyclic display of measured values NO, YES



3.03.08	ERROR MSG	Display error messages NO, YES
3.03.09	DATE	Display date NO, YES
3.03.10	AN INPUT	Display analog inputs NO, YES
3.03.11	SIGN LEVEL	Display signal level NO, YES
3.04.00	CURR OUTP	Submenu 3.04.00 Current output
3.04.01	FUNCTION	Function of current output OFF (switched off) ACT FLOW (actual flow) CORR FLOW (corrected flow), see Function 3.02.02 and 3.02.08 through 3.02.11 F/R IND (forward/reverse indication of actual flow) VOS (velocity of sound, range is defined in Function 3.01.11 and 3.01.12) GAIN (sensor signal gain, range is 0 dBV through 100 dBV) AN INP 1 (analog input 1) AN INP 2 (analog input 2)
3.04.02	DIRECTION	Direction of current output FORWARD (forward flow measurement) BOTH (forward and reverse flow measurement indicating both in the same range) F/R SPEC (forward and reverse flow measurement indicated in different range see Function 3.04.04)
3.04.03	RANGE	Range of current output OTHER (user defined, see Function 3.04.04 through 3.04.06) 0-20/22 mA (0 pct - 100 pct / limit) 4-20/22 mA(0 pct - 100 pct / limit)
3.04.04	0 pct	Current value for 0% scale Range: 0 through 16 mA
3.04.05	100 pct	Current value for 100% scale Range: 4 through 20 mA Value must be at least 4 mA greater than current value for 0% scale
3.04.06	LIMIT	Limitation of current value Range: 20 through 22 mA
3.04.07	ERR INDIC	IERR = 3.6 MA IERR = 21.5 MA (only available for NAMUR devices)
3.05.00	PULSE OUTP	Submenu 3.05.00 Pulse output
3.05.01	FUNCTION	Function of pulse output OFF (switched off) ACT FLOW (actual flow) CORR FLOW (corrected flow), see Function 3.02.01 and 3.02.08 through 3.02.11 F/R IND (forward/reverse flow indication) VOS (velocity of sound, range defined in Function 3.01.11 and 3.01.12) DIG OUTPUT (digital output, see Function 3.05.03) BATCH OUTP (batch output indication, see Function 3.02.01) GAIN (sensor signal gain, range is 0 dBV through 100 dBV) AN INP 1 (analog input 1) AN INP 2 (analog input 2)



3.05.02	DIRECTION	Direction of pulse output FORWARD (forward flow measurement) BOTH (forward and reverse flow measurement indicating both in the same range)
3.05.03	DIG OUTPUT	Function of digital output PATH ERR (measuring path error indication) TOTAL ERR (Totalizer error indication) ALL ERR (indication of all errors) AN INP ERR (analog input error indication) OVERRANGE (overrange indication) TRIP POINT (trips when actual flow (Q) goes over a set limit)
3.05.04	TRIP PNT 1	First trip point Range: 0 through 120% of Q100%
3.05.05	TRIP PNT 2	Second trip point Range: 0 through 120 % of Q100%
3.05.06	TIME CONST	Time constant of pulse output 25 ms MASTER TC (see Function 3.01.04)
3.05.07	OUTPUT	Unit of pulse output (see Function 1.03.00) PULSE FREQUENCY, pulses per unit time, see Function 3.05.08) PULSE/UNIT, Totalizer pulse output, pulses per unit volume, see Function 3.05.09
3.05.08	PULSE RATE	Pulse rate (frequency) value for 100 % scale pulse/s, pulse/hr, pulse/min Range: 1 pulse/hr through 2000 pulse/s
3.05.09	PULSE/UNIT	Pulse value per volume unit for totalisation pulse/m <sup>3</sup> , pulse/l, pulse/US.Gal, pulse/bbl, free user definable unit
3.05.10	PULSE/UNIT	Pulse value per heat energy unit for totalisation Pulse/MJ, pulse/Gcal, pulse/Mcal, pulse/GJ
3.05.11	PULS WIDTH	Pulse width for frequencies ≤ 10 Hz 25 ms, 50 ms, 100 ms, 200 ms, 500 ms
3.06.00	DIG INPUT	Submenu 3.06.00 Digital input
3.06.01	FUNCTION	Function of digital input OFF (switched off) RST TOTAL (reset display Totalizer) RST ERROR (reset error messages) FORCE ZERO (set outputs to minimum values) BATCH (start batch)
3.07.00	USER DATA	Submenu 3.07.00 User data
3.07.01	LANGUAGE	Language for display texts GB/USA (English) D (German) F (French)
3.07.02	ENTRY CODE	Entry code for setting mode NO (entry with key only) YES (entry with key and code 1, factory set on 9 x key, see Function 3.07.03)
3.07.03	CODE 1	Code 1 Press any 9-keystroke combination and then press the same combination again. Each keystroke is acknowledged by "Ж" in the display. If both combinations are equal, "CODE OK" appears and the new code can be stored, else "WRONG CODE" appears and the desired code has to be entered again.

3.07.04	LOCATION	Tag name setting Free settable tag for identification, maximum 10 characters. Characters assignable to each place: A..Z / blank character / 0..9 Factory setting: KROHNE
3.07.05	UNIT TEXT	Text for user-defined unit Definition: volume/time Characters assignable to each place: A..Z / blank character / 0..9 Fraction bar "/" in 5th place is unalterable Factory setting: XXXX/YYYY
3.07.06	UNIT VOL	User-defined unit volume Quantity of user-defined volume per m3. Range: 10-5 through 107 Factory setting: 1
3.07.07	UNIT TIME	User-defined unit time Amount of user-defined time in seconds Range: 10-5 through 107 Factory setting: 1
3.07.08	RST ENABLE	Enable Totalizer reset NO (Totalizer reset disabled) YES (Totalizer reset enabled)
3.07.09	ERR LIMIT	Error limit in % of measured value for plausibility filter on the sensor paths.
3.07.10	CNT DECR	Counter decrement setting for plausibility filter
3.07.11	CNT LIMIT	Counter limit for plausibility filter When "0" is set, the plausibility filter will become inactive Range: 0 through 1000 Factory setting: 0
3.09.00	COMMUNIC	Submenu 3.09.00 Communication
3.09.01	PROTOCOL	Communication protocol OFF (no communication) HART (HART) PROFIB PA (PROFIBUS PA)
3.09.02	HART ADDR	HART address Range: 00 through 16
3.09.03	PP/FF ADDR	PROFIBUS PA/FOUNDATION Fieldbus address Range: 000 through 126

4.00.00	PARAM ERR	Main menu 4.00.00 Parameter error
4.01.00	FLOW VELOC	Volume flow velocity (v) value incorrect. The flow speed is calculated from the full scale volume flow and the meter size. Ensure condition $0.5 \text{ m/s} \leq v \leq 20 \text{ m/s}$ (1,5 to 66 feet/s) is met!
4.01.01	FULL SCALE	Full-scale value for 100% volume flow rate, see Function 3.01.01
4.01.02	METER SIZE	Meter size, see Function 3.01.08
4.02.00	CURR OUTP	Current output range incorrect. Setting for 100% is compared with setting for 0%. Ensure condition $100 \text{ pct} - 0 \text{ pct} \geq 4 \text{ mA}$ is met!
4.02.01	RANGE	Range of current output, see Function 3.04.03
4.02.02	0 pct	Current value for 0% scale, see Function 3.04.04
4.02.03	100 pct	Current value for 100% scale, see Function 3.04.05
4.03.00	LF CUTOFF	Low-flow cut-off range incorrect: If low flow cut-off is set to on, the value for CUTOFF-OFF is compared with the value of CUTOFF-ON on. Ensure condition $\text{CUTOFF-OFF} - \text{CUTOFF-ON} \geq 1\%$ is met!
4.03.01	LF CUTOFF	Low-flow cut-off, see Function 3.01.05
4.03.02	CUTOFF ON	Cutoff "on" value, see Function 3.01.06

4.03.03	CUTOFF OFF	Cutoff "off" value, see Function 3.01.07
4.04.00	ENERGY	Full scale value for heat energy rate (E) incorrect. The fullscale value is compared with the maximum value that can be measured and should meet the condition: $E_{max} < E_{fullscale} < E_{max}/1000$ The maximum value that can be measured is at maximum flow and 200° C temperature difference.
4.04.01	HEAT FS	Full-scale value for 100 % heat energy rate, see Function 3.02.12
4.05.00	PULSE/VOS	Unit of pulse output for velocity of sound function incorrect Ensure "PULSE RATE" is selected for "VOS"!
4.05.01	PULS FUNCT	Function of pulse output, see Function 3.05.01
4.05.02	PULSE OUTP	Unit of pulse output, see Function 3.05.07
4.06.00	VOS	Velocity of sound range incorrect: Ensure condition $MAX\ VOS - MIN\ VOS \geq 1\ m/s\ (3.3\ feet/sec)$ is met!
4.06.01	MIN VOS	Minimum velocity of sound, see Function 3.01.11
4.06.02	MAX VOS	Maximum velocity of sound, see Function 3.01.12
4.07.00	PULSE OUTP	Pulse output frequency value (f) incorrect. The max frequency is calculated from the pulse/unit setting and the max value of the measured value. Ensure condition $1\ pulse/hr \leq f \leq 2000\ pulse/s$ is met.
4.07.01	PULSE/UNIT	Pulse value for volume flow rate unit, see Function 3.05.09
4.07.02	PULSE/UNIT	Pulse value for heat power rate unit, see Function 3.05.10
4.08.00	PULS WIDTH	Pulse output pulse width incorrect Ensure condition $pulse\ width \leq 0.5 \times pulse\ period\ time$ is met.
4.08.01	PULS WIDTH	Pulse width for frequencies $\leq 10\ Hz$ , see Function 3.05.11
4.09.00	HART	Current output range for HART incorrect. If Hart is activated the minimum possible current should be 4 mA. Ensure condition $CURR\ 0\ pct \geq 4\ mA$ is met.
4.09.01	CURR RANGE	Range of current output, see Function 3.04.03
4.09.02	CURR 0 pct	Current value for 0% scale, see Function 3.04.04
4.10.00	INP/OUTP	The digital input (C) and current output (I) are not allowed to be switched on simultaneously. If the Profibus option is activated only one of the following input/output functions can be used: digital input (C), current output (I), pulse output (P). The current output is deactivated by setting the function of current output to off en setting the range of current output to 0-20mA.
4.10.01	INP FUNCT	Function of digital input, see Function 3.06.01
4.10.02	CURR FUNCT	Function of current output, see Function 3.04.01
4.10.03	CURR RANGE	Range of current output, see Function 3.04.03
4.10.04	PULS FUNCT	Range of pulse output, see Function 3.05.01
4.13.00	EPROM	EPROM checksum error, reset device.

## 6 Description of functions

### 6.1 Menu structure

In this chapter the different functions of the menu structure are described in more depth. Since the UFC 030 converter can be equipped with different options, the availability of certain options depends on the function of the converter (see 3.02.01).

#### Main menu 0.00.00 Error/Totalizer

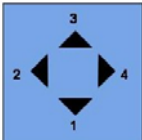
This menu is accessible from the measuring mode by pressing the ↵ key and entering "CODE 2" (↑→).

Depending on the programming of Function 3.03.08 ERROR MSG, errors occurring during process flow measurement are represented with flashing display lines and/or a compass field. Depending on the programming of Function 3.03.07 CYCL DISP, the error messages alternate with the display of the measured value(s) every 5 seconds, or they can be manually selected by pressing the ↑ key.



1. Flashing line with number of errors that have occurred.
2. Flashing line with description of error message(s).
3. Flashing bar, indicating "new" errors, not yet acknowledged.
4. Compass field, indicating measuring path error(s):

#### Indication of measuring path errors:



- 1, 2, 3: for measuring path 1, 2 and 3, open or shorted sensor no measured value from path.
4. Noise error, too much noise on measuring path(s). Flow meter functions outside specification

The following list gives an alphabetical overview of error messages that can occur during process flow measurement and what to do. The error messages only appear when Function 3.03.08 ERROR MSG is YES.

Error message	Description of error message	What to do
ADC AN INP	Analog input internal error, A1 or A2	Switch off and on the flow meter. If the error still exists, contact KROHNE representative
COMMUNIC	Communication device internal error	Reset the error, wait for one minute. If the error re-appears, contact KROHNE representative
CURR > MAX	Current output overflow (> 22 mA)	Check flow velocity
DSP	Digital signal processor (DSP) internal error	Only checked at power-up. Switch off and on the flow meter. If the error still exists, contact KROHNE representative
EE MENU	Menu parameters corrupted	Contact KROHNE representative
EE SERVICE	Service parameters internal error	Contact KROHNE representative
EMPTY PIPE	Measuring tube not completely filled,	Fill measuring tube completely

	flowreading to 0, error on all 3 paths.	
FLOW > MAX	Measuring range overflow (flow > 2 x Qmax)	Check flow velocity
FRONT END	Front end internal error	Only checked at power-up. Switch off and on the flow meter. If the error still exists, contact KROHNE representative
INP1 < MIN	Analog input 1 too low (< 3.6 mA)	Check analog input 1 connection
INP1 > MAX	Analog input 1 too high (> 22 mA)	Reduce analog input 1 current
INP2 < MIN	Analog input 2 too low (< 3.6 mA)	Check analog input 2 connection
INP2 > MAX	Analog input 2 too high (> 22 mA)	Reduce analog input 2 current
RESTART	Flow meter restarted	Reset errors
UNRELIABLE	Flow data disturbed, same as right compass field (4)	Check flow conditions
OPEN CIRC	Sensor X.X not connected or defect (combined with "SENSOR X.X" message).	Check connection sensor X.X. For sensor numbering: see description test function 2.03.04.
PATH 1	Measuring path 1 error	Check flow conditions
PATH 2	Measuring path 2 error	Check flow conditions
PATH 3	Measuring path 3 error	Check flow conditions
PULS > MAX	Pulse output overflow (> 120 %)	Check flow velocity
SENSOR X.X	Sensor X.X error (combined with "OPEN CIRC" or "SHORT CIRC" message)	Check connection sensor X.X.
SHORT CIRC	Sensor X.X short-circuited (combined with "SENSOR X.X" message)	Check connection sensor X.X
TIME/DATE	Real time clock internal error	Not available, reserved for future use.
TOT > DISP	Totalizer out of display range (maximum 8 characters)	Reset Totalizer or change Totalizer unit
TOT CHKSUM	Totalizer corrupted	Reset Totalizer
UP2	µP2 internal error	Contact KROHNE service

### Function 0.00.01 through 0.00.02 View error messages list/Reset error messages

All occurred error messages are stored in an error messages list and can be viewed using Function 0.00.01 VIEW ERR. The messages are kept in this list until the cause of the errors has been removed and the error messages have been reset using Function 0.00.02 RST ERR. Errors that have been reset, but whose cause has not been removed, are kept in the list but are displayed without bar. This allows identification of previously acknowledged and unacknowledged errors.

### Function 0.00.03 Reset Totalizer

Reset display Totalizer(s). Only available when Function 3.07.08 RST ENABLE is YES. Note that all Totalizer values are reset.

### Main menu 1.00.00 Operation

The functions in this menu are a subset of Main menu 3.00.00 Installation, and are selected in this menu as most commonly used functions for a quick installation. Note that parameters set in these functions are automatically set in both menus.

### Main menu 2.00.00 Test functions

This menu is for testing the display, the in- and outputs and for information on hard- and software numbers. See chapter 7.1 on functional checks.



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**Main menu 3.00.00 Installation**  
**Submenu 3.01.00 Volume flow parameters**

**Function 3.01.01 Full-scale value for 100% volume flow rate**

The following units can be applied:

m <sup>3</sup> /s - cubic metre per second	US.Gal/s - US gallons per second
m <sup>3</sup> /min- cubic metre per minute	US.Gal/min - US gallons per minute
m <sup>3</sup> /hr- cubic metre per hour	US.Gal/hr - US gallons per hour
L/s - liter per second	bbls/hr - barrels per hour
L/min -liter per minute	bbls/day - barrels per day
L/hr -liter per hour	free unit, a user-definable unit, which can be defined using Function 3.07.05 to 3.07.07.

Range depends on diameter (DN) and volume flow velocity (v):

$$Q_{\min} [\text{m}^3/\text{h}] = 0,9 \times \text{DN}^2 \quad (v_{\min} = 0.5 \text{ m/s})$$

$$Q_{\max} [\text{m}^3/\text{h}] = 31,25 \times \text{DN}^2 \quad (v_{\max} = 20 \text{ m/s})$$

$$Q_{\min} [\text{US GPM}] = 3,9 \times \text{DN}^2 \quad (v_{\min} = 1.5 \text{ feet/s})$$

$$Q_{\max} [\text{US GPM}] = 138 \times \text{DN}^2 \quad (v_{\max} = 20 \text{ m/s})$$

**Function 3.01.02 through 3.01.03 Zero value / Zero calibration**

Although zero calibrated at the factory the flow sensor might still give an offset flow reading, at "zero" flow in the pipeline (measuring tube completely filled with medium. Function 3.01.02 ZERO VALUE can be used for zero calibration. It can be set to either FIXED, which will give a factory zero setting, or MEASURED, which will allow to compensate for the small signal using Function 3.01.03 ZERO CAL.

**Function 3.01.04 Master time constant of display and outputs**

This is the time that it takes for the display and the current and pulse outputs to reach 66% of the end value, after a change in the flow rate. The time constant does not apply for totalisation. The time constant does not apply for the current output in F/R setting.

If required, a different time constant value can be set for the pulse/frequency output under Function 3.05.06 TIME CONST.

**Function 3.01.05 through 3.01.07 Low-flow cut off for display and outputs / Cut off "on" value/ Cut off "off" value**

Due to the extreme low flow sensitivity of the UFM 3030, it will detect the slightest movement of fluid, even at zero flow. To avoid these measurements causing outputs and Totalizer changes, the low flow cut-off can be used to force reading to zero. These are set as a percentage of Full Scale, as configured in Fct.1.01.01 or 3.01.01.

When the flow rate decreases below the "on" value, the display and outputs are set to their "zero" values. When the flow increases above the "off" value, measurements are resumed. The "off" value must be larger than the "on" value by at least 1%. With Function 3.01.05 LF CUTOFF set to NO, factory settings are used for the "on" and "off" values.

**Function 3.01.08 Meter size**

The nominal diameter of the measuring tube. See the flow sensor nameplate. This value can be entered in mm or in inches.

**Function 3.01.09 Flow sensor constant GK**

At the factory, each flow sensor is calibrated and supplied with a calibration constant. This constant can be found on the flow sensor nameplate.

---

### **Function 3.01.10 Definition of forward flow direction**

The forward flow direction is indicated with an arrow on the flow sensor. If the actual flow is in the direction of the arrow then the flow is in the positive direction and the converter will have a positive flow reading. By setting this function to NEGATIVE, the converter's reading can be reversed. This can be useful when the process flow direction is changed so the flow sensor will not need to be reversed.

### **Function 3.01.11 through 3.01.12 Minimum/Maximum velocity of sound**

In media of varying composition, the ultrasonic wave speed will vary, like in oil-water mixtures. This is identifiable by means of measuring the velocity of sound. The current output and the pulse output can be programmed to indicate the velocity of sound, see Function 3.04.01 and 3.05.01. Their "zero" values (0% scale) will then correspond with the velocity of sound set in Function 3.01.11 MIN VOS, where their "full-scale" values (100% scale) will correspond with the velocity of sound set in Function 3.01.12 MAX VOS. See also Function 3.03.06 VOS for the display of the velocity of sound. NOTE: Only necessary for setting span for outputting VOS, is not needed to measure flow!

### **Submenu 3.02.00 Version**

#### **Function 3.02.01 Function of converter**

This function is factory pre-set, and can be changed between STANDARD and the appropriate version that is defined in the converter's hardware. The following versions are possible:

STANDARD, standard functionality

CORR T version with temperature correction of the measured flow, using analog input 1

CORR T+P version with temperature- and pressure correction of the measured flow, using analog inputs 1 and 2

HEAT version, reserved for measurement of heat power and heat energy totalisation.

BATCH version for batch volumes.

The batch function can be used for repetitive dosing of a fixed volume. It provides simple single stage batching. A batch volume can be set using FUNCTION 3.2.13. The digital input is used to start a batch, see FUNCTION 3.6.1. The digital output is used to indicate that the set batch volume has been reached, see Function 3.5.1. The forward flow Totalizer counts the actual batch volume and is reset at the start of every new batch. The reverse flow Totalizer counts the total of all batches.

The following table gives an overview of the additional features of each version, in comparison with the standard version.

Remark: with every change from a converter function to STANDARD, the Totalizer is switched off. See function 3.03.03 to set the Totalizer

Menu Function \ Converter Function	CORR T	CORR T+P	BATCH
Flow display (Function 3.03.01)	Additional corrected volume flow indication		
Totalizer display (see Function 3.03.02 through 3.03.05)	Corrected volume flow totalizer indication		Automatic volume flow Totalizer and batch Totalizer indication
	Selectable		
Current output function (see Function 3.04.01)	Outputs proportional with corrected volume flow		Used as digital input
Pulse output function (see Function 3.05.01)	Selectable		Indicate end batch
Analog input 1 (see Function 3.02.02 through 3.02.03)	Temperature correction		
Analog input 2 (see Function 3.02.02 through 3.02.07)		Pressure correction	
Digital input (see Function 3.06.01)			Start/Stop batch

Note: Depending on the programming of Function 3.03.07 CYCL DISP, the additional or selectable indications can be manually selected by pressing the ↑ key, or they are alternating with the display of the measured value(s). The corrected volume flow indication or volume flow Totalizer indication is marked with the letter "C" at the left of the display 2nd (middle) line. The batch Totalizer indication is marked with the letter "B".

### Function 3.02.02 through 3.02.07 4/20 mA Reference for analog input 1/2

These functions are available depending on the version (see Function 3.02.01). The analog inputs are supplied with the 4-20 mA current range signal coming from the temperature- and pressure transducers. Their 4 mA and 20 mA values represent a certain temperature- or pressure value, which must be defined in these functions.

### Function 3.02.08 through 3.02.11 Product constant K0/K1/K2 /Product density at T = 15 °C

Calculation of the corrected volume.

Only available for the CORR T or CORR T + P version (see Function 3.02.01).

One of the features of the 3-beam ultrasonic flow meter is the capability of calculating the corrected volume. Corrected volume calculation can be carried out either based on temperature compensation or based on temperature and pressure compensation.

The corrected volume is calculated to standard conditions defined as 15°C and, if applicable, 1.01325 Bara. For this purpose the analog inputs are set to connect a temperature transmitter and a pressure transmitter. For accurate calculations it is advised to calibrate the individual P and T instruments.

The corrected volume is calculated from the following formula:

$$V_{\text{corrected}} = V_{\text{actual}} * VCF$$

$V_{\text{corrected}}$  = calculated corrected volume at standard conditions i.e. 15°C and 1.01325 bara

$V_{\text{actual}}$  = actual volume measured by the 3-beam flow meter

VCF = Volume Correction Factor and is calculated from  $[CtI \times Cpl]$



The calculation of the Volume Correction Factor is based on the standards of the American Petroleum Institute (API), and consists of two individual correction factors: chapter 11.1 standard 2540 for calculating the temperature correction (Ctl) and chapter 11.2.1 M for calculating the pressure correction (Cpl).

The correction for the influence of temperature on liquid (Ctl) is calculated from:

$$C_{tl} = \text{EXP} [-\alpha t (T_{\text{actual}} - 15) * (1 + 0.8 \alpha t (T_{\text{actual}} - 15))]$$

$T_{\text{actual}}$  = actual liquid temperature [°C]

$\alpha t$  = thermal expansion coefficient

The thermal expansion coefficient  $\alpha t$  is calculated from the standard density at 15°C and three constants of the measured product (K0, K1 and K2).

$$\alpha t = K_0/\rho_{15}^2 + K_1/\rho_{15} + K_2$$

Product	Density range (kg/m <sup>3</sup> ) $\rho_{15}$ at 15 °C		K0	K1	K2
Crude	610.5	1075.0	613.9723	0	0
Gasoline	653.0	770.0	346.4228	0.4388	0
Transition area	770.5	787.5	2680.3206	0	-0.00336312
Jet group	788.0	838.5	594.5418	0	0
Fuel oil	839.0	1075.0	186.9696	0.4862	0
Free fill	500.0	2000.0	0	0	0

As a rule of thumb the volume correction factor can be estimated as 0.1% per degree Celsius. (0,055% per degree Fahrenheit)

### Correction for the influence of pressure on liquid (Cpl)

When the feature has been selected for the compensation of the measured volume for the influence of temperature and pressure, no extra parameters have to be programmed for the pressure correction. The calculation of this pressure correction is only depending on the given standard density at 15°C. Based on the density the compressibility factor is calculated from the following mathematical model:

$$F = \text{EXP} [-1.62080 + 0.00021592 * T_{\text{actual}} + 0.87096/\rho_{15} * 10^{-6} + 0.0042092 * T_{\text{actual}}/\rho_{15} * 10^{-6}]$$

$T_{\text{actual}}$  = actual liquid temperature [°C]

$\rho_{15}$  = density at standard condition i.e. at 15 °C [kg/m<sup>3</sup>]

By using this calculated compressibility factor the Correction for pressure is calculated from:

$$1 C_{pl} = 1/ 1-F * P_{\text{actual}} * 10^{-4}$$

F = compressibility factor

$P_{\text{actual}}$  = absolute actual pressure [bar]

As a rule of thumb the volume correction factor can be estimated as 0.01% per bar (0,00068% per PSI)

With the fluid density entered and the corrected volume calculated, the corrected volume flow can be displayed as mass flow. This can be done as follows:

3.1.1. Set the unit to free user definable unit (\*\*\*\*\*)

3.7.5. Set the required unit text e.g. kg/hr.

3.7.6. Set the amount of mass per m<sup>3</sup> in the unit as displayed e.g. kg.

3.7.7. Set the time unit relative to seconds e.g. for hour enter 3600

---

### Function 3.03.01 Display of flow

To display the flow, three options are available

Rate; flow is shown with the unit as set in function 3.01.01

Percentage; flow is shown as a percentage of the full scale as set in 3.01.01

No display; no flow is shown.

### Function 3.03.02 Function of Totalizer

Two Totalizers (counters) are available. The Totalizer values are incremented and stored once a second. The following settings for the function of the Totalizers are available.

ACTUAL FLOW; the actual flow is used for counting the total volume in the Totalizer. Two Totalizers are available, one for each direction. The sum of the two can also be displayed.

CORRECTED FLOW; the corrected flow is used for counting the total volume in the Totalizers.

BOTH; Both the actual and the corrected flow are used for counting the total volume in the Totalizers. Both are only counted in the positive direction

### Function 3.03.03 Display of Totalizer

A Totalizer can be selected here for displaying.

FORWARD (forward volume units)

REVERSE (reverse volume units)

BOTH (both, alternating)

SUM (sum of both)

BOTH + SUM (both and sum)

NO DISPLAY (Totalizers not displayed, however Totalizers continue counting)

TOTAL OFF (Totalizer switched off, counting is halted)

### Function 3.03.04 Total volume

Unit for volume Totalizer can be set in this function.

Available units: x10 m<sup>3</sup>, m<sup>3</sup>, liter, US.Gallon, Barrel

The max. value of the Totalizer is 99999999 x10 m<sup>3</sup> and will roll over to 0 at overrun.

### Function 3.03.04 Total energy

Unit for the total heat energy counter.

Available units: x10GJ, GJ, MJ, Gcal, Mcal.

The maximum value of the Totalizer is 99999999 x10 GJ and will roll over to 0 at overrun.

### Function 3.03.06 Unit for velocity of sound

The display of the velocity of sound, as described in Function 3.01.11 through 3.02.12.

The following units can be applied:

NO DISPLAY no display of velocity of sound

m/s metre per second

feet/s feet per second m<sup>3</sup>

### Function 3.03.07 Cyclic display of measured values

Whenever more than one measured value is to be displayed (e.g. Flow rate and Totalizer), each value can be selected manually by pressing the  $\hat{\uparrow}$  key, or the values can be alternately displayed each 5 seconds by turning the cyclic display function on.. This also includes the display of various readings as described in Function 3.03.08 through 3.03.11.

### Function 3.03.08 Display error messages

Enable/disable the display of error messages as described in section 5.1. When enabled, the converter display will FLASH when an error occurs, and the error code will be displayed. It will continue to flash until the alarm is acknowledged or cleared. An unacknowledged alarm will be displayed with 3 horizontal lines in front of the error message. Acknowledging the alarm will remove the lines. If the alarm is acknowledged but the cause is not removed the error will stay in the error list. To remove the error from the list the cause must be removed and the error must be reset.

When it is turned off, the compass display indicates errors are present, but the display will not flash.

---

### **Function 3.03.09 Display date**

Not available, reserved for future use.

### **Function 3.03.10 Display analog input**

Enable/disable the display of the analog inputs.

Only available for converter functions CORR T and CORR T + P (see Function 3.02.01). The display of the values represented by the current signal coming from the temperature- and pressure transducers. See Function 3.02.02 through 3.02.07.

### **Function 3.03.11 Display gain**

Enable/disable the display of the signal level from the sensors. For each measuring path this level is displayed as a gain value 0 dBV through 80 dBV at the input amplifier.

## **Submenu 3.04.00 Current output**

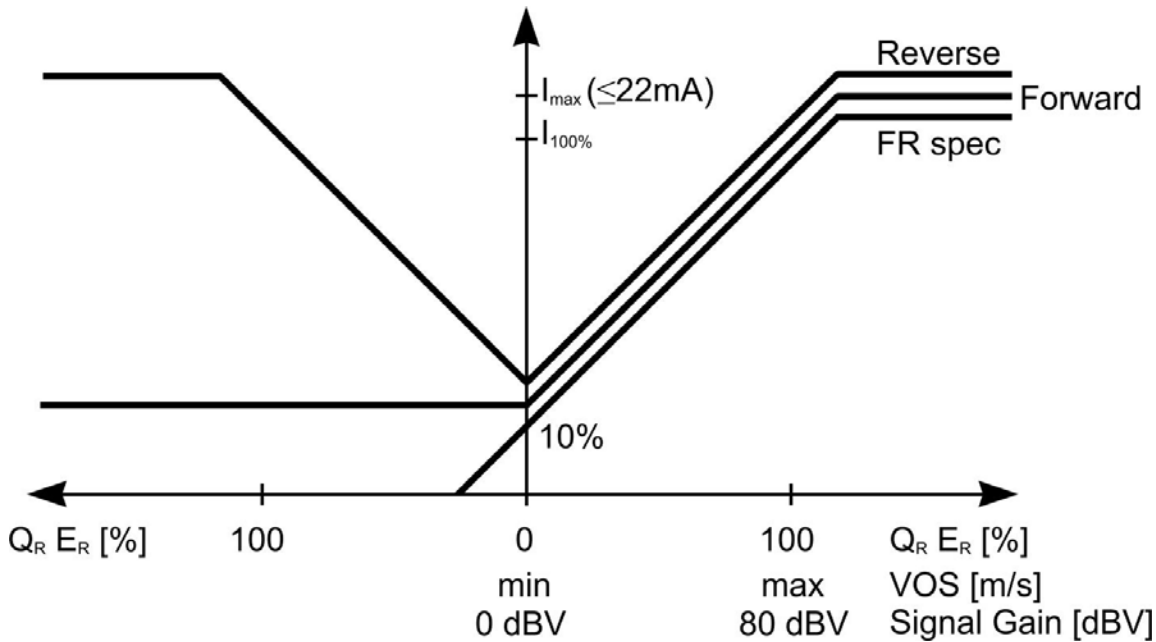
### **Function 3.04.01 Function of current output**

The current output can be programmed for the following functions:

- OFF switched off, current output steady at current value for 0 % scale, see Function 3.04.03
- ACT FLOW proportional with the actual volume flow, see Function 3.01.0.1 FULL SCALE
- CORR FLOW proportional with the corrected volume flow, only available if the converter function is set to CORR T or CORR T + P (see Function 3.02.01)
- F/R IND forward/reverse flow indication, see Function 3.01.10, 100 pct mA value for forward flow, 0 pct mA value for reverse flow, see Function 3.04.03 through 3.04.05
- VOS proportional with the velocity of sound, see Function 3.01.11 through 3.01.12
- SIGN LEVEL proportional with the signal level, see Function 3.03.11
- AN INP 1 proportional with the signal on analog input 1, see Function 3.02.01, Only available if the converter function is set to CORR T or CORR T + P (see Function 3.02.01)
- AN INP 2 proportional with the signal on analog input 2, see Function 3.02.01. Only available if the converter function is set to the CORR T or CORR T + P (see Function 3.02.01)

### **Function 3.04.02 Direction of current output**

Only available when ACT FLOW or CORR FLOW is selected in Function 3.04.01. When FORWARD is selected, the current output will only be active when the flow is in the forward flow direction as defined in Function 3.01.10 FLOW DIR, while when BOTH is selected, the current output will be active forward and reverse flow direction. Use F/R SPEC to indicate the reverse flow in the range from 0 mA through 0 pct mA (see Function 3.04.04 0 pct). I.e. when the flow goes from the forward direction to the negative direction, the current output will pass the "0 pct" mA value down to 0 mA, where it stops.



Abbreviations used:

$I$  Current output

$I_{10\%}$  Current output at 0 % scale

$E_F$  Forward energy flow rate

$I_{100\%}$  Current output at 100 % scale

$Q_R$  Reverse volume flow rate

$I_{max}$  Current output maximum

$E_R$  Reverse energy flow rate

When VOS or Signal gain is set, only the forward characteristic applies

### Function 3.04.03 Range of current output

The range of the current output can be set to standard 0-20mA or 4-20 mA or to "other" for other user specified spans. Max reading is 22 mA. The range for "other" is set using functions 3.04.04 to 3.04.06.

### Function 3.04.04 0 pct

mA setting for 0 percent of the range. It can be set between 0 and 16 mA. Default is 4 mA

### Function 3.04.05 100pct

mA setting for 100 percent of the range. It can be set between 4 and 20 mA. Default is 20 mA

### Function 3.04.06 Limit

Limit of current output. Max setting and default setting: 22 mA. Limit it to 20mA when safety systems reserve higher currents as Fault Codes.

### Function 3.04.07 Error indication

Only available for NAMUR version. Allow to predefine the current (3.6 or 21.5 mA) in case of failure.

### Function 3.05.00 Pulse/frequency output

#### Function 3.05.01 Function of pulse output

The pulse output can be programmed for the following functions:

- OFF switched off, contact closed
- ACT FLOW proportional with the actual volume flow, see Function 3.01.01 FULL SCALE
- CORR FLOW proportional with the corrected volume flow, available depending on version, see Function 3.02.01
- F/R IND forward/reverse flow indication, see Function 3.01.10, contact closed for forward flow, contact open for reverse flow
- VOS proportional with the velocity of sound, see Function 3.01.11 through 3.01.12
- DIG OUTPUT digital output, see Function 3.05.03

- BATCH OUTP batch output indication, contact closes at start of the batch and opens when the batch is reached. Only available for the BATCH version (see Function 3.02.01)
- SIGN GAIN, gain of sensor amplifier, proportional with the signal level, see Function 3.03.11
- AN INP 1 proportional with the signal on analog input 1, see Function 3.02.01
- FUNCTION, only available for the converter functions CORR T and CORR T + P (see Function 3.02.01)
- AN INP 2 proportional with the signal on analog input 2, see Function 3.02.01 FUNCTION, only available for the converter functions CORR T and CORR T + P (see Function 3.02.01)

### **Function 3.05.02 Direction of pulse output**

Only available when ACT FLOW or CORR FLOW is selected in Function 3.05.01. When FORWARD is selected, the pulse output will only be active when the flow is in the forward flow direction as defined in Function 3.01.10 FLOW DIR, while when BOTH is selected, the pulse output will be active in both flow directions.

### **Function 3.05.03 Function of digital status output**

Only available when DIG OUTPUT is selected in Function 3.05.01. The pulse output now acts as a digital output and can be programmed for the following functions:

- PATH ERR: measuring path error indication (contact open), see also the error message list in Section 5.1: PATH 1 through 5
- TOTAL ERR: Totalizer error indication (contact open), see also the error messages list in section 5.1: TOT > DISP and TOT CHKSUM
- ALL ERR: indication of all errors (contact open), see also the error messages list in Section 5.1
- AN INP ERR: analog input error indication (contact open), see also the error messages list in Section 5.1: INP1 < MIN, INP1 > MAX, INP2 < MIN and INP2 > MAX
- OVERRANGE: over range indication (contact open): CURR > MAX, FLOW > MAX and FREQ > MAX see also the error messages listed in Section 5.1
- TRIP POINT: Status output trips if the flow (Q) goes over a set value. An hysteresis is build in. Set points can be set using function 3.05.04 and 3.05.05.

### **Function 3.05.04 through 3.05.05 trip point settings**

Only available when TRIP POINT is selected in Function 3.05.03 DIG OUTPUT. These two settings form a hysteresis. If PNT 1 < PNT 2 then output will close if flow < PNT 1 and output will open if flow > PNT 2, if PNT 1 > PNT 2 then output will close if flow > PNT 1 and output will open if flow < PNT 2.

### **Function 3.05.06 Time constant of pulse output**

The time constant of the pulse output can be set to either 25 ms, which is the lowest value, or MASTER TC, which will result in the value, set in Function 3.01.04 MASTER TC. The time constant setting only applies to actual flow and corrected flow.

### **Function 3.05.07 pulse output function**

The function of the pulse output can be set to either PULSE RATE (frequency) or PULSE/UNIT (Totalizer pulse).

PULSE RATE: Is set by entering a frequency at 100 % volume flow rate

PULSE/UNIT: Is set by entering a value for the number of pulses for each volume (or energy) unit. Each pulse having a fixed volume, i.e. 1 pulse / 0.1 liter. This is the best method of remote totalizing, as pulses simply need to be counted, i.e. 10 pulses = 1 liter.

See Function 3.05.08 through 3.05.10.

### **Function 3.05.08 Pulse rate**

If the function of 3.05.07 is set to pulse rate, the frequency of the pulse can be set that will be available at 100% flow. The frequency can be set to: pulse/s, pulse/min, pulse/hr. The default setting is 1000 pulses/second (Hz), the max setting is 2000.



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### **Function 3.05.09 Pulse/unit**

If the function of 3.05.07 is set to pulse/unit, the unit and number of pulses per unit can be set for the flow measurement using this function. Options are; puls/m<sup>3</sup>, puls/l, puls/US.Gal., puls/bbl. Also a user definable unit can be set. The max number of pulses per unit is 7870000, the default setting is 1. NOTE: Check that the max. flow span will not cause the number of pulses generated per second to exceed the maximum of 2 000 Hz.

### **Function 3.05.10 Pulse/unit (heat energy measurement)**

If the function of 3.05.07 is set to pulse/unit, the unit and number of pulses per unit can be set for the heat power measurement using this function. Options are; pulse/MJ, pulse/GCal, pulse/MCal, pulse/GJ. The max number of pulses per unit is 1000000, the default setting is 1.

### **Function 3.05.11 Pulse width**

For frequencies < 10 Hz, the following pulse widths can be applied:

25 ms pulse width for P100% < 10 Hz

50 ms pulse width for P100% < 10 Hz

100 ms pulse width for P100% < 5 Hz

200 ms pulse width for P100% < 2.5 Hz

500 ms pulse width for P100% < 1 Hz

>10 Hz to 1000 Hz, 50% duty cycle. >1000 to max. 2000 Hz, 70% / 30% Duty cycle.

Pulse width may vary 5ms, pulse period may vary 25 ms.

### **Submenu 3.06.00 Digital input**

#### **Function 3.06.01 Function of digital input**

The digital input terminal is the same as the current output terminal. Therefore, when a digital input function is selected, the function of the current output (see Function 3.04.01) needs to be set to OFF and the current output range has to be set to 0-20mA (see Function 3.04.03).

The digital input can be programmed for the following functions:

OFF switched off, no function

RST TOTAL reset display Totalizer(s), see also Function 0.00.03 RST TOTAL, independent of the programming of Function 3.07.08 RST ENABLE

RST ERROR reset error messages, see also Function 0.00.02 RST ERR

FORCE ZERO force display and outputs to their "zero" values

BATCH start (input high) or stop (input low) a batch, only available for the BATCH version (see Function 3.02.01)

### **Submenu 3.07.00 User data**

#### **Function 3.07.01 Through 3.07.04 Language for display texts / Entry code for setting mode / Code 1 / Tag name setting**

See the descriptions in Section 4.3.

#### **Function 3.07.05 through 3.07.07 User-defined unit for volume flow rate and volume flow Totalizer**

Instead of choosing from pre-defined units for the volume flow as in Function 3.01.01 FULL SCALE, a user-defined unit can be programmed. This unit is to be defined as a volume unit per time unit. In Function 3.07.05 UNIT TEXT the text can be defined, in Function 3.07.06 UNIT VOL the amount of volume units that will fit in a m<sup>3</sup> must be programmed, and in Function 3.07.07 UNIT TIME the amount of seconds that will fit in a time unit must be programmed.

Example: to program barrels per day, program in Function 3.07.06 6,289 (= 1/0,159) and in 3.07.07 8,640E4 (=24\*60\*60).

#### **Function 3.07.08 Enable Totalizer reset**

Enable the reset of the display Totalizer(s), see Function 0.00.03 RST TOTAL. Note that this function doesn't affect the ability to reset the display Totalizer(s) using the digital input, see Function 3.06.01.

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### **Function 3.07.09 through 3.07.11 Plausibility filter**

A plausibility filter can be set for the sensor measuring paths. There are 3 settings; an error limit, an error counter decrease step value and an error counter limit.

Every measured value outside the error limit is not processed and will increase an internal plausibility counter by 1, until a counter limit has been reached. The corresponding measuring path will then be made inactive. The error limit is set using function 3.07.09. Range: 1 through 99%, default setting: 20%.

The counter limit is set using Function 3.07.11. Default setting is 0, the function is switched off.

Every measured value within the error limit will decrease the internal plausibility counter by the number programmed in Function 3.07.10. The higher the number the faster an inactive measuring path will become active again. Range: 1 through 99, default setting: 4.

Whenever one or more measuring paths are made inactive, the display compass field will indicate that, combined with the display of error messages. Also see Section 5.1.

### **Submenu 3.08.00 Logging**

Reserved for future use.

### **Submenu 3.09.00 Communication**

#### **Function 3.09.01 Through 3.09.03 Communication protocol / HART/ PROFIBUS PA**

The definition of the communication protocol and its address (when appropriate). The HART communication protocol is standard available, the PROFIBUS PA communication protocol is optional.

### **Main menu 4.00.00 Parameter error**

The parameter error menu as described in Section 4.2, see also the descriptions in Section 4.3.

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**7 Functional checks**

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**7.1 Test functions of the signal converter Function 2.1 to 2.5**

The signal converter has several different test functions.

**Display test, Function 2.01.01**

Select function 2.01.01 as described in sect. 4.2 and 4.3.

Press Right arrow to start.

All segments in the 3 lines of the display are activated sequentially.

The test can be terminated by pressing the ↵(return) key.

**Test, current output I, Function 2.02.01**

**WARNING** – this will affect the current output, and will no longer be process output!

A milliamp-meter must be connected between terminals V+ and I for this test, see the connection diagrams in section 2.

Select Function 2.02.01 as described in sect. 4.2 and 4.3.

Select current value with ↑ key:

- 0 mA
- 4 mA
- 12 Ma
- 20 mA
- 22 mA

The milliamp-meter indicates the current value selected. Press the ↵ key to terminate the test and display the actual value again

**Test, frequency output F, Function 2.02.02**

**WARNING** – this will affect the pulse/frequency output, and will no longer be process output!

An electronic Totalizer (EC) must be connected to terminal P<sub>r</sub> for this test.

Select function 2.02.02 as described in sect. 4.2 and 4.3.

Select frequency value with ↵ key:

- 1 Hz
- 10 Hz
- 100 Hz
- 1000 Hz
- 2000 Hz

The Totalizer indicates the frequency value selected.

Press the ↵key to terminate the test and display the actual value again.

**Test of the analog inputs ( if applicable) 2.03.01 or 2.03.02**

Connect a current source to terminal A1/GND or A2/GND.

Select Function 2.03.01 or 2.03.02.

Set the current source to a value 4..22mA.

Read the measured value from the display of the flow meter.

Press '<-' to terminate the test.

**WARNING:** a current >30mA will result in damage of the analog input. Make sure the current will not exceed the 30mA.



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### **Test of the status inputs (if applicable) 2.03.03**

Connect a voltage source to terminal I/GND.

Select Function 2.03.03.

Apply a voltage <5 V and check if the display indicates a '0' level as value.

Apply a voltage >15 V and check if the display indicates a '1' level as value.

Press '<-' to terminate.

### **Device info 2.04.00**

Select the 2.04 menu. The various sub-menus (2.04.01 .. 2.04.09) will show:

- manufacturer
- model no.
- serial no.
- uP2 hardware no.
- uP2 Software no.
- Front Hardware no.
- DSP Hardware no.
- DSP software no.
- Time count

## **7.2 Measuring zero flow value**

Set zero flow in the pipeline. Make sure the flow sensor is completely filled with liquid.

Select function 1.01.02 or 3.01.02, ZERO VALUE and set this to MEASUREMENT

Select 1.01.03 or 3.01.03, ZERO CAL, zero calibration will start upon entry of this function.

the zero measurement will take approximately 15 seconds, display indicating BUSY. At the end the display shows "STORE NO". Use the '^' to select "STORE YES" if desired use the "<-" to store and exit the zero calibration routine. Remark: if fixed zero value is selected (1.01.02 or 3.01.02) a zero calibration routine is not possible.

## 8 Service and Repair



The following instructions are for use by qualified personnel only.  
To avoid electric shock, do not perform any servicing other than the operating instructions of this manual unless you are qualified to do so

### 8.1 Replacement of electronic unit of signal converter

The UFC 030 ultrasonic flow converter can be used as a replacement unit for the UFC 030 K (compact system) and The UFC 030 F (separate system).  
A special electronic unit is available for hazardous-duty versions (see Ex, FM or CSA installation instructions).

Always switch off power source before commencing work!

1. Use the special wrench to remove the cover from the terminal box.
2. Disconnect the connectors from the terminals (only for non EX version)
3. Use the special wrench to remove the cover from the electronic compartment.
4. Remove screws A, fold display board to side, and remove plug B (ribbon cable, display board).
5. Remove screws D using a screwdriver for recessed-head screws and carefully remove the complete electronics.
6. Remove plug CO 1/2 or CO 3/4 or CO 5/6 (depending on flow meter version).  
On the new electronic unit, check the power supply voltage and fuse F1 and replace if necessary. Also see paragraph 8.3, change of power supply fuse.
7. Reassemble in reverse order (points 6 to 1). Important: Ensure that the screw thread of the covers on the electronic and terminal compartment is well greased at all times using Teflon grease.
8. Sensor specific data must be entered in the converter. Contact KROHNE service on how to do this.
9. All application specific settings must be re-entered after replacement of the electronic unit.
10. The supplied report on settings contains the standard factory setting.  
It is recommended, to check, and if off, calibrate the zero and store the new zero value, see sect. 7.2 and Function 1.1.3 / 3.1.3.

### 8.2 Replacement of ultrasonic flow sensor in separate systems

Always switch off power source before commencing work!

Specific calibration data for each flow sensor are determined during factory calibration. Flow sensor specific data must be set in the UFC 030 ultrasonic flow converter when a flow sensor is replaced. Contact KROHNE service for assistance on how to do this.

The flow sensor constant GK is specified on the nameplate. Enter value of primary constant GK in Function 3.1.9.

If the new flow sensor has a different meter size, this must be set under Function 3.1.8. Also the full-scale range for Q100% must be set using Function 3.1.1 (for F/R operation also see Function 3.1.2 and 3.1.3).

A zero check (Function 1.1.4) is advisable following setting of new data.

### 8.3 Change of power supply fuse

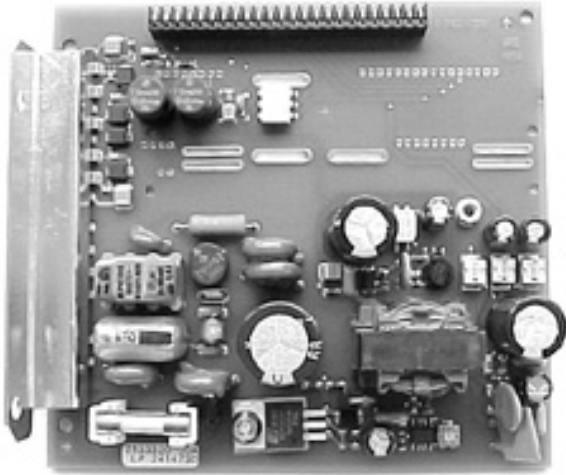


For continued fire protection or protection against other damage, replace with a fuse specified in this handbook.

Before demounting the electronics from the housing disconnect instrument from the mains. Always switch off power source before commencing work!

Only applicable for the 100-240 Vac power supply.

The 24Vac/dc power supply is provided with an auto restoring electronic fuse that does not need replacement.



The main fuse is mounted on the power board of the electronics. If this fuse is blown there will be no reading on the display and the backlight will be off. The fuse should not blow normally unless a problem has developed in the instrument. Try to determine and correct cause of the blown fuse, then replace only with a fuse of the correct rating and type. The main fuse can only be reached by demounting the complete electronics from the housing.

1. Use the special wrench to remove the cover from the front compartment.
2. Remove screws A, fold display board to side, and remove plug B (ribbon cable, display board).
3. Power fuse F1 is now accessible. It must be replaced by the same type of fuse as specified below.
4. Reassemble in reverse order.

#### Fuse specification

To avoid unsafe situations replace a blown main fuse only with a type with the following specifications:

Dimensions	5 x 20 mm (miniature cartridge fuse)
Rated current	800 mA
Characteristic	Time Delay (T)
Rated voltage	250 V
Breaking capacity	1500 A (ceramic body fuse, high breaking capacity)
Standard	IEC 60127-2
Approvals	UL and OR CSA, VDE, SEMKO, BSI

## 8.4 Cleaning



If cleaning with removed covers disconnect the instrument from mains power. Avoid cleaning solvent entering or remaining inside the instrument.

- To clean this instrument, use a soft cloth dampened in a solution of mild detergent and water.
- Do not spray cleaner direct onto the instrument when covers are removed.
- Do not use high pressure water spray for cleaning
- Do not use chemicals containing petrol, benzene, toluene, xylene, acetone or similar solvents.
- Do not use abrasive cleaners on any part of the instrument.

## 8.5 Turning the display circuit board

To ensure horizontal positioning of the display irrespective of the position of the compact flow meter the display circuit board can be turned through  $\pm 90^\circ$  or  $180^\circ$ .

- Switch off power supply!
- Unscrew cover from electronics compartment using the special wrench.
- Remove 2 screws from the display circuit board.
- Turn circuit board into desired position.
- Replace screws, if necessary transposed, in the circuit board (do not kink or squeeze the ribbon cable).
- Grease screw thread before replacing housing cover.

## 8.6 Turning the signal converter housing

To facilitate access to connecting, indicating and operating elements on the compact flow meters installed in locations that are hard to reach, the signal converter housing can be turned through  $\pm 90^\circ$  except for hazardous-duty version like EEx, FM, CSA, etc.

Any damage resulting from failure to follow these instructions carefully will not be covered by our warranty!

The connection wires between the flow sensor and signal converter housing are extremely short and can break easily.

Switch off power source!

- Clamp the flow meter firmly by the flow sensor housing.
- Secure converter housing against slipping and tilting.
- Remove the 4 hexagon socket screws connecting the two housings.
- Carefully turn the converter housing clockwise or anti-clockwise a maximum of  $90^\circ$ , but do not lift the housing. If the gasket should stick, do not attempt to lever it off.
- To conform to the requirements of protection category IP 67 (equivalent to NEMA 6) keep connecting faces clean and tighten the 4 hexagon socket screws uniformly at diametrically opposed points.
- To prevent corrosion, paint the gap between two parts.

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## 9 Returning the flow meter for service or repair

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Your ultrasonic flow meter has been carefully manufactured and tested by a company with ISO 9001 certification and volumetrically calibrated in one of the world's most accurate test rigs.

If installed and operated in accordance with the operating instructions, your flow meter will rarely present any problems. Should you nevertheless need to return a flow meter for checking or repair, please pay attention to the following:

Due to statutory regulations concerning protection of the environment and the health and safety of our personnel, KROHNE will only handle, test and repair returned flow meters that have been in contact with liquids without risk to personnel and environment or that have been properly cleaned from such liquids. KROHNE will only service your flow meter if it is accompanied by a statement in line with the following model confirming that the flow meter is safe to handle.

If the flow meter has been operated with toxic, caustic, flammable or water polluting liquids, you are kindly requested:

To check and ensure, if necessary by rinsing or neutralising, that all cavities in the flow meter are free from dangerous substances.

To enclose a statement with the flow meter confirming that the flow meter is safe to handle and stating the liquid used. KROHNE regrets that they can not service your flow meter unless accompanied with such a statement.

**The following specimen statement is available on the KROHNE website as a word file. Please attach the form to the returned meter.**

### Specimen statement:

Company:  Department:   
Address:   
Name:  Tel. No.

Details enclosed flowmeter:

Type:   
KROHNE Order No.

Has been operated with the following liquid:

Because the liquid is:

water-pollutant  toxic  caustic  flammable (tick where applicable)

We have checked that the flowmeter and all cavities in the flowmeter are

free from such substances  flushed\* out and  neutralised (tick where applicable).

We hereby confirm that there is no risk to man or environment through any residual liquid in or on the flowmeter or in any of its cavities.

Date:   
Signature:

Place:  
Company Stamp:

### Spare parts

For more information please contact your local KROHNE sales representative!

**10 Dimensions**

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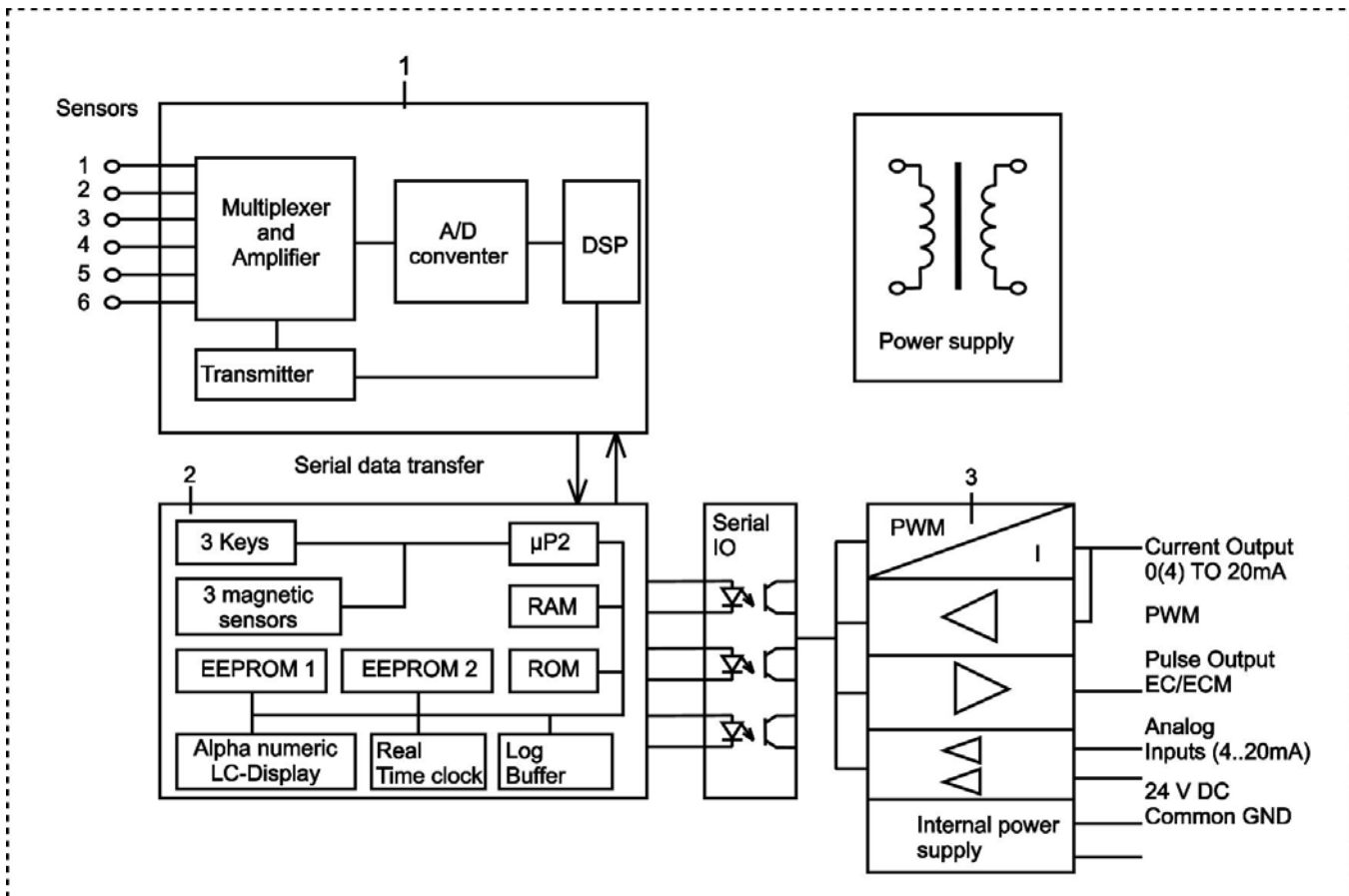
Go to the technical datasheet. The latest version of the technical datasheet (and other documentation) can be found on the KROHNE Download Center via [www.krohne.com](http://www.krohne.com). You will also find a digital copy on the product information CD that is delivered with the product.

**11 Block diagram**

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The converter consists of four functional groups.

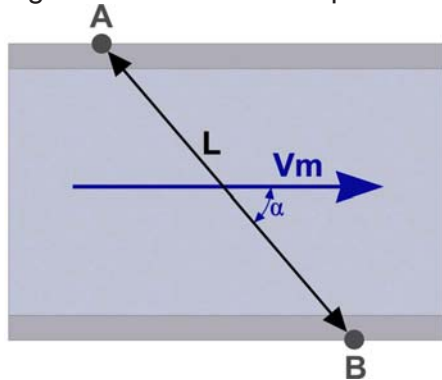
- Functional group 1 generates the ultrasonic waves, controls the sensors and carries out high-precision measurement of the propagation time by means of a digital signal processor (DSP).
- In functional group 2 the digitised data supplied by the DSP are evaluated by microprocessor  $\mu$ P 2 in accordance with the functions, operating and flow sensor data which are factory set. The DSP data and data from the galvanic isolated inputs is used to calculate the various flow values. In turn, the galvanic isolated output circuits are updated. In the event of a power failure, last counts are saved in EEPROM 2. In the same way as operating and functional check data are permanently stored in EEPROM 1. Both are retained for 10 years without auxiliary power.
- Functional group 3. This group is galvanically isolated from the other groups. It consists of various outputs (current and pulse) and inputs (digital and analog). All input/output circuits share the same common.
- Functional group 4 Power supply. The power supply is a switching, high efficient module with a wide input range. Two variations of the power supply are available. One for high voltage AC supply and one for low voltage AC/DC supply. The AC power supply has a wide range from 85 to 265 Volts.



## 12 Ultrasonic measurement principle

### 12.1 Transit time differential method

UFM 3030 operates just like all KROHNE ultrasonic flow meters by the transit-time differential method. This measuring principle is based on a simple physical fact. Imagine two canoes crossing a river diagonally, one with the flow and one against the flow. Naturally the canoe that is travelling with the flow will reach the opposite side sooner than the canoe that is travelling upstream. Acoustic signals behave in a comparable way.



$L$  = acoustic path length  
 $V_m$  = flow velocity of the medium

By means of ultrasonic sensors in the UFM 3030 the transit time of acoustic signals that travel upstream and downstream are measured. The difference in transit time is proportional to the mean flow velocity and is transformed into an output signal by the electronics.

The three measuring beams in a UFM 3030 make a three-dimensional cross section of the medium that flows through the measuring tube. These measuring lines are positioned that the influence of the flow profile (laminar or turbulent) are largely reduced. Combined with the use of the latest signal processing techniques (DSP) this results in a stable and reliable measurement.

### 12.2 Three beam ultrasonic measurement

The flow velocity measurement of the 3-beam ultrasonic flow meter is based on measurement at three positions in the measuring tube. Two of the acoustic beams are located in symmetrical arrangement on the outside and the third beam is located in the centre of the measuring tube.

Each individual acoustic path of measurement forms an angle  $\varphi$  with the tube centerline.

The ultrasonic waves travel from point A to point B at speed

$$V_{AB} = C_0 + V_m \times \cos\varphi$$

and, conversely, from point B to point A at speed

$$V_{BA} = C_0 - V_m \times \cos\varphi$$

The following applies to the transit times from points A to B :

$$t_{AB} = \frac{L}{C_0 + V_m \times \cos\varphi}$$

and from point B to A

$$t_{BA} = \frac{L}{C_0 - V_m \times \cos\varphi}$$

$t_{AB}$  and  $t_{BA}$  are measured continuously. The mean flow velocity  $V_m$  of the product is calculated using the last two equations:

$$V_m = GK \times \frac{t_{BA} - t_{AB}}{t_{AB} \times t_{BA}}$$

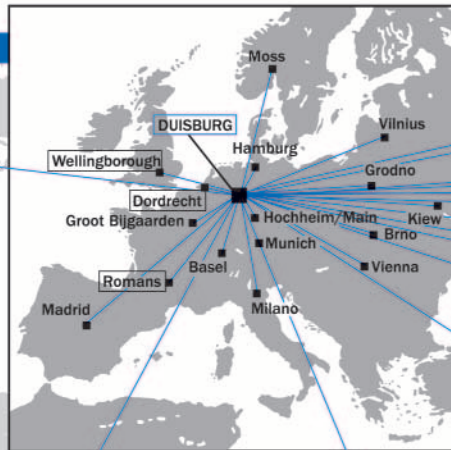
A	Transmitter and receiver
B	Transmitter and receiver
L	Acoustic path, distance between ultrasonic sensors
$v_m$	Average flow velocity of fluid
$t_{AB}$ ( $V_{AB}$ )	Time of travel (propagation speed) of sound waves from points B to A
$C_0$	Sound velocity in the medium (fluid)
GK	Calibration constant
$\varphi$	Angle between tube center line and line of measurement



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