

## Installation and operating instructions

# ALTOFLUX 2W IFM 4042 K

## Electromagnetic flowmeters



### Applicable to Software Versions

- Display/Control unit  
No. **3.19019.xx00**
- ADC module  
No. **3.19749.xx00**
- I/O module  
No. **3.18748.xx00**

Variable area flowmeters

Vortex flowmeters

Flow controllers

**Electromagnetic flowmeters**

Ultrasonic flowmeters

Mass flowmeters

Level measuring instruments

Communications engineering

Engineering systems & solutions

## How to use these Instructions

The flowmeters are supplied ready for operation.

- Installation in the pipeline (Section 1) Pages 5-10
- Electrical connection (Section 2) Pages 11-13
- Start-up (Section 3) Page 17

**Power the flowmeter. THAT'S ALL. The system is operative.**

## Your operating data

Here you can note down the settings of the signal converter !

Fct. No.	Function	Settings
1.01	<b>Full-scale range</b>	
1.02	<b>Time constant</b>	
1.03	Low-flow cutoff	- ON:                      - OFF:
1.04	<b>Display</b>	Flow
		Counter
		Messages
1.05	<b>Current output</b>	Function
		Range
		Error
1.06.	<b>Pulse output</b>	Function
		Pulse width
		Pulses / Volume
1.07	<b>Status output</b>	
3.01	<b>Language</b>	
3.02	<b>Primary head</b>	Meter size
		GKL value
		Flow direction
3.4	<b>Application</b>	Empty pipe
		Field current
		Mode field current
		Limit
		Filter
3.5	<b>Hardware</b>	Function of terminal B:
3.6	<b>HART</b>	off                      HART
		Current 4 mA trim.:
		Current 20 mA trim.:
		Address
		I-Multidrop:

## Contents

•	Your operating data	2
•	System description	4
•	Product liability and warranty	4
•	CE / EMC / Standards / Approvals	4
•	Software history	4

### **Teil A Installation and Start-up 5 - 17**

<b>1</b>	<b>Installation</b>	<b>5 - 10</b>
1.1	Items included with supply	5
1.2	Handling	5
1.3	Installation location	6
1.4	Suggestions for installation	7
1.5	Installation in the pipeline	8
1.6	Torques	9
1.7	Grounding	10
<b>2</b>	<b>Electrical connection</b>	<b>11 - 16</b>
2.1	Information on electrical connection and connection data	11
2.2	Output circuit diagrams	12 - 13
2.3	Characteristic of the outputs	14 - 16
<b>3</b>	<b>Start-up</b>	<b>17</b>
3.1	Power ON and measurement	17
3.2	Factory settings	17

### **Teil B IFC 040 Signal converter 18 - 33**

<b>4</b>	<b>Operation of the signal converter</b>	<b>18 - 33</b>
4.1	KROHNE operator control concept	18
4.2	Operating and check elements	19
4.3	Function of keys	20 - 21
4.4	Table of settable function	22 - 32
4.5	Error messages in measuring mode	33
4.6	Reset counter and cancel error messages	33

### **Teil C Technical Data, Block diagram und Measuring principle 34 - 43**

<b>5</b>	<b>Technical Data</b>	<b>34 - 40</b>
5.1	Full-scale ranges	34
5.2	Error limits at reference conditions	35
5.3	IFC 040 Signal converter	36 - 37
5.4	IFS 4002 Primary head	38
5.5	Dimensions and weights	39
5.6	Limits	40
<b>6</b>	<b>Block diagram of signal converter</b>	<b>41</b>
<b>7</b>	<b>Measuring principle</b>	<b>42</b>
<b>8</b>	<b>If you need to return flowmeters for testing or repair to KROHNE</b>	<b>43</b>

## System description

Electromagnetic 2-wire flowmeters with IFC 040 signal converter are precision instruments designed for linear flow measurement of liquid products.

The process liquids need to be electrically conductive,  $\geq 5 \mu\text{S/cm}$   
(for cold demineralized water  $\geq 20 \mu\text{S/cm}$ ).

Depending on the meter size, the full-scale range  $Q_{100\%}$   
can be set between 85 Liter/h and 763  $\text{m}^3/\text{h}$ , equivalent to a flow velocity  $v = 0,3\text{-}12 \text{ m/s}$ ,  
see flow table in Section 5.1.

## Product liability and warranty

Electromagnetic 2-wire flowmeters with IFC 040 signal converter are designed solely for measuring the volumetric flowrate of electrically conductive, liquid process products.

These flowmeters are also available for use in hazardous areas. Special codes and regulations apply in this connection and these are referred to in the special 'EEx' notes.

Responsibility for suitability and intended use of these electromagnetic flowmeters rests solely with the operator.

Improper installation and operation of the flowmeters (systems) may lead to loss of warranty.

In addition, the "General conditions of sale" forming the basis of the purchase contract are applicable.

If flowmeters need to be returned to KROHNE, please note the information given on the last-but-one page of these Instructions. KROHNE regret that they cannot repair or check your flowmeter(s) unless accompanied by the completed form sheet.

## CE / EMC / Standards / Approvals

Electromagnetic flowmeters with IFC 040 signal converter meet the protection requirements of **Directive 89/336/EEC** in conjunction with **EN 50081-1** (1992) and **EN 50082-2** (1995), and **Directives 73/23/EEC** and **93/68/EEC** in conjunction with **EN 61010-1**, and also bear the **CE symbol**..



## Software history

Display and control unit		PC user software		Hart® module	
IFC 040		IFC 040			
Software	Status	Software	Status	Software	Status
<b>3.19019.xx00</b>	<b>current</b>	<b>3.19136.xx00</b>	<b>current</b>	<b>3.18748.xx00</b>	<b>current</b>
ADC module		I/O module			
Software	Status	Software	Status		
<b>3.19749.xx00</b>	<b>current</b>	<b>3.18748.xx00</b>	<b>current</b>		

## 1 Installation

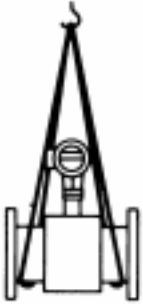
### 1.1 Items included with supply

- Flowmeter in the size as ordered
- Connecting wires for grounding, refer to Section 1.7 Grounding
- Certificate of calibration data
- Grounding rings (option), if ordered
- Installation and operating instructions for the signal converter

Fitting accessories (stud bolts, screws, gaskets, etc.) **are not supplied, to be provided by customer!**

### 1.2 Handling

Do not lift flowmeter by the signal converter housing or the terminal box.



Do not set flowmeter down on the signal converter housing.



### 1.3 Installation location

- **Temperatures**

Refer to Section 5.6 "Limits" for operating pressure and vacuum load based on flange standards and type of tube liner.

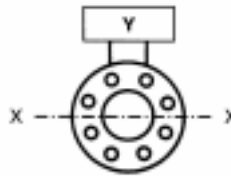
Standard	Ambient temperature		Process temperature	
		-25 to +60 °C -25 to +40 °C	-13 to +140 °F -13 to +104 °F	-25 to ≤+ 60 °C -25 to ≤+140 °C
EEx	-25 to +60 °C -25 to +40 °C	-13 to +140 °F -13 to +104 °F	-25 to ≤+ 60 °C -25 to ≤+140 °C	-13 to ≤+140 °F -25 to ≤+284 °F
<b>Storage and handling</b>	-25 to +60 °C -13 to +140 °F			

- **Location and position as required,**

but in a horizontal pipe run  
electrode axis

X — • — • — • — • — X

should be approximately horizontal.



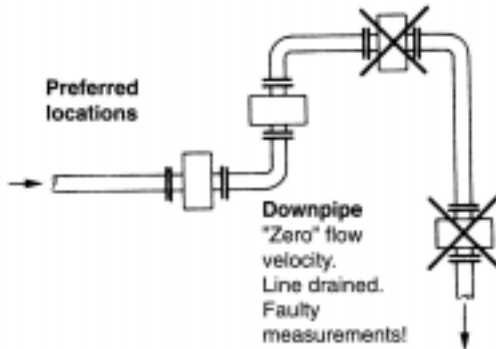
Y Signal converter housing

- **Measuring tube must be completely filled at all times.**
- **Direction of flow is arbitrary:** arrow on flowmeter can normally be ignored. For exceptions, refer to Sect. 3.2 "Factory settings" in the Installation and Operating Instructions for the signal converter.
- **Stud bolts and nuts:** to install, make sure there is sufficient room next to the pipe flanges.
- **Vibration:** support pipeline on both sides of flowmeter. Level of vibration in conformity with IEC 068-2-34: below 2.2g for flowmeters in the 20-150 Hz frequency range.
- **Do not expose to direct sunlight:** fit a sunshade if necessary, not included with flowmeter, to be provided by customer.
- **Avoid strong electromagnetic fields** in vicinity of flowmeter.
- **Inlet run 5 × DN and outlet run 2 × DN,** straight pipeline, measured from electrode axis (DN = meter size)
- **Vortex and corkscrew flow:** increase length of inlet and outlet runs or install flow conditioners.
- **Mixing different process liquids:** install flowmeter upstream of the mixing point or at an adequate distance downstream (min. 30 × DN), otherwise display may be unsteady.
- **Plastic pipelines and internally coated metal pipelines:** grounding rings required, refer to Sect. 1.7 "Grounding".
- **Insulated pipeline:** do not insulate flowmeter.
- **Zero setting: not necessary.** To check, it should be possible to set "zero" flow velocity when the measuring tube is completely filled. Shutoff valves should therefore be provided, either downstream of the flowmeter or upstream and downstream of the flowmeter.
- **Electrical connection to VDE 0100** "Regulations governing heavy-current installations with line voltages up to 1000 V" or **equivalent national regulations.**
- **Hazardous areas:** subject to special regulations, refer to special 'EEx' information (texts with grey background).

## 1.4 Suggestions for installation

To avoid measuring errors due to gas/air inclusion or to pipe running empty, please observe the following:

**Highest point of pipe run**  
(Air bubbles collect in measuring tube - faulty measurements!)



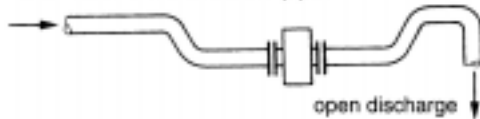
### Horizontal pipe run


Install in slightly ascending pipe section. If not possible, assure adequate velocity to prevent air, gas or vapor from collecting in upper part of flow tube.

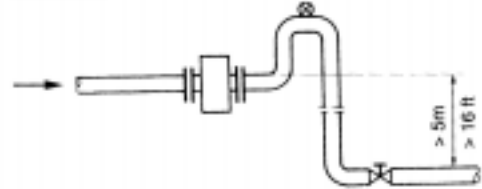


### Open feed or discharge

Install meter in low section of pipe.

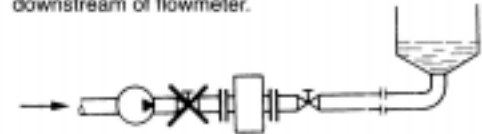


**Downpipe over 5 m (16 ft) length**  
Install air valve  downstream of flowmeter.



### Long pipeline

**Always** install control and shutoff valves downstream of flowmeter.



### Pumps

**Never** install flowmeter on pump suction side.



## 1.5 Installation in the pipeline

- **Installation material not included**, to be provided by customer (stud bolts, nuts, gaskets, etc.).
- **Pipe flanges and operating pressure:** refer to "limits" tables in Section 5.6
- **Distance between pipe flanges:**  
see fitting dimension **a** in Section 5.5 "Dimensions and weights"
- **High-temperature service**  
Where process temperatures exceed 100°C/212°F, provide facilities to compensate for longitudinal expansion on heat-up of the pipeline.  
For short pipelines, use resilient gaskets, and  
for long pipelines install flexible pipe elements (e.g. elbows).
- **Flange position:** Install flowmeter in line with pipe axis.  
Pipe flange faces must be parallel to each other.
- **Gaskets**  
No additional gaskets required for primary heads fitted with tube liners of Teflon® - PFA or Teflon® - PTFE. Refer to Sect. 1.6 for torques.
- **Grounding rings / protection rings (option)**  
On plastic pipelines and internally coated metal pipelines, grounding rings are required to form the conductive connection with the process liquid. Refer to Sect. 7 "Grounding" for electrical connection.

**Please note:** The cylindrical neck must be inside the measuring tube (to protect the liner, particularly at the inlet edge).

### Grounding ring No. 1

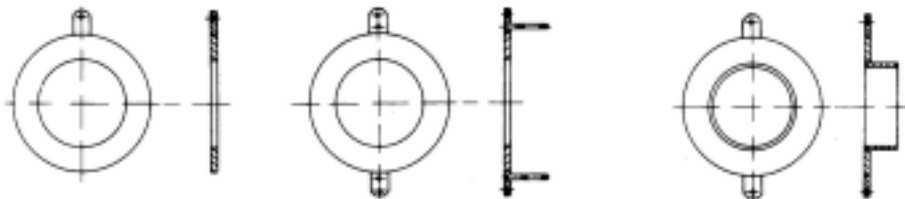
3 mm/0.12" thick

### Grounding ring, protective ring No. 2

for flowmeters with Teflon®-PTFE liner, solidly fitted to the flanges, 3 mm/0.12" thick

### Grounding ring, protective ring No. 3

with cylindrical neck, to protect the liner particularly at the inlet edge against abrasive products, 3 mm/0.12" thick. Length: 30 mm/1.18"



Teflon® is a registered trademark of Du Pont.



## 1.6 Torques

- **Stud bolts:** tighten uniformly in diagonally opposite sequence.  
See table for number and type.
- **10 Nm ~ 1.0 kpm ~ 7.23 ft x lbf**

Meter size DN mm	Pressure rating PN	Bolts	Max. torques	
			Nm	ft x lbf
10	40	4 x M 12	7.6	5.5
15	40	4 x M 12	9.3	6.7
25	40	4 x M 12	22	11
50	40	4 x M 16	55	31
80	25	8 x M 16	47	25
100	16	8 x M 16	39	30
150	16	8 x M 20	68	47

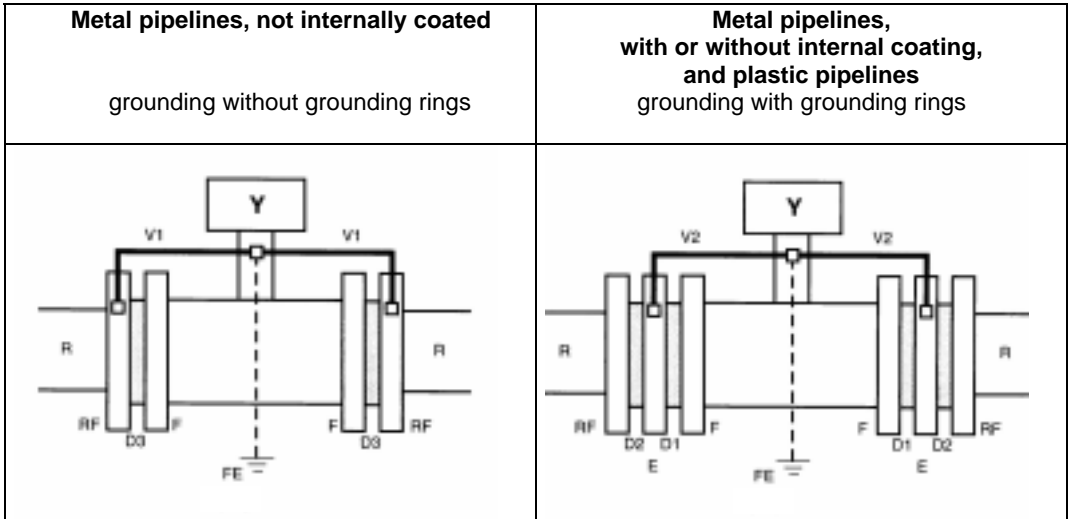
Meter size inches	Flange class lb	Bolts for ANSI class 150 flanges	Max. torques	
			Nm	ft x lbf
$\frac{3}{8}$	150	4 x $\frac{1}{2}$ "	3.5	2.5
$\frac{1}{2}$	150	4 x $\frac{1}{2}$ "	3.5	2.5
1	150	4 x $\frac{1}{2}$ "	6.7	4.8
2	150	4 x $\frac{5}{8}$ "	24	17.4
3	150	4 x $\frac{5}{8}$ "	43	31.1
4	150	4 x $\frac{5}{8}$ "	34	24.6
6	150	8 x $\frac{3}{4}$ "	61	44.1

1.7 Grounding

- All flowmeters must be properly grounded to avoid personnel shock hazard.
- The ground conductor should not transmit any interference voltages, therefore do not ground any other electrical devices together with this conductor.

**Repeater power supply unit**

- Protective separation (PELV) must be ensured (VDE 0100 / VDE 0106 or IEC 364 / IEC 536, or equivalent national regulations).
- For measurement reasons, connect an **FE functional ground conductor**.



- D1, D2, D3** Gaskets, not included with supply, to be provided by customer.
- E** Grounding rings (option)
- F** Flowmeter flanges
- FE** Functional ground, wire  $\geq 4 \text{ mm}^2 \text{ Cu}$  (10 AWG), not included with supply, to be provided by customer.
- R** Pipeline
- RF** Pipe flanges
- V1, V2** Interconnecting wires, included with supply
- Y** Terminal box or signal converter

## 2 Electrical connection

### 2.1 Information on electrical connection and connection data

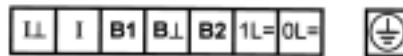
- **Rated values:** The flowmeter housings protect the electronic equipment from dust and moisture and should always be kept properly closed. Creepage distances and clearances in air have been dimensioned in conformity with VDE 0110 and IEC 664 for contamination category 2. Supply circuits and output circuits are designed to meet the standards of overvoltage classes III and II, respectively.
- **Safety isolation:** The flowmeter must be provided with an isolating facility.
- **Note information on instrument nameplate(s).**
- **PE conductor / FE functional ground must be connected to the separate U-clamp terminal** in the terminal compartment of the signal converter.
- For measurement reasons, the flowmeter must be properly grounded. The ground conductor should not transmit any interference voltages. Therefore, do not ground any other electrical devices together with this conductor.
- In hazardous areas, the ground conductor is used simultaneously for equipotential bonding.

**CAUTION:** Where a **power booster** (1L= / 0L=) is used, **electrical isolation** is required between the power booster and the current output, otherwise the electronic equipment will sustain irreparable damage.

#### Standard power terminals



#### EEx power terminals



FE  
PE

Functional ground

Safety conductor / equipotential bonding

<b>I</b>	<b>Current output</b>	$V_{max} = 36\text{ V}$	$I_{max} = 22.4\text{ mA}$ (fault current)
<b>I⊥</b>	(not polarity sensitive)	$V_{nom} = 24\text{ V}$	$I_{nom} = 4 - 20\text{ mA}$
		$V_{min} = 14\text{ V}$	$I_{min} = 3.6\text{ mA}$ (fault current)

<b>B 2</b>	<b>Pulse or status output</b>	<b>NAMUR terminals (B2 + B⊥)</b>	
<b>B⊥</b>	NAMUR	$I_{open} = 0.4\text{ mA}$	$I_{closed} = 6\text{ mA}$
<b>B 1</b>	<b>Pulse or status output</b>	<b>High-current terminals (B1 + B⊥)</b>	
<b>B⊥</b>	high current	closed:	$V_{max} = 2\text{ V}$ $I_{max} = 100\text{ mA}$
		open:	$V_{max} = 36\text{ V}$ $I_{max} = 2\text{ mA}$
			$V_{nom} = 24\text{ V}$ $I_{nom} = 1,5\text{ mA}$

**B⊥**    **Common ground** (negative)    Take note of polarity!

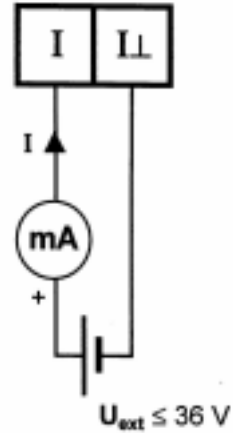
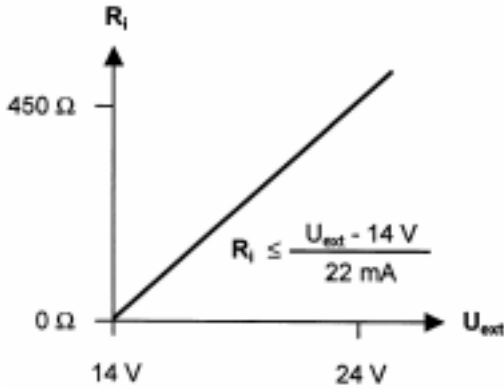
<b>1L=</b>	<b>Power booster</b>	<b>2nd power terminal</b>	
<b>0L=</b>	(not polarity sensitive)	$V_{max} = 36\text{ V}$	$V_{min} = 14\text{ V}$
		$V_{nom} = 24\text{ V}$	$I_{nom} = 22\text{ mA}$

**I +**    not used, no internal connection

**10**    for internal use only

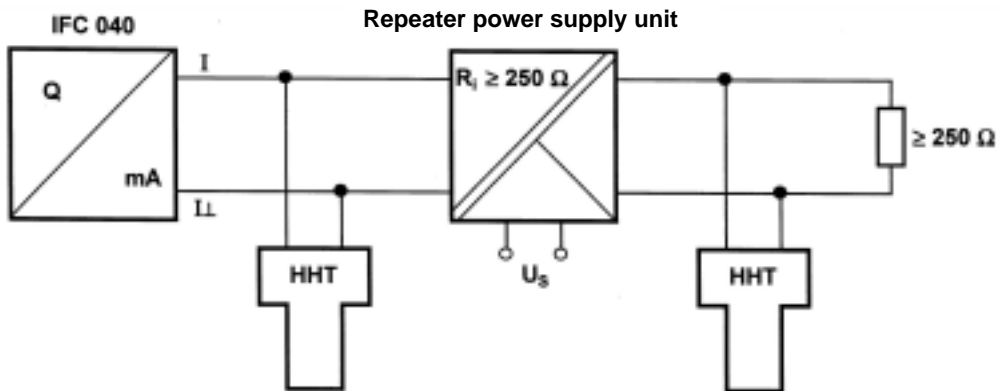
2.2 Output circuit diagrams

Supply power and current output - standard



Note data given in Sect. 2.1!

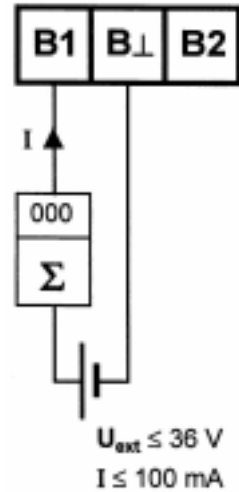
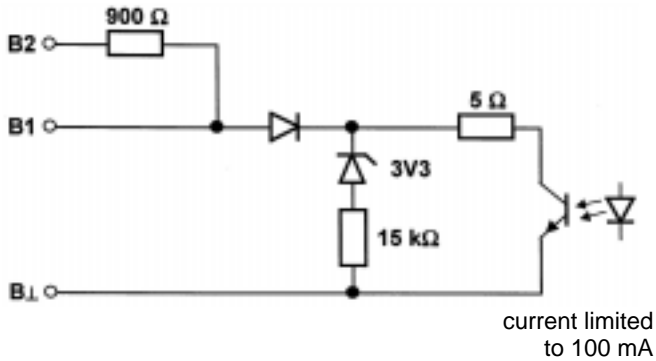
Supply power and current output - operation via repeater power supply unit



Repeater power supply unit, e.g.:  
 CEAG 6 / 420 or  
 Phoenix Contact PI/Ex-ME-RPSS-I/I

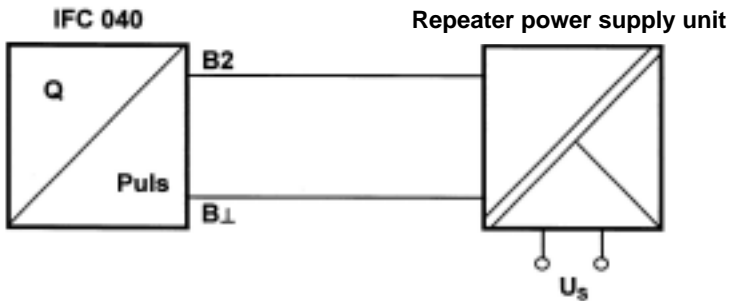
Note data given in Sect. 2.1!

**Pulse or status output**



Note data given in Sect. 2.1!

**Pulse or status output - operation via repeater power supply unit**



Repeater power supply unit e.g.:

Phoenix PI/Ex-ME-2NAM/COC

Note data given in Sect. 2.1!

2.3 Characteristic of the outputs

Fig. 1 Low-flow cutoff SMU (see Fct. 1.3 in Section 4.4)

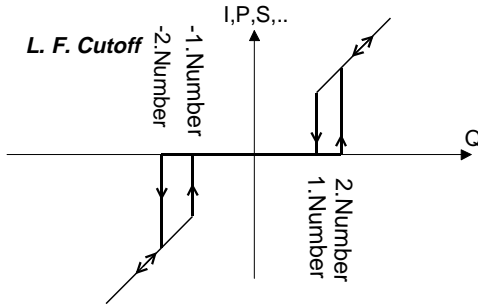
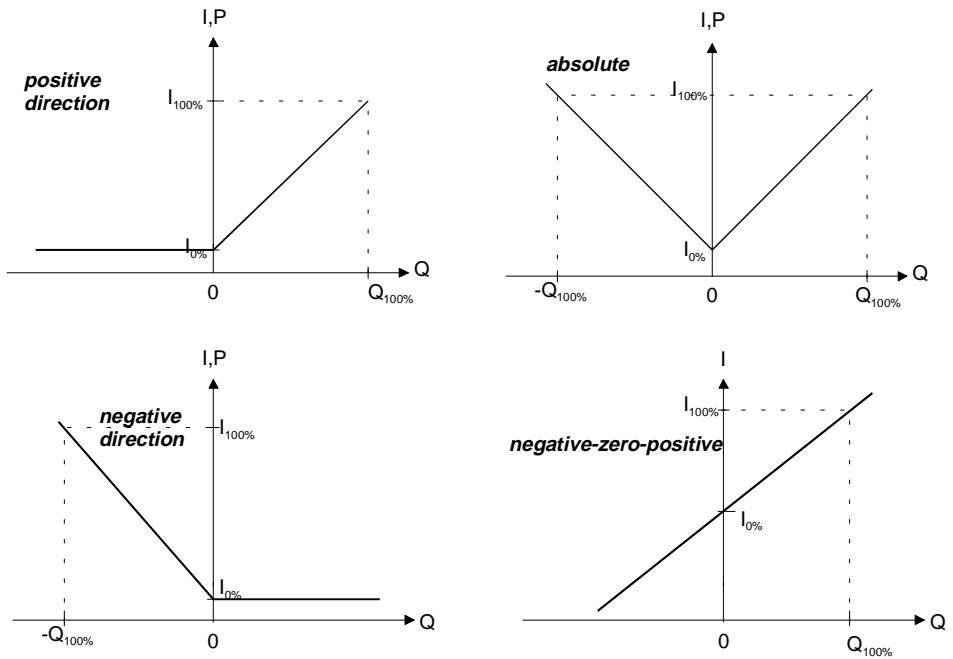
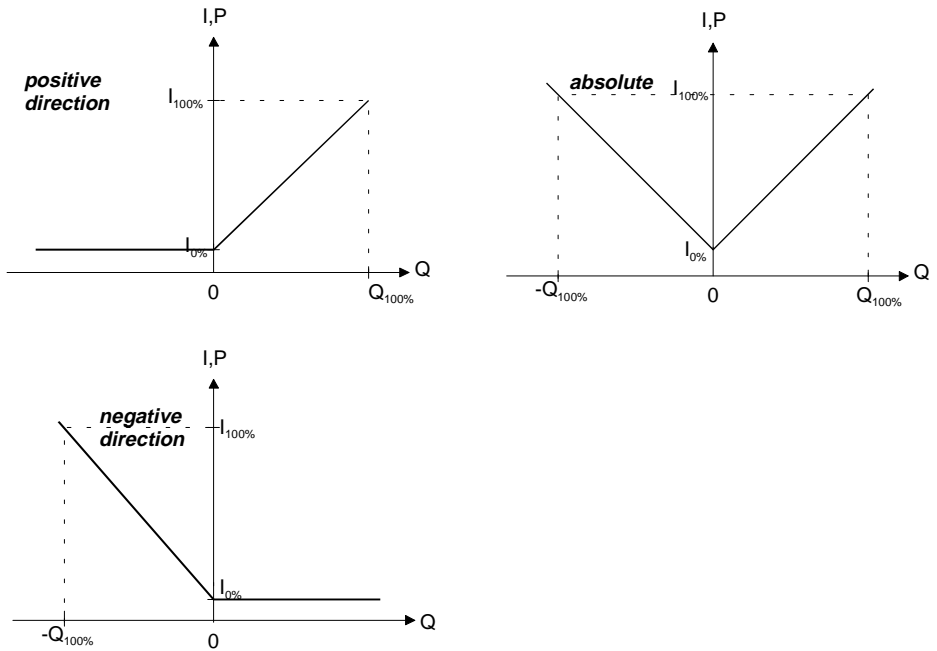


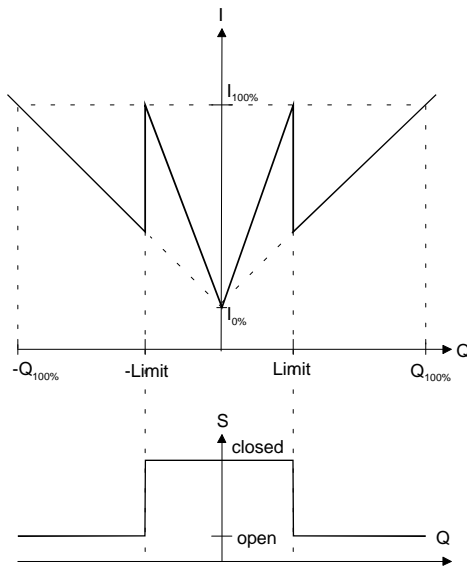
Fig. 2 Current output (see Fct. 1.5 in Section 4.4)



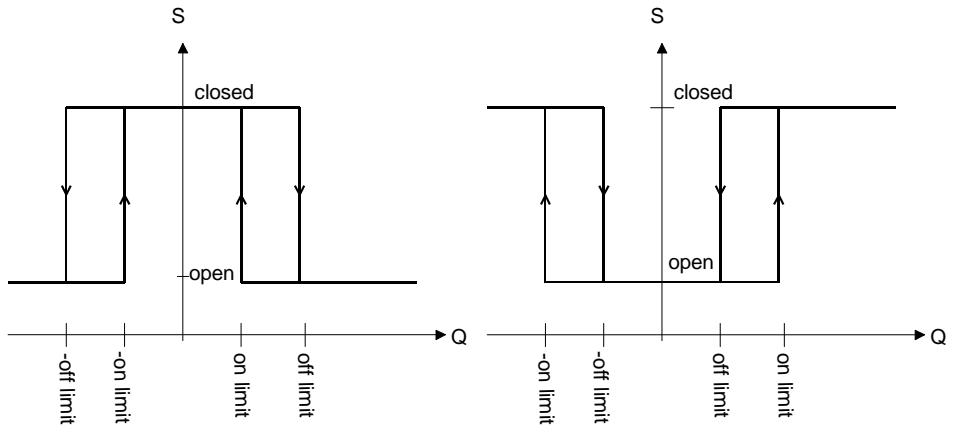
**Fig. 3 Pulse output** (see Fct. 1.6 in Section 4.4)



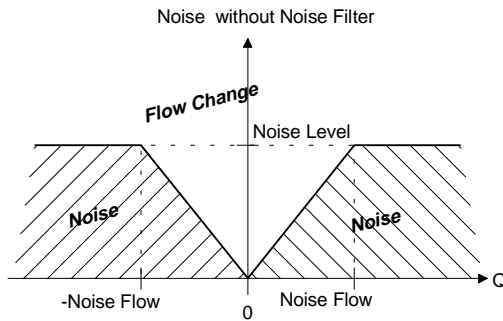
**Fig. 4 Status output: Automatic range change BA** (see Fct. 1.7 in Section 4.4)



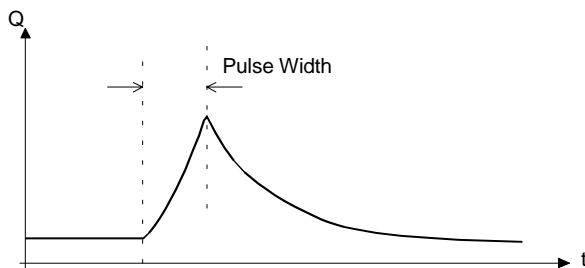
**Fig. 5 Status output: Limit switches**  
(see Fct. 1.7 in Section 4.4)



**Fig. 6 Noise / Change of flow** (see Fct. 3.4 in Section 4.4)



**Fig. 7 Pulse duration** (see Fct. 3.4 in Section 4.4)





### 3 Start-up

#### 3.1 Power ON and measurement

- Before powering the system, please check that it has been correctly installed according to Sections 1 and 2.
- The flowmeter is delivered ready for operational use. All operating data have been factory-set in accordance with your specifications.  
**Please also refer to Section 3.2 “Factory settings”.**
- Power the unit, and the flowmeter will immediately start process flow measurements.
- When powered, the display shows in succession: START UP and READY. This is followed by indication of the current flow rate and/or the current counter count, on either a continuous or alternating basis, depending on the setting under Fct. 1.04.
- For operator control, refer to Section 4.

#### 3.2 Factory settings

All operating data are factory set according to your order specifications.

If you have not made any particular specifications at the time of ordering, the devices are delivered with the standard parameters and functions listed in the table below.

To facilitate easy and rapid start-up, the current output is set to process flow measurement in “absolute”, so that the current flow rate is displayed independent of the direction of flow. On the display, measured values may possibly be shown with a “ - ” sign.

This factory setting for the current output may possibly cause measuring errors:

For example, when pumps are switched off and a “backflow” occurs that is not within the range of the low-flow cutoff SMU, or when separate displays and counts are required for both flow directions.

To avoid faulty measurements, therefore, it may be necessary to change the factory setting of some or all of the following functions. **For operator control see Section 4.4:**

- Low-flow cutoff SMU, Fct. 1.03
- Display, Fct. 1.04
- Current output, Fct. 1.05
- Pulse output, Fct. 1.06

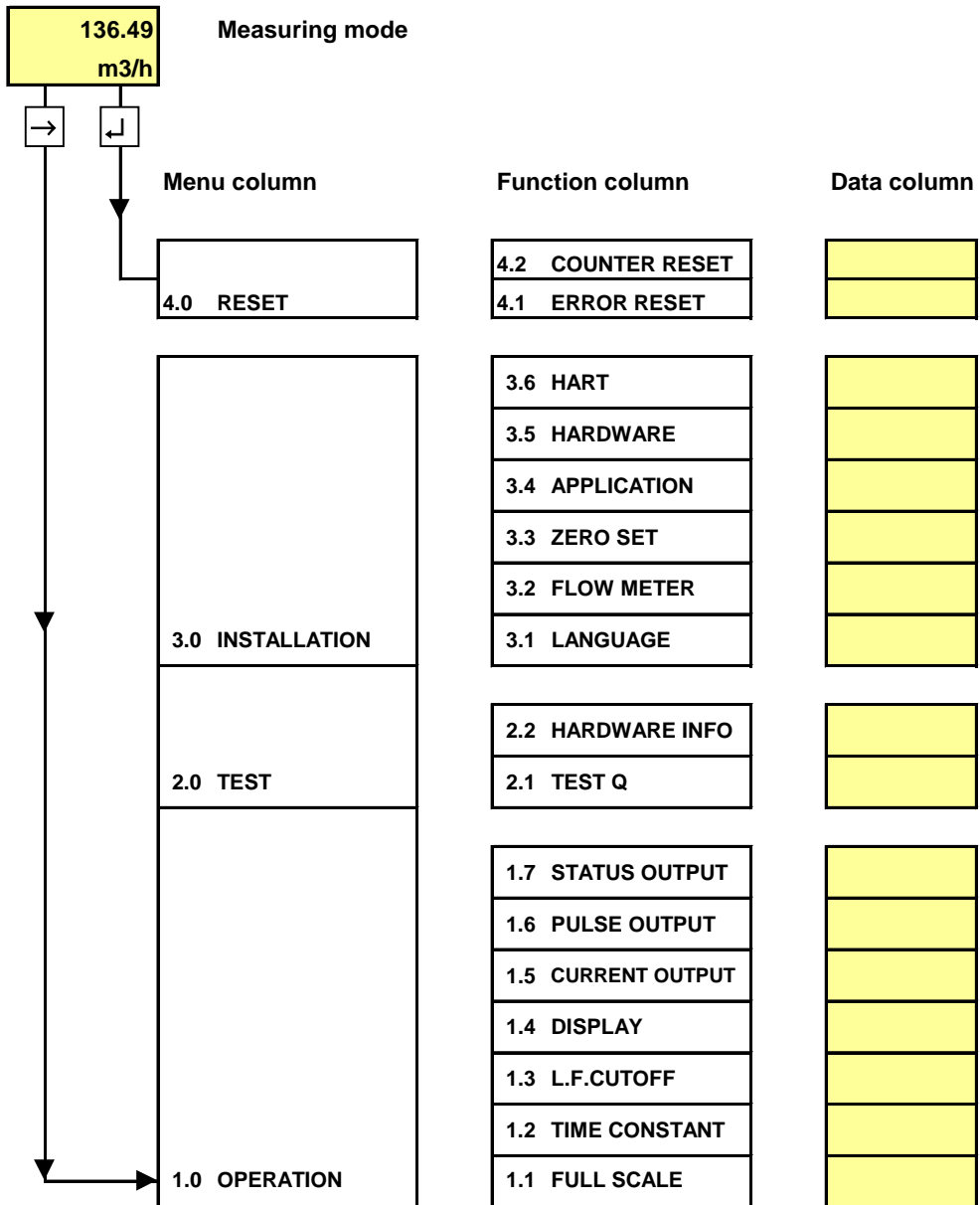
#### Standard factory settings

Function	Setting
1.01	Full scale range $Q_{100\%}$
1.02	Time constant
1.03	Low-flow cutoff
1.04	Display
	Flow rate
	Counter
1.05	Current output
	Function
	Range
	Error message
1.06	Pulse output
	Function
	Pulse per volume
	Pulse width

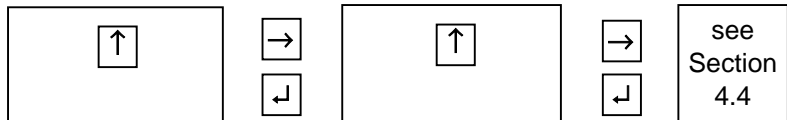
Function	Setting
1.07	Status output
3.01	Language
3.02	Primary head
	Meter size
	Flow direction
	(see arrow on primary head)
3.04	Application
	Empty pipe
	Field current
	Mode field current
	Limit
	Filter
3.05	Hardware
3.06	HART

**4 Operation of the signal converter**

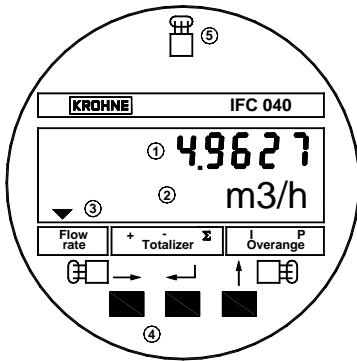
**4.1 KROHNE operator control concept**



Direction of movement



## 4.2 Operating and check elements



## Control by way of ...

- ... **the 3 keys** ④, after twisting off the cover of the electronics compartment using the special wrench (supplied).
- ... **the 3 magnetic sensors** ⑤ **and the bar magnet** (supplied) without opening the housing.

**PLEASE NOTE !**

Do not damage the screw thread and gasket of the cover, never allow dirt to accumulate, and make sure they are well greased at all times.

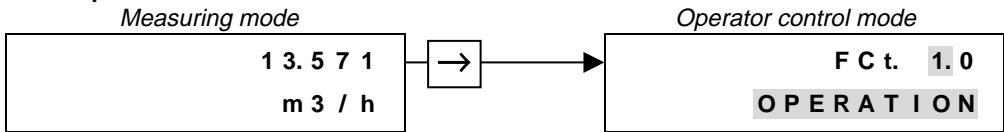
Replace any damaged gasket immediately!

- |   |  |          |                             |
|---|--|----------|-----------------------------|
| ① | Display  | 1st line |                             |
| ② | Display  | 2nd line | 4-character light writing   |
| ③ | Display  | 3rd line | Arrows to identify display  |
|   | <i>Flowrate</i>  |          | Current flow rate           |
|   | <i>Counter</i>   | +        | Positive counter            |
|   |  | -        | Negative counter            |
|   |  | $\Sigma$ | Sum counter (+ and -)       |
|   | <i>Overrange</i>   | I        | Overranging, current output |
|   |  | P        | Overranging, pulse output   |
| ④ | Keys for operator control of signal converter  |          |                             |
| ⑤ | Magnetic sensors to set the converter by means of a handheld bar magnet without opening the housing.<br>Function of sensors same as keys ④ |          |                             |

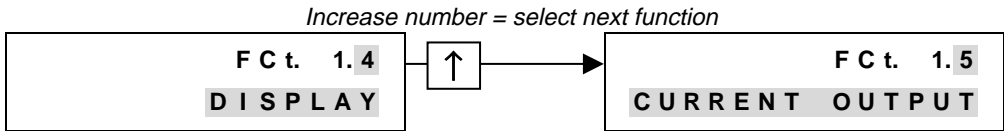
### 4.3 Function of keys

The **cursor**, flashing part of display or horizontal scrolling, has a **grey** background.

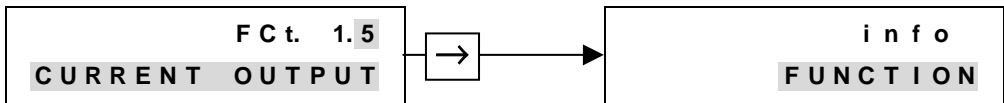
#### To start operator control



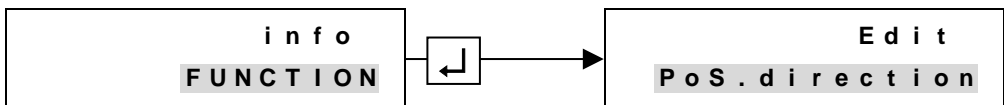
#### To select function



#### To transfer to subfunction

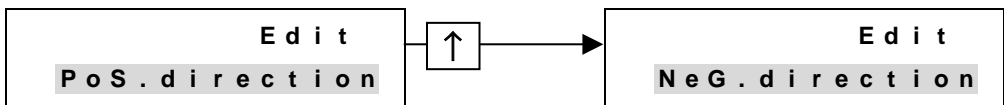


#### To transfer to setting of subfunction

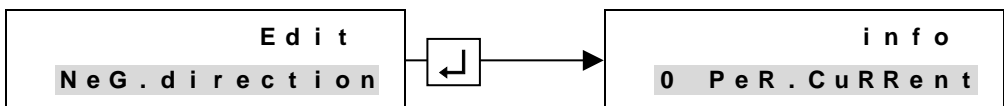


#### To alter texts

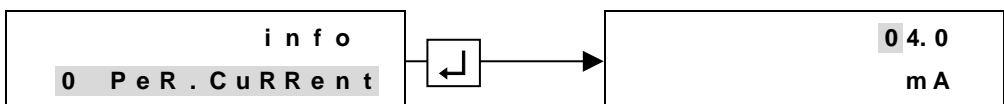
When (e.g. flow) units are changed, the numerical value is converted automatically.



#### To transfer to next subfunction

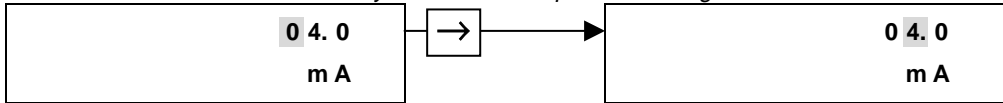


#### To transfer to setting of subfunction

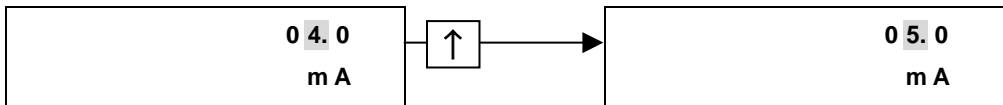


**To move cursor (flashing position)**

*each keystroke moves 1 place to the right*

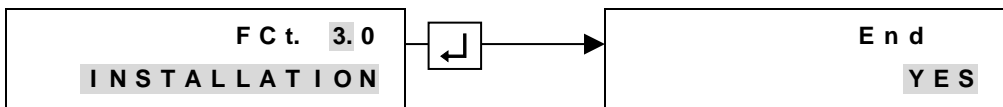


**To change a number**



**To terminate operator control**

Press key ↵ repeatedly until one of the functions  
**1.0 OPERATION, 2.0 TEST or 3.0 INSTALLATION**  
 is displayed.



**Store new parameters** Press key ↵ to confirm "YES", measuring mode continued with the new parameters.

**Do not store new parameters** Press key ↵ to confirm "NO", return to Fct. 1.0 OPERATION

## 4.4 Table of settable functions

Display texts		Description and settings
<b>Fct. 1.1</b> <b>FULL SCALE</b>	→	<b>Full-scale range</b>
XXX.XXX m <sup>3</sup> /h l/s Ga./m ↑ "user unit" <i>Range: 0.3-12 m/s = 1-40 ft/s</i>	↵	Set full-scale range, i.e. for the maximum occurring flow rate. This affects all functions where values have to be set as % of full-scale range:  Fct. 1.3 SMU Fct. 1.7 Status output Fkt. 3.4 Application  Fct. 1.5 Current output Fct. 2.1 Test Q
<b>Fct. 1.2</b> <b>TIME CONSTANT</b>	→	<b>Time constant</b>
XX.X S <i>Range 0.5 ... 99.9s</i> <i>Standard 3.0s</i>	↵	Setting the time constant for a two-pole low pass for signal damping. This time is needed after an abrupt change in the flow rate in order to attain 67% of the new flow value. The time constant acts equally on the current output and the display, and also on the status output when the 'sign' or 'limit value' functions are selected. The value can be transmitted via the HART interface with or without use of the time constant. If the time constant is changed, the noise level needs to be reset if the noise filter is activated (see Fct. 3.4 Application "Filter setting").
<b>Fct. 1.3</b> <b>L.F. CUTOFF</b>	→	<b>Low-flow cutoff (SMU)</b> For characteristic, see Fig. 1 in Section 2.3
XX XX Perc. <i>Range 1 ... 20%</i> <i>(1<sup>st</sup> value &lt; 2<sup>nd</sup> value)</i> <i>Standard: 04 ... 05%.</i>	↵	At low flows, flow display and counting are suppressed. This also applies to the negative flow direction. Cutoff 'off' value (1st figure) and cutoff 'on' value (2nd figure) must be set as a percentage of the full-scale range (see Fct. 1.1 Full-Scale). The SMU acts on the current output, pulse or status output, all counters and also values via the HART interface and the display.
<b>Fct. 1.4</b> <b>DISPLAY</b>	→	<b>Display</b> Setting for display form of measured values and messages in the local display. The following settings are possible:
inFo <b>diSPlaY Flow</b>	↵	<b>Display of flow</b>
Edit Percent no diSPlaY m <sup>3</sup> /h l/s Ga./m ↑ "user unit" <i>Standard: Percent</i>	↵	Select unit for display of current flow. Nothing displayed when "no display" has been set.

Display texts		Description and settings
inFo <b>dim. counter</b>	↵	<b>Dimension of counters</b>
Edit m3   Gal. ↑ "user unit" Standard: m3	↵	Select unit (dimension) for positive, negative and sum counters.
inFo <b>disPL,Format</b>	↵	<b>Display format</b>
8.88888 88.8888 888.888 8888.88 88888.8 888888. Auto. "units see above" Standard: 888888.	↵	Select format for positive, negative and sum counters. The first six settings have fixed positions for the decimal point. If an off-scale indication occurs here, the marker flashes against the displayed value. Off-scale indication can be prevented by selecting a different format. The setting "Automatic" will change the display such that always the highest counter value is displayed, if necessary in exponential format. An appropriate warning is shown when an off-scale indication occurs, provided the display of messages is activated in Function 1.4 "Display" setting "Display of messages". A change of format will not alter the value of the counter.
inFo <b>PoS cnt.disP.</b>	↵	<ul style="list-style-type: none"> <li>• <b>Positive counter display</b></li> <li>• <b>Negative counter display</b></li> <li>• <b>Sum counter display</b></li> </ul> The positive, negative and sum counter display functions allow the respective counter to be switched on (Yes) or off (No). When several displays are selected, display of numerical values is cyclic.
Edit YES ↑ NO Standard: No	↵	
inFo <b>neG cnt.disP.</b>	↵	
Edit YES ↑ NO Standard: No	↵	
inFo <b>Sum cnt.disP.</b>	↵	
Edit YES ↑ NO Standard: No	↵	
inFo <b>diSP.meSSaGeS</b>	↵	<b>Display of messages</b>
Edit YES ↑ NO Standard: Yes	↵	Setting as to whether, in addition, messages from self-test functions are to be displayed (Yes) or not (No).

Display texts		Description and settings
<b>Fct. 1.5</b> <b>CURRENT OUTPUT</b>	→	<b>Current output</b> For characteristic, see Fig. 2 in Section 2.3
<i>For HART function "No" or address "0"</i>		Settings for the current output Not possible when "Address 1 –15" is set under Fct. 3.6 HART (equivalent to multidrop mode). In that case, only a constant current needs to be set, see Fct. 3.6 HART "I Multidrop". Fct. 1.5 Current output then has "no function".
inFo <b>Function</b>	↵	
Edit <div style="text-align: right;">off</div> PoS.direction neG.direction abSolute ↑ neG-0-PoS <i>Standard: absolute</i>	↵	Setting the characteristic of the current output "off" = 0 per cent current output  Please note: Fct. 1.7 Status output, "Automatic range change" setting.
inFo <b>0 Perc.current</b>	↵	<b>0 per cent current</b>
XX.X <div style="text-align: right;">mA</div> <i>Range 4.0 ... 14.0mA</i> <i>Standard: 4.0 mA</i>	↵	Setting of current at "zero" flow( $I_{0\%}$ )
inFo <b>100 Perc.current</b>	↵	<b>100 per cent current</b>
XX.X <div style="text-align: right;">mA</div> <i>Range 10.0 ... 20.0 mA</i> $I_{0\%} < I_{100\%}$ <i>Standard: 20 mA</i>	↵	Setting of current at 100 % flow ( $I_{100\%}$ ), according to the full-scale range ( $Q_{100\%}$ ) under Fct. 1.1 Full Scale.
inFo <b>error current</b>	↵	<b>Fault current</b>
XX.X <div style="text-align: right;">mA</div> <i>Range 3.6 ... 22.4 mA</i> $I_{Error} < I_{0\%} \text{ or } I_{100\%} < I_{Error}$ <i>Standard: 22 mA</i>	↵	The fault current that is output in the event of a fault.  Please note: When the current output is overranged, the maximum current is 21mA and has been preset by factory.



Display texts		Description and settings
<b>Fct. 1.6</b> <b>PULSE OUTPUT</b>	→	<b>Pulse output</b> Settings for the pulse output  Characteristic, see Fig. 3 in Section 2.3  Only possible when "Pulse output" is set under Fct. 3.5 Hardware. When "Status output" selected, Fct. 1.6 has "no function".
<b>Function</b>	↵	<b>Function</b>
Edit off PoS.direction neG.direction abSolute ↑ <i>Standard: absolute</i> <i>Other selection</i>	↵	Setting of the characteristic of the pulse output "off" = switch at output open
<b>Pulse width</b>	↵	<b>Pulse width</b> Minimum interpulse period = half pulse width
XXX0. mS <i>Range 30 ... 1000 ms</i> <i>Standard: 50 ms</i>	↵	Pulse width defines the time during which the switch at the output is closed and high current flows between terminals B1 or B2 and B┘. The maximum pulse rate is selected at the same time, as the interpulse period is at least equal to half the pulse width: $\text{Pulse rate}_{\max} = \frac{1}{1.5 \times \text{pulse width}}$
<b>Pulse/Volume</b>	↵	<b>Pulses / Volume</b> Number of pulses per unit volume
XXX.XXX m3 l Gal. ↑ "user unit" <i>Range 0 ... 10 Hz</i> <i>Standard: 1 pulse per m3</i>	↵	Pulses/Volume is used to set the number of pulses that are output for the given volume. If 10.0 is set at Unit m <sup>3</sup> , 10 pulses are output per cubic metre. If 0.01 is set at Unit l, one pulse is output per 100 litres. <ul style="list-style-type: none"> <li>• A large pulse width together with a high pulse rate will cause overranging. Therefore, pulse rate is limited so that the minimum interpulse period does not drop below half the pulse width. In that case, error message due to overranging of the pulse output, i.e. marker flashes and, if activated in Fct. 1.4 "Display", is output in the form of horizontal scrolling.</li> <li>• When the pulse output is overranged, the missing pulses are output later, at times of lower flow.</li> </ul>

Display texts		Description and settings																					
Fct. 1.7 <b>STATUS OUTPUT</b>	→	<b>Status output</b> Settings for the status output  Only possible when "Status output" set under Fct. 3.5 Hardware. When "Pulse output" selected, Fct. 1.7 has "no function".																					
inFo <b>Function</b>	↵																						
Edit  off on all error SiGn overflow emPtY PiPe  auto.ranGe (für Stromausgang)  ↑ limit value <i>Standard: off</i>	↵	Setting the characteristic of the pulse output <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:50%; text-align: center;">Switch open</th> <th style="width:50%; text-align: center;">Switch closed</th> </tr> </thead> <tbody> <tr> <td>permanently</td> <td>-</td> </tr> <tr> <td>-</td> <td>permanently</td> </tr> <tr> <td>error</td> <td>no error</td> </tr> <tr> <td>positive flow</td> <td>negative flow</td> </tr> <tr> <td>no overranging</td> <td>overranging</td> </tr> <tr> <td>pipe/tube completely filled</td> <td>pipe/tube empty</td> </tr> <tr> <td>range above limit</td> <td>range below limit</td> </tr> <tr> <td>normal function</td> <td>zoom-in function active</td> </tr> <tr> <td>inactive</td> <td>active</td> </tr> </tbody> </table>		Switch open	Switch closed	permanently	-	-	permanently	error	no error	positive flow	negative flow	no overranging	overranging	pipe/tube completely filled	pipe/tube empty	range above limit	range below limit	normal function	zoom-in function active	inactive	active
Switch open	Switch closed																						
permanently	-																						
-	permanently																						
error	no error																						
positive flow	negative flow																						
no overranging	overranging																						
pipe/tube completely filled	pipe/tube empty																						
range above limit	range below limit																						
normal function	zoom-in function active																						
inactive	active																						
inFo <b>limit</b>	↵	<b>When automatic range change selected</b> the limit value must be set as a percentage of the full-scale range ( $Q_{100\%}$ ), (see Fct. 1.1):																					
XXX Perc. <i>Range 5 ... 80%</i> <i>Standard: 20%</i>	↵	Below the set limit value, the current output has a zoom-in function. The flow range from "0" to "Limit" is projected to the $I_{0\%}$ to $I_{100\%}$ range.  For characteristic of automatic range change, see Fig. 4 in Section 2.3																					
inFo <b>1.limit.value</b>	↵	<b>When limit value selected</b> the 'on' and 'off' values must be set as a percentage of the full-scale range ( $Q_{100\%}$ ) (see Fct. 1.1):																					
XXX Perc. <i>Range 0.1 ... 110 %</i> <i>Standard: 10 %</i>	↵	with adjustable hysteresis, as the 'on' value can be smaller or larger than the 'off' value.																					
inFo <b>2.limit.value</b>	↵	For characteristic of limit switch, see Fig. 5 in Section 2.3																					
XXX Perc. <i>Range 0.1 ... 110 %</i> <i>Standard: 20 %</i>	↵																						

Display texts			Description and settings
<b>FCt. 2.1</b>			<b>Test measuring range Q</b>
	<b>TEST Q</b>	→	
Edit	not Sure		Operator inquiry as to whether test to be carried out?
↑	YeS Sure	↵	
	-110.0		If "YeS Sure", fixed values for the outputs can be set relative to the full-scale range.  No setting for the outputs. When the function is terminated, the outputs operate as before.
	-100.0		
	-50.0		
	-10.0		
	0.0		
	10.0		
	50.0		
	100.0		
↑	110.0	↵	
	Perc.		
<b>FCt. 2.2</b>			<b>Hardware information and error status</b>
	<b>HARDWARE INFO</b>	→	
inFo.no	modul ADC	↵	In the event of an error, scan and note down all information (software number = Info Number, and status). Important if factory needs to be consulted.
	x.xxxxx. xxxx	↵	
StAtUS	modul ADC	↵	Settings are not possible here.
	xxxxxx xxxx	↵	
inFo.no	modul IO	↵	
	x.xxxxx. xxxx	↵	
StAtUS	modul IO	↵	
	xxxxxx xxxx	↵	
inFo.no	modul diSPlaY	↵	
	x.xxxxx. xxxx	↵	
StAtUS	modul diSPlaY	↵	
	xxxxxx xxxx	↵	
inFo.no	modul HART	↵	
	x.xxxxx. xxxx	↵	
StAtUS	modul HART	↵	
	xxxxxx xxxx	↵	

Display texts		Description and settings
<b>Fct. 3.1</b>		<b>Select language for display texts</b>
<b>LANGUAGE</b>	→	
Edit ↑ EnGliSh French German <i>Standard: English</i>	↵	
<b>Fct. 3.2</b>		<b>Primary head – to set data</b> Data have been factory-set. Changes here only necessary when the electronic unit has been replaced.
<b>FLOW METER</b>	→	
inFo		<b>Meter size (nominal diameter)</b>
<b>diameter</b>	↵	
XXX.X mm <i>Range 10 - 250 mm = 3/8" - 6"</i> <i>Standard: see nameplate</i>	↵	Set nominal diameter / meter size of the primary head (flowmeter). DN 150 / 6" is currently the largest size available.
inFo		<b>Full-scale range</b>
<b>Full Scale</b>	↵	
XXX.XXX m3/h l/s Ga./m ↑ "user unit" <i>Range: 0.3-12 m/s = 1-40 ft/s</i>	↵	Set full-scale range, i.e. the maximum occurring flow. This affects all functions in which values have to be set as % of the full-scale range:  Fct. 1.3 Low-flow cutoff      Fct. 1.5 Current output Fct. 1.7 Status output      Fct. 2.1 Test Q Fct. 3.4 Application
inFo		<b>Primary constant</b>
<b>PrimarY conStant</b>	↵	
XX.XXXX GKL <i>Range 1.0 ... 19.9999</i> <i>Standard: see nameplate</i>	↵	The primary constant is used for setting three calibration values for the primary head.  GKL describes the calibration value at 100mA <sub>pp</sub> field current (see nameplate).
X.XXXX K50 <i>Range 0.5 ... 1,5</i> <i>Standard: see nameplate</i>	↵	K50 describes the variation at 50mA <sub>pp</sub> field current compared to 100mA <sub>pp</sub> (see nameplate).
X.XXXX K25 <i>Range 0.5 ... 1.5</i> <i>Standard: see nameplate</i>	↵	K25 describes the variation at 25mA <sub>pp</sub> field current compared to 100mA <sub>pp</sub> (see nameplate).
inFo		<b>Define direction of flow</b> according to direction shown by arrow on the primary head
<b>Flow direction</b>	↵	
Edit ↑ PoS. Flow neG. Flow <i>Standard: pos. flow</i>	↵	Set the main direction of flow or the forward flow in the case of F/R mode: <b>in direction of arrow</b> = PoS. DFI. (positive flow) <b>opposite dir. of arrow</b> = neG. DFI. (negative flow)

Display texts		Description and settings
<b>FCt. 3.3</b>  <b>ZERO POINT</b>	→	<b>Calibrate the zero</b>
Edit  ↑  not Sure YeS Sure	↵	Carry out only after a replacement of the electronic unit or if, at low flow, an offset is presumed.  Please note! • Measuring tube must be completely filled with the process liquid! • Flow must truly be “zero”!
8 XXX.X  Perc.	↵	Display of current flow rate as a percentage of the full-scale range. (The segments of the “8” are reduced in keeping with the progress of measurement.)
Edit  not Save Yes Save	↵	Save new zero value?

Display texts		Description and settings
<b>Fct. 3.4</b>		<b>Application</b> = set characteristic of measuring point
<b>APPLICATION</b>	→	
inFo		<b>Pipe/tube has run dry</b>
<b>emPtY PiPe</b>	↵	
Edit		The empty pipe identifier can be switched on (YES) and off (NO). A load-independent current of approx. 25nA flows continuously from the electrodes to ground (pipeline / grounding rings). If this current can no longer flow, and the empty pipe identifier is activated, the measured value is set to zero and an error message is enabled (see Fct. 1.4, setting of "Display messages"). If not required, deactivate the empty pipe identifier (=NO).
YES NO ↑ Standard: Yes	↵	
inFo		<b>Field current</b>
<b>Field current</b>	↵	Default value for maximum allowable field current.
Edit		If the available energy is not sufficient for the set maximum field current, automatic reduction to the next lower value. Where flow is pulsating, it is advised to reduce the field current from 100mA <sub>pp</sub> (setting: 100-50-25mA) to 50mA <sub>pp</sub> (setting: 50-25mA). Above approx. 10-20% flow, continuous measurement is then present.
100-50-25mA 50-25mA 25mA ↑ Standard: 100-50-25mA	↵	
inFo		<b>F current mode</b>
<b>ModuS F.current</b>	↵	
Edit		<ul style="list-style-type: none"> <li>The double setting is standard (follows flow at a faster rate),</li> <li>The triple setting reduces strong interference (e.g. from solids contents).</li> </ul>
two times three times ↑ Standard: two times	↵	
inFo		<b>Limitation</b>
<b>limit</b>	↵	
Edit		1 150% setting is standard, 2 300% and 1000% settings (advisable with pulsating flow or low conductivity), all as percentage of full-scale value, see Fct. 1.1.  Please note: 3 if noise filter used (see following function), set limitation to 1000%. 4 Do not increase limitation if process liquids contain solids.
150 Perc. 300 Perc. 1000 Perc. ↑ Standard: 150 %	↵	
inFo		<b>Filter</b>
<b>Filter</b>	↵	
Edit		<ul style="list-style-type: none"> <li>Filter 'off' setting is standard,</li> <li>Noise filter if conductivity is low (for characteristic, see Fig. 6 in Section 2.3)</li> <li>Activate pulse filter if solids contents or other pulsed interference involved (for characteristic see Fig. 7 in Section 2.3).</li> </ul> Please note: Further settings are required when pulse filter or noise filter is activated, see below:
Filter off PulSe Filter noiSe Filter ↑ Standard: filter off	↵	

Display texts		Description and settings
selection "Pulse Filter"		... pulsed interference is suppressed. In addition to the setting "Limitation" over the total measuring range, see above, "Pulse duration" and "Pulse limitation" dynamically limit abrupt changes in the measured value.
inFo <b>PulSe duration</b>	↵	<b>Pulse duration</b>
XX.X  S <i>Range 0.1 ... 25.0 s</i> <i>Standard: 1.0 s</i>	↵	Setting the pulse duration limitation  Time must be longer than the duration of the pulsed interference (see Fig. 7 in Section 2.3).
inFo <b>PulSe limit</b>	↵	<b>Pulse limitation</b>
XXX  Perc <i>Range 1 ... 100 %</i> <i>Standard: 5 %</i>	↵	The pulse limitation allows setting of the size of change from one measured value to the next (as percentage of the full-scale range, see Fct. 1.1).
selection "noiSe Filter"		... suppresses unsteady measured values caused e.g. by low electrical conductivity of the process liquid or high solids contents. When noise filter is activated, the "Limitation", see above, should be set to 1000%, otherwise measured values are too low in the upper flow range.
inFo <b>noiSe SuPPreS.</b>	↵	<b>Noise rejection</b>
Edit  two times three times ↑ four times <i>Standard: two times</i>	↵	The level of noise rejection can be selected as a factor of the interference level.
inFo <b>noiSe Flow</b>	↵	<b>Noise flow</b> Adjustment when noise is dependent on flow.
XXX  Perc. <i>Range 5 ... 100 %</i> <i>Standard: 20 %</i>	↵	<ul style="list-style-type: none"> <li>• approx. 20% in normal 2-wire operation</li> <li>• approx. 80% when operated with power booster</li> </ul> in both cases as percentage of full-scale range (see Fct. 1.1) (see Fig. 6 in Section 2.3)
inFo <b>noiSe level</b>	↵	<b>Noise level</b> Setting of the noise level (unsteadiness) that can be observed without use of the filter.
XX.X  Perc.  <i>Range 0.1 ... 25.0 %</i>  <i>Standard: 5 %</i>	↵	Setting the noise level "peak-to-peak" (e.g. width on a recorder or difference between minimum and maximum value in display) as percentage of full-scale range (see Function 1.1). Measurement at high flow rate (maximum flow rate) when filter deactivated. If time constant has been changed (see Fct. 1.2) this setting must be carried out again. The filter will not take effect if the noise level is set too low. It is better to set the noise level too high rather than too low (see Fig. 6 in Section 2.3).

Display texts		Description and settings
<b>Fct. 3.5</b>		<b>Hardware</b>
<b>HARDWARE</b>	→	Setting the function of terminals B1 and B2
inFo		
<b>Function term.B</b>	↵	
Edit		This is active when "Pulse output" selected (see Fct. 1.5) and the status output (see Fct. 1.6) has "no function".
PulSe outPut		
↑ StatuSoutPut	↵	This is active when "Status output" selected (see Fct. 1.6) and the pulse output (see Fct. 1.5) has "no function".
<i>Standard: pulse output</i>		
<b>Fct. 3.6</b>		<b>HART®</b>
<b>HART</b>	→	Settings for HART® communication (FSK modulation with 1200 bauds on the current output)
inFo		
<b>Function</b>	↵	<b>Function</b> activate (=YES) or deactivate (=NO) the interface
Edit		When HART® interface is activated, the decimal point on the left in the display flashes when communication is taking place (in the multidrop mode only when the appropriate device responds).
YES		
↑ NO	↵	
<i>Standard: No</i>		
inFo		
<b>I 4mA trim.</b>	↵	The 'I 4mA trim.' and 'I 20mA trim.' values correspond to the values to be set via the HART® interface (Cmd #45 and #46).
X.XXX		
mA	↵	These values have no function when HART® is deactivated.
<i>Range 3.700 ... 5.000 mA</i>		
<i>Standard: 4.000 mA</i>		
inFo		
<b>I 20mA trim.</b>	↵	
XX.XXX		
mA	↵	
<i>Range 18.000 ... 21.000 mA</i>		
<i>Standard: 20.000 mA</i>		
inFo		
<b>AdreSS</b>	↵	<b>Address</b>
XX		
Adr	↵	Set address for a device in the case of HART® communication.
<i>Range 0 ... 15</i>		
<i>Standard: 0</i>		If the address is greater than "0", the current output is operated with constant current (multidrop).
<i>selection "1 ... 15"</i>		
inFo		
<b>i multi drop</b>	↵	<b>Multidrop mode</b>
XX.X		
mA	↵	In the multidrop mode a constant current is present at the current output. This is 4 mA in accordance with the HART® agreements. However, if there are sufficient reserves in the network, better measuring results are obtained with 5 mA to 6 mA (signal-to-noise ratio). Set 4mA when operating with the power booster (no benefit from higher values).
<i>Range 4.0 ... 20.0 mA</i>		
<i>Standard: 5.0 mA</i>		



## 4.5 Error messages in measuring mode

Warnings	Description of error	Eliminate error
Pipe empty (1)	Pipe (partially) empty	Fill pipe
	Poor grounding, or none at all	Check grounding system
	Electrical conductivity too low	Check process liquid
	Electrodes contaminated	Clean electrodes
	Electrode wire break	Repair wires
Field coil defective	Short-circuit, break, or excess temperature	Check and eliminate fault
Linearity	Analog/digital converter (ADC) defective	Replace electronic unit
	Primary head defective	Replace primary head
	K 50 constant incorrect	Correct, see nameplate
	ADC zero incorrect	Replace electronic unit
Low energy	Energy too low for correct measurements	Voltage is less than 14 V, increase energy
Overranging (2)	ADC overranged	Change Fct. 3.4 Limitation
Overflow current	Measured value higher than full-scale range	Check device parameters and correct if necessary
Overflow pulse (3)	Pulse rate too high, max. 1 / (1.5×pulse width)	Check device parameters and correct if necessary
Overflow counter	Overflow of a counter	Reset counter
Line interrupt (4)	Power failure	Delete error message and, if necessary, reset counter
Fatal error	Severe error, measurement interrupted	Replace electronic unit

- (1) Is checked only when "Application" is activated in Fct. 3.4  
 (2) Value for checking overranging is set in Fct. 3.4 "Application" relative to full-scale range  
 (3) Missing pulses are recovered at times when pulse rate is low  
 (4) Is checked only when a counter is activated in Fct. 1.4 "Display"

## 4.6 Reset counters and cancel error messages

Display texts		Description and settings
... measuring mode ...	↵	Entry into RESET menu
FCt. 4.0 RESET MENUE	→	
FCt. 4.1 ERROR RESET	↑	Resetting the messages power failure and counter overflow
rESet ↑ NO YES ↵		
FCt. 4.2 COUNTER RESET	→	Reset all counters
rESet ↑ NO YES ↵		

## 5 Technical data

### 5.1 Full-scale ranges

#### Full-scale range $Q_{100\%}$

Flow  $Q = 100\%$  85 Liter/h - 763 m<sup>3</sup>/h (0.37 – 3361 US Gal/min), adjustable as required, equivalent flow velocity 0,3 – 12 m/s (1 – 40 ft/s)

Units m<sup>3</sup>/h, Liter/s, US Gal/min user-defined unit, e.g. US MGal/min

#### Flow tables

v = flow velocity in m/s

v = flow velocity in ft/s

Meter size		Full-scale range $Q_{100\%}$ in m <sup>3</sup> /h		
DN mm	inch	v=0.3m/s (minimum)	v=1m/s	v=12 m/s (maximum)
10	3/8	0.0849	0.2827	3.392
15	1/2	0.1909	0.6362	7.634
25	1	0.5302	1.767	21.20
50	2	2.121	7.069	84.82
80	3	5.429	18.10	217.1
100	4	8.483	28.27	339.2
150	6	19.09	63.62	763.4

Meter size		Full-scale range $Q_{100\%}$ In US Gal/min		
DN mm	inch	v=1 ft/s (minimum)	v=3.3 ft/s	v=40 ft/s (maximum)
10	3/8	0.0849	0.2827	3.392
15	1/2	0.1909	0.6362	7.634
25	1	0.5302	1.767	21.20
50	2	2.121	7.069	84.82
80	3	5.429	18.10	217.1
100	4	8.483	28.27	339.2
150	6	19.09	63.62	763.4

**5.2 Error limits at reference conditions**

**Display, digital values, pulse output**

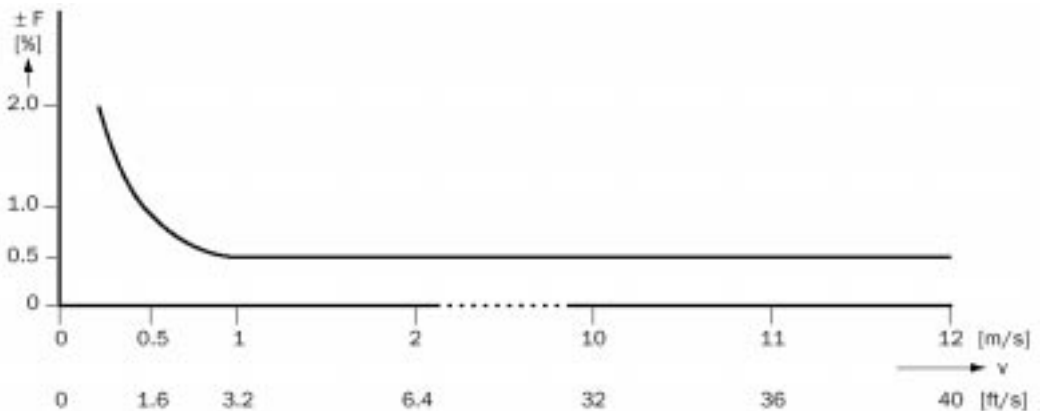
- calibrated in accredited test rigs to EN 17 025 by direct comparison of volume

**F** maximum error in % of measured values (not typical values)

**v** Flow velocity in m/s and ft/s

**Reference conditions similar to EN 29104**

Product	water at 10 – 30 °C / 50 – 86 °F
Electrical conductivity	>300 µS/cm
Power supply (rated voltage)	U <sub>N</sub> (±2%)
Ambient temperature	20 - 22 °C / 68 – 71.6 °F
Warm-up time	60 min
Inlet / outlet runs	10 x DN / 2 x DN (DN = meter size)
Primary head	properly grounded and centered
Measuring time	100 s



<b>Meter size</b>	<b>Maximum error</b> in % of measured value (MV) at ...
<b>DN mm</b> <b>inch</b>	<b>v ≥ 1 m/s / ≥ 3 ft/s:</b> <b>v &lt; 1 m/s / &lt; 3 ft/s:</b>
DN 10 - 150    3/8" – 6"	≤ ± 0,5% MV                                      ≤ ± 5 mm/s / ≤ ± 0.2 inch/s

**Current output**                      Same error limits as above, additionally ± 10 µA

<b>Reproducibility at constant flow</b>	<b>v ≥ 1 m/s / ≥ 3 ft/s:</b>	<b>v &lt; 1 m/s / &lt; 3 ft/s:</b>
	≤ ± 0,1% MV	≤ ± 1 mm/s / ≤ ± 0.04 inch/s

<b>External influences</b>	<b>typical values</b>	<b>maximum values</b>	
<u>Ambient temperature</u>			
Pulse output	0,003 % MV <sup>1)</sup>	0,01 % MV <sup>1)</sup>	} at 1 K / 1.8 °F variation
Current output	0,01 % MV <sup>1)</sup>	0,025 % MV <sup>1)</sup>	
<u>Power supply</u>	< 0,02 % MV	0,05 % MV	at 10 % variation

**1)** All KROHNE signal converters undergo burn-in tests, duration minimum 20 hours at varying ambient temperature -20 to + 60 °C / -4 to +140 °F. The tests are controlled by computers.

## 5.3 IFC 040 Signal converter

**Current output**

Function

- all operating data configurable
- for passive mode
- standard HART<sup>®</sup> communication

Current: fixed ranges  
variable ranges

4-20 mA

for Q = 0%	$I_{0\%} = 4\text{--}14\text{ mA}$	adjustable in 0.1 mA increments
for Q > 100%	$I_{100\%} = 10\text{--}20\text{ mA}$	
for Q = 100%	$I_{\max} = 21\text{ mA}$	

Current: fixed ranges  
variable ranges

4-20 mA

for Q = 0%

**Binary output**

Function

- used as pulse or status output
- all operating data configurable
- galvanically isolated from current output and all input circuits

Passive mode

Selectable according to NAMUR (DIN 19 234)  
or as contact:

- |          |          |
|----------|----------|
| • open   | • open   |
| • closed | • closed |

Pulse output

digital pulse division, interpulse period non-uniform,  
therefore if frequency and cycle meters connected  
allow for minimum counting interval:

$$\text{gate time, counter} \geq \frac{10}{P_{100\%}[\text{Hz}]}$$

pulse width 30 – 1000 ms  
(adjustable in 10 ms increments)

Status output

configurable as measuring range identification for  
automatic range change, indicator for flow direction,  
overflow, errors, trip point or empty pipe indication**Time constant**

0.5 – 99.9 s, adjustable in 0.1 s increments

**Low-flow cutoff**

cutoff "on" value: 1 – 19%	cutoff "on" value: 1 – 19%
cutoff "off" value: 2 – 20%	

<b>Local display</b>	3-field LCD
Display function	actual flowrate, forward, reverse and sum counters (6-digit), and status messages
units: actual flowrate	m <sup>3</sup> /h, liter/s., US gallon/min or in user defined unit, e.g. US Mgallon/day
counter	m <sup>3</sup> , liter, US gallon or in user defined unit, e.g. US Mgallon/day
Language of plain text	English, German, French, others on request
Display: top field	6-character, 7-segment, numeral and sign display, and symbols for key acknowledgement
middle field	4-character, 14-segment text display
bottom field	6 markers to identify display in measuring mode and messages of outputs
<b>Hazardous duty versions</b>	Connections in following protection classes can be selected by customer during installation: <ul style="list-style-type: none"> <li>• intrinsic safety "i"</li> <li>• increased safety "e" <b>or</b></li> <li>• flameproof enclosure "d"</li> </ul>
<b>Power supply</b>	
<b>A) Current output (2-wire connection)</b>	4-20 mA via propriery power supply 14-36 V
<b>B) Power Booster</b> Additionally to A) = 2x2 –wire connection	For demanding applications without changing or removing the meter. Connect power terminals to... <ul style="list-style-type: none"> <li>• propriery power supply 22 mA, 14-36 V DC <b>or</b></li> <li>• 24 V DC, max. 1 W</li> </ul> (same protection as A = galvanically isolated)
<b>Housing</b>	
Material	die-cast aluminium with polyurethane finish
Ambient temperature	- 25 to + 60°C / -13 to +140 °F
Protection category (IEC 529/ EN 60529)	IP 67, equivalent to NEMA 6

## 5.4 IFS 4002 Primary head

<b>Meter sizes</b>	DN 10, 15, 25, 50, 80, 100, 150 and $\frac{3}{8}$ " , $\frac{1}{2}$ " , 1" , 2" , 3" , 4" , 6"	
<b>Pipe flanges</b> to DIN 2501 (= BS 4504)  to ANSI B 16.5	DN 10, DN 15, DN 25, DN 50, DN 80 / PN 40 DN 100, DN 150 / PN 16, $\frac{3}{8}$ " , $\frac{1}{2}$ " , 1" , 2" , 3" , 4" , 6" , class 150 lb / RF	
<b>Electrical conductivity</b>	$\geq 5 \mu\text{S/cm}$ $\geq 20 \mu\text{S/cm}$ for demineralized cold water	
<b>Temperatures</b>	Ambient temperature -25 to + 60 °C -13 to +140 °F  -25 to + 40 °C -13 to +104 °F	Process temperature -25 to $\leq$ + 60 °C -13 to $\leq$ +140 °F  -25 to $\leq$ +140 °C -13 to $\leq$ +284 °F
<b>Insulation class of field coils</b>	H / $\leq 140$ °C / $\leq 284$ °F process temperature	
<b>Power supply for field coils</b>	from signal converter	
<b>Electrode design</b>	Flat elliptical electrodes, fixed mounted, surface polished	
<b>Protection category (EN 60 529 / IEC 529)</b>	IP67, equivalent to NEMA 6	
<b>Grounding rings</b>	Available as option	
<b>Materials</b>		
<u>Measuring tube</u>	austenitic stainless steel	
<u>Liner</u> DN 10 – 15 / $\frac{3}{8}$ " - $\frac{1}{2}$ " DN 25 – 150 / 1" - 6"	Teflon® - PTFE Teflon® - PFA (reinforced with stainless steel mesh)	
<u>Electrodes</u> Standard Option	Hastelloy C Stainless steel 1.4571 or SS 316 Ti, Hastelloy B, titanium, tantalum, platinum- Iridium, others on request	
<u>Connecting flanges</u> * DIN: DN 10 - 80 ( $\frac{3}{8}$ " - 3") $\geq$ DN 100 ( $\geq 4$ ) ANSI	steel 1.0460 (C 22.8) or ANSI C 1020 steel 1.0038 (RST 37.2) or ANSI C 1035 steel ASTM A 105 N	
<u>Housing</u> * DN 10-15 / $\frac{3}{8}$ " - $\frac{1}{2}$ " $\geq$ DN 25 / $\geq 1$ "	GTW-S 30 Sheet steel	
<u>Grounding rings</u>	Stainless steel 1.4571 or SS 316 Ti, Hastelloy C, Hastelloy B, titanium, tantalum	

\* with polyurethane coating

5.5 Dimensions and weights

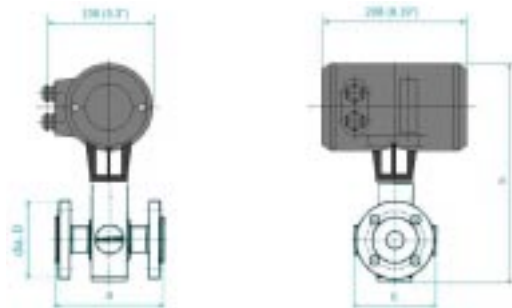
Flange connections to ...			Dimensions in mm and (inch)
DIN 2501	DN 10- 150	PN 40, 16	see table
Ansi B 16.5	3/8" - 6"	150 lb/ RF ≥ 300 lb/ RF	see table dimensions supplied on request

- Dimension "a" without flange gaskets (not necessary with Teflon® PTFE liner or PFA liner
- For meter size 3/8" a flange connection 1/2" is necessary.

Meter size		Dimensions in mm and (inch)								approx. Weight in kg (lb)	
DIN	ANSI	a (fitting length)			b	c	ø D		with DIN flanges	with ANSI flanges	
		DIN	ISO 13359	ANSI			DIN, ISO	ANSI			
10	40	3/8	150 (5.91)	-	150 (5.91)	330 (12.99)	121 (4.76)	90 (3.54)	88.9 (3.50)	7.5 (17)	8.5 (19)
15	40	1/2	150 (5.91)	200 (7.87)	150 (5.91)	330 (12.99)	121 (4.76)	95 (3.74)	88.9 (3.50)	7.5 (17)	8.5 (19)
25	40	1	150 (5.91)	200 (7.87)	150 (5.91)	301 (11.85)	121 (4.76)	115 (4.53)	108 (4.25)	9.5 (21)	11 (25)
50	40	2	200 (7.87)	200 (7.87)	200 (7.87)	383 (15.08)	160 (6.30)	165 (6.50)	152 (6.00)	11 (25)	11 (25)
80	40	3	200 (7.87)	200 (7.87)	200 (7.87)	400 (15.75)	173 (6.81)	200 (7.87)	191 (7.50)	15 (33)	16 (36)
100	16	4	250 (9.84)	250 (9.84)	250 (9.84)	451 (17.76)	233 (9.17)	220 (8.66)	228 (8.98)	18 (40)	21 (46)*
150	16	6	300 (11.81)	300 (11.81)	300 (11.81)	492 (19.37)	257 (10.12)	285 (11.22)	279 (10.98)	25 (55)	21 (46)*

- max. process pressure rating acc. DIN flanges, see column "PN"  
PN 40 = 580 psig and PN 16 = 232 psig

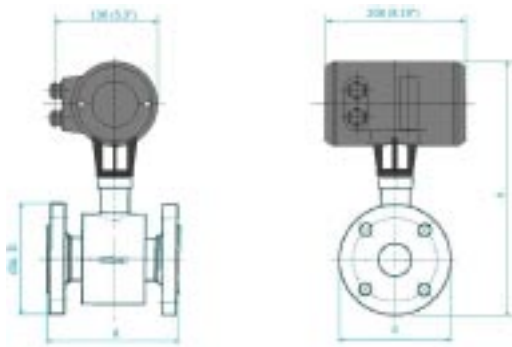
DN 10 – 40 / 3/8" - 1 1/2"



Tolerance details for fitting length dimensions "a"

Standard min ± 1mm / ± 0.04"  
ISO DIN 13 359 +0 / -3 mm / +0 / -0.12"

DN 50 – 150 / 2" – 6"



## 5.6 Limits

## PLEASE NOTE !

- The limits specified in the table for process temperature and operating pressure make allowance for the tube liner and the flange standard.
- Refer to certificates of conformity for max. allowable operating data for hazardous-duty versions, provided only with hazardous-duty equipment.
- Abbreviation used:**  
**DIN** = DIN 2501 (= BS 4504)  
**ANSI** = ANSI B 16.5

## Limits for Teflon® PFA liner und Teflon® PTFE liner

Liner	Flanges			Max. operating pressure in bar (psig) at a process temperature of ...						
	Standard	Nominal diameter	Pressure rating / Class	≤ 40 °C (≤ 105 °F)	≤ 60 °C (≤ 140 °F)	≤ 70 °C (≤ 158 °F)	≤ 90 °C (≤ 195 °F)	≤ 100 °C (≤ 210 °F)	≤ 120 °C (≤ 250 °F)	≤ 140 °C (≤ 284 °F) 1)
PFA	DIN	DN 25, 50, 80	PN 40	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)
		DN 100, DN 150	PN 16	16 (232)	16 (232)	16 (232)	16 (232)	16 (232)	16 (232)	16 (232)
	ANSI	1", 2", 3", 4", 6"	150 lb	19.6 (284)	19.0 (275)	18.7 (271)	18.1 (262)	17.7 (256)	17.0 (246)	16.2 (235)
			300 lb	on request						
PTFE	DIN	DN 10, DN 15	PN 40	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)
		ANSI	3/8", 1/2"	150 lb	19.6 (284)	19.0 (275)	18.7 (271)	18.1 (262)	17.7 (256)	17.0 (246)
				300 lb	on request					

1) ambient temperature with max. +40 °C / +104 °F

## Vacuum load

Liner	Nominal diameter		Max. operating pressure in mbar (psia) at a process temperature of ...						
	DIN	ANSI	≤ 40 °C (≤ 105 °F)	≤ 60 °C (≤ 140 °F)	≤ 70 °C (≤ 158 °F)	≤ 90 °C (≤ 195 °F)	≤ 100 °C (≤ 210 °F)	≤ 120 °C (≤ 250 °F)	≤ 140 °C (≤ 284 °F)
PFA	DN 25 - 150	1" - 6"	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
PTFE	DN 10, DN 15	3/8", 1/2"	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	500 (7.3)	750 (9.7)

Teflon® is a registered trademark of Du Pont.



## 6 Block diagram of signal converter

### 1 AD converter

- overdrive-proof signal processing, processes flow peaks up to 20 m/s (65ft/s) more rapidly and accurately than competition modules
- digital signal processing and sequence control
- high-resolution Delta-Sigma A/D converter, digitally controlled and monitored
- high signal-to-noise ratio, signal processing: patent pending

### 2 Field power supply

- The low-loss field power supply generates the pulsed, electronically controlled DC current for the magnetic coils of the primary head
- The field current ensures matched to the power, an optimum signal amplitude and signal-to-noise separation

### 3 Current output, HART® modem

- galvanically isolated from all other terminals, but not from power booster
- converts the digital output signal from the  $\mu P 2$  microprocessor into a proportional current
- communication via HART®

### 4 Binary output

- galvanically isolated from other groups
- can be used as pulse or status output
- output (B1), terminal for up to 100 mA
- output (B2), terminal according NAMUR (DIN 19 234)

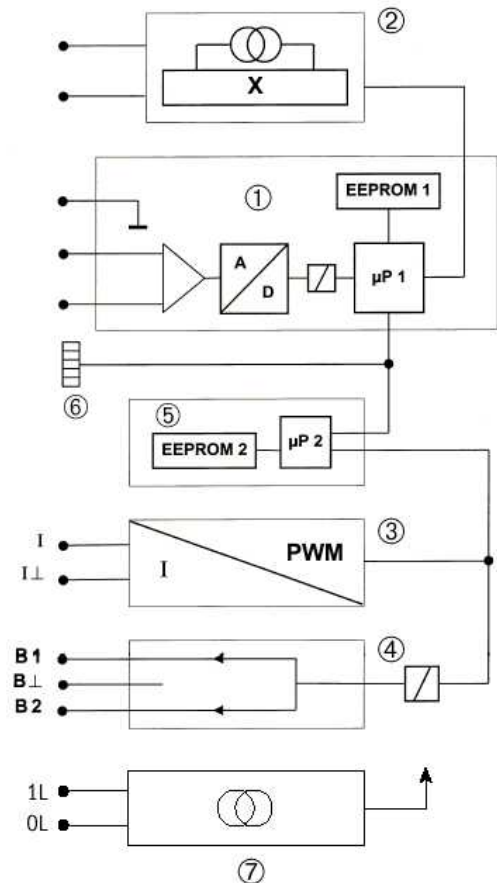
### 5 Display/operator control unit

- large LCD display, 3-line
- 3 keys for operator control of the signal converter
- connection to the internal IMoCom bus

### 6 IMoCom bus plug connector

- for connection of external control and test devices

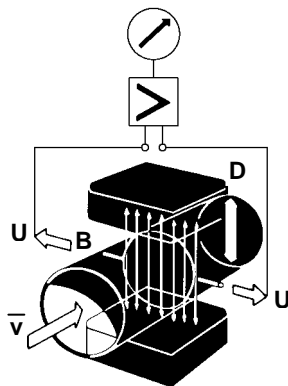
### 7 Power booster input



## 7 Measuring principle

The flowmeter is designed for electrically conductive fluids.

Measurement is based on Faraday's law of induction, according to which a voltage is induced in an electrically conductive body which passes through a magnetic field. The following expression is applicable to the voltage:



$$U = K \times B \times \bar{v} \times D$$

$U$  = induced voltage

$K$  = an instrument constant

$\bar{v}$  = mean velocity

$B$  = magnetic field strength

$D$  = tube diameter

Thus the induced voltage is proportional to the mean flow velocity, when the field strength is constant.

Inside the electromagnetic flowmeter, the fluid passes through a magnetic field applied perpendicular to the direction of flow. An electric voltage is induced by the movement of the fluid (which must have a minimum electrical conductivity). This is proportional to the mean flow velocity and thus to the volume of flow:

The induced voltage signal is picked up by two electrodes which are in conductive contact with the fluid and is transmitted to a signal converter for a standardized output signal.

This method of measurement offers the following advantages:

1. No pressure loss through pipe constriction or protruding parts.
2. Since the magnetic field passes through the entire flow area, the signal represents a mean value over the pipe cross-section; therefore, only relatively short straight inlet pipes  $5 \times DN$  from the electrode axis are required upstream of the primary head.
3. Only the tube liner and the electrodes are in contact with the fluid.
4. Already the original signal produced is an electrical voltage which is an exact linear function of the mean flow velocity.
5. Measurement is independent of the flow profile and other properties of the fluid.

The magnetic field of the primary head is generated by a square wave current fed from signal converter to the field coils.

This field current alternates between positive and negative values. Alternate positive and negative flowrate-proportional signal voltages are generated at the same frequency by the effect of the magnetic field, which is proportional to the current. The positive and negative voltages at the primary head electrodes are subtracted from one another in the signal converter. Subtraction always takes place when the field current has reached its stationary value, so that constant interference voltages or external or fault voltages changing slowly in relation to the measuring cycle are suppressed. Power line interference voltages coupled in the primary head or in the connecting cables are similarly suppressed.

**8 If you need to return flowmeters for testing or repair to KROHNE**

Your electromagnetic flowmeter

- 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 these operating instructions, your flowmeter will rarely present any problems. Should you nevertheless need to return a flowmeter for checkout or repair, please pay strict attention to the following points:

Due to statutory regulations concerning protection of the environment and the health and safety of our personnel, Krohne may only handle, test and repair returned flowmeters that have been in contact with liquids if it is possible to do so with-out risk to personnel and environment. This means that Krohne can only service your flowmeter if it is accompanied by a certificate in line with the following model confirming that the flowmeter is safe to handle.

can only service your flowmeter if it is accompanied by a certificate in line with the following model confirming that the flowmeter is safe to handle. If the flowmeter has been operated with toxic, caustic, flammable or water-endangering liquids, you are kindly requested

- to check and ensure, if necessary by rinsing or neutralizing, that all cavities in the flowmeter are free from such dangerous substances. (Directions on how you can find out whether the primary head has to be opened and then flushed out or neutralized are obtainable from Krohne on request.)
- to enclose a certificate with the flowmeter confirming that the flowmeter is safe to handle and stating the liquid used. Krohne regret that they cannot service your flowmeter unless accompanied by such a certificate.

**Specimen certificate**

Company: ..... Address: .....

Department: ..... Name: .....

Tel. No.: .....

The enclosed electromagnetic flowmeter

Type: ..... Krohne Order No. or Series No.: .....

has been operated with the following liquid: .....

Because this liquid is  
water-endangering \* / toxic \* / caustic \* / flammable \*

- we have
- checked that all cavities in the flowmeter are free from such substances \*
  - flushed out and neutralized all cavities in the flowmeter \*
- (\* delete if not applicable)

We confirm that there is no risk to man or environment through any residual liquid contained in this flowmeter.

Date: ..... Signature: .....

Company stamp: