OPTIBATCH 4011 C

Handbook

Mass flowmeter for process batching

KROHNE

IMPRINT

1.1 Intended use

This flowmeter has been specifically designed for the fast batching measurement of mass or volume and is intended for use in filling machines or bespoke applications.

1.2 CE certification

CE marking

This device conforms with the following EC directives:

- EMC Directive 2004/108/EC
- Low Voltage Directive 2006/95/EC
- Pressure Equipment Directive 97/23/EC

The manufacturer declares conformity and the device carries the CE mark.

1.3 Associated documents

This handbook should be read in conjunction with relevant documents in relation to:

- hazardous areas
- communications
- concentration
- corrosion

1.4 Safety instructions from the manufacturer

1.4.1 Copyright and data protection

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1.4.2 Disclaimer

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This disclaimer does not apply in case the manufacturer 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.

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The manufacturer 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.

1.4.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.4.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

1.4.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

DANGER!
This information refers to the immediate danger when working with electricity.

DANGER!
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

DANGER!
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

DANGER!
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.

WARNING!
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.

CAUTION!
Disregarding these instructions can result in damage to the device or to parts of the operator's plant.

INFORMATION!
These instructions contain important information for the handling of the device.

LEGAL NOTICE!
This note contains information on statutory directives and standards.

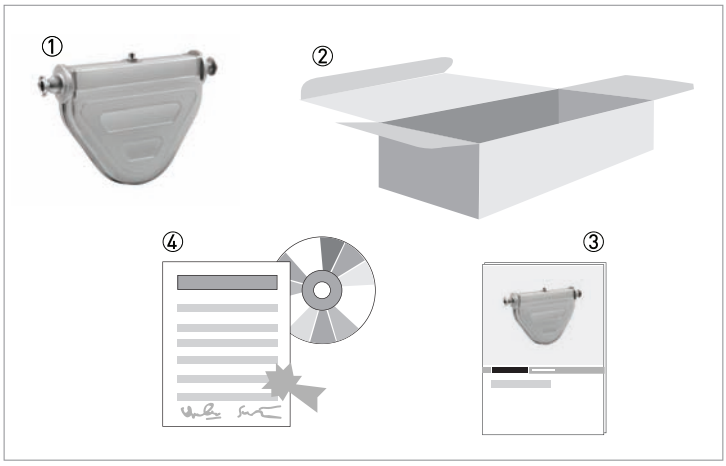
- HANDLING
  This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➲ RESULT
This symbol refers to all important consequences of the previous actions.

1.5 Safety instructions for the operator

WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery



① Mass flowmeter.
② Carton.
③ Documentation.
④ CD-ROM and calibration certificate.

If any items are missing, please contact the manufacturer.

2.2 Device description

This device has been designed for the mass or volume measurement of liquid products in batching and filling machines.

With excellent repeatability and low flow stability, the device is supplied ready to install and operate. The operating data is factory set according to the order specification but can be changed with the use of Toolbox.

3.1 Storage

- Store the device in a dry and dust-free location.
- Avoid direct exposure to the sun.
- Store the device in its original packing.
- Do not allow the ambient temperature to fall below -50°C / -58°F or rise above +85°C / +185°F.

3.2 Notes on installation

INFORMATION!
Inspect the cartons carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Do a check of the packing list to make sure that you have all the elements given in the order.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.3 Mounting restrictions

3.3.1 General installation principles

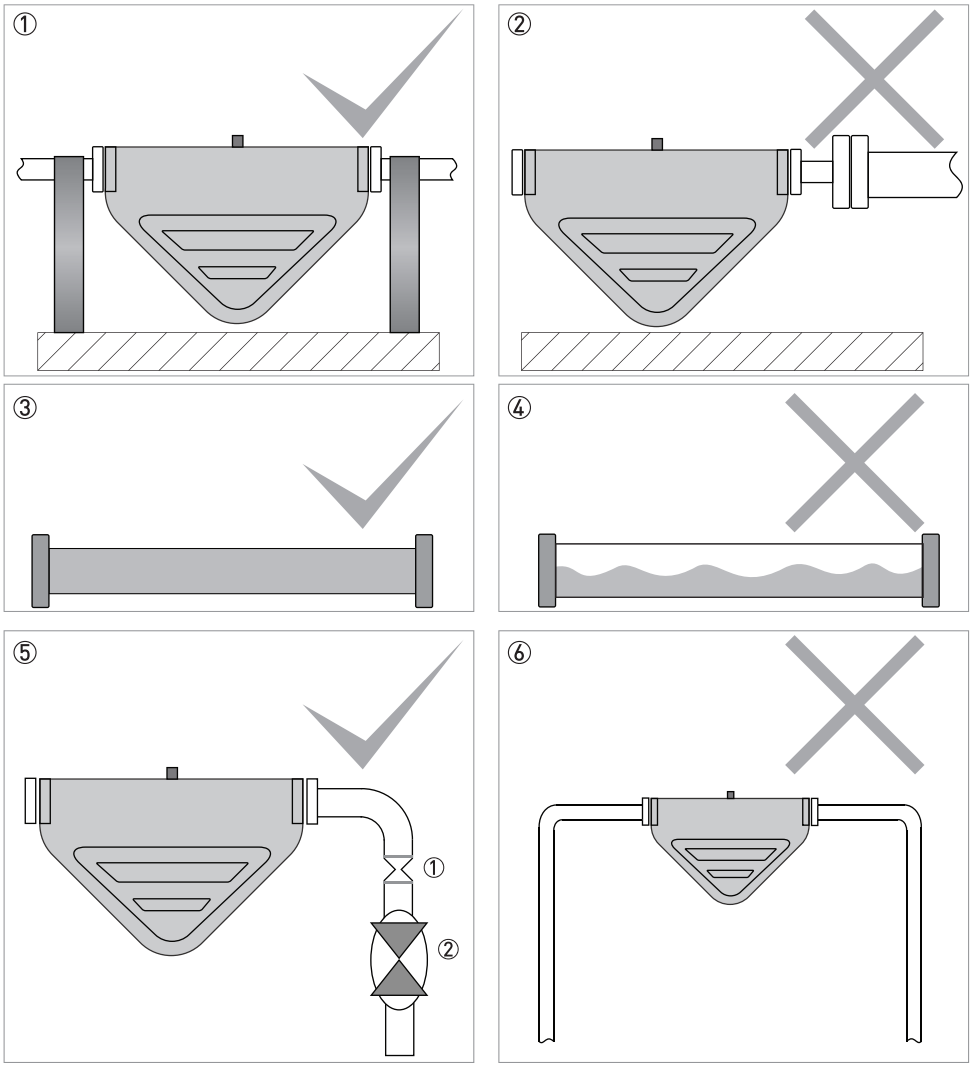


Figure 3-1: General mounting restictions

① Fully support the weight of the meter. The meter can be supported with clamps close to the connecting flanges.
② Do not use extreme reductions in process pipework size.
③ Make sure that the process pipework is full at all times.
④ Do not let the flow fall in the process pipework. Low process flow will cause a measuring error.
⑤ If the meter has been installed with an open-ended down-pipe, Install an orifice plate or restrictor (①) to make sure that the pipework remains full during measurement. A fast-acting batch or shut-off valve (②) should also be installed downstream of the meter.
⑥ It is recommended that you DO NOT mount the meter at the highest point in the pipework because it can cause air / gas to collect in the meter.

3.3.2 Carousel installation

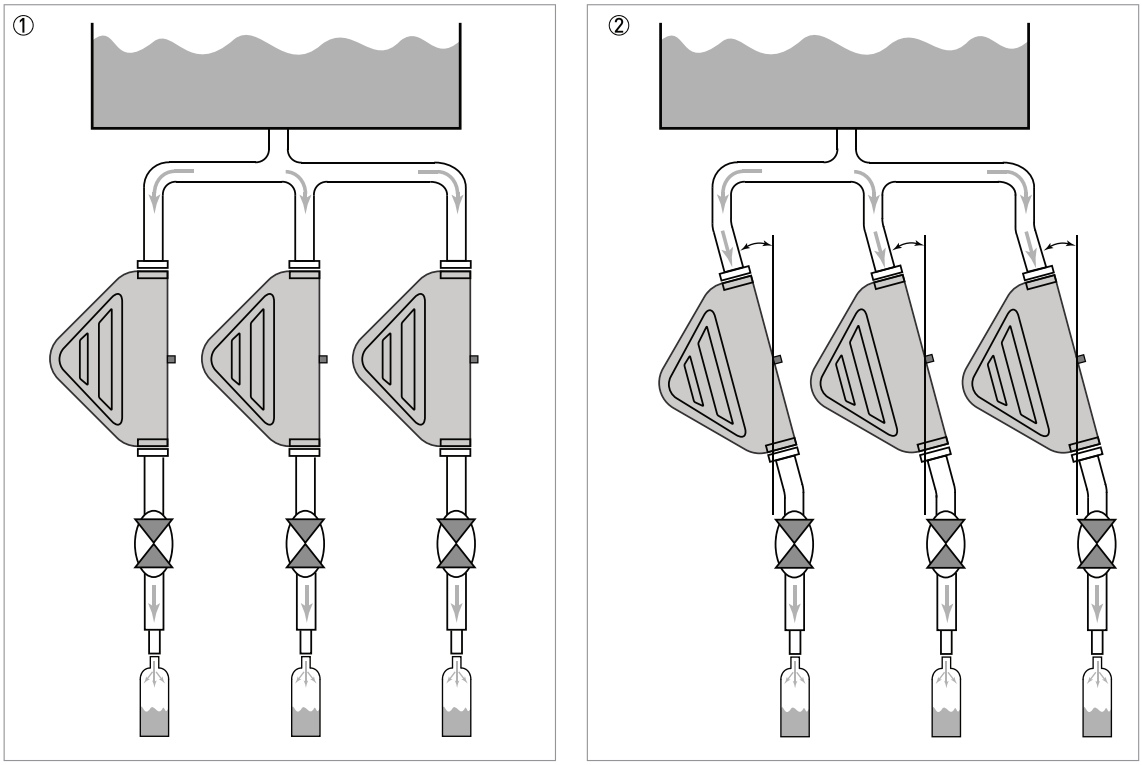
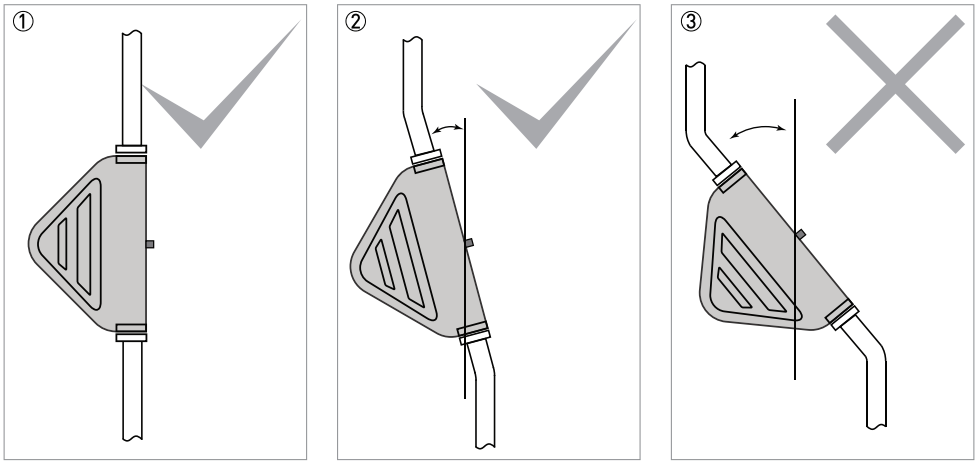


Figure 3-2: Carousel installation

① Typical installation
② Installation showing the maximum offset angle which is 12º from the vertical

- Where the meter has to be installed at an angle, DO NOT exceed the maximum offset angle.
- If the maximum angle is exceeded, the meter will not self drain.

3.3.3 3A and EHEDG approval



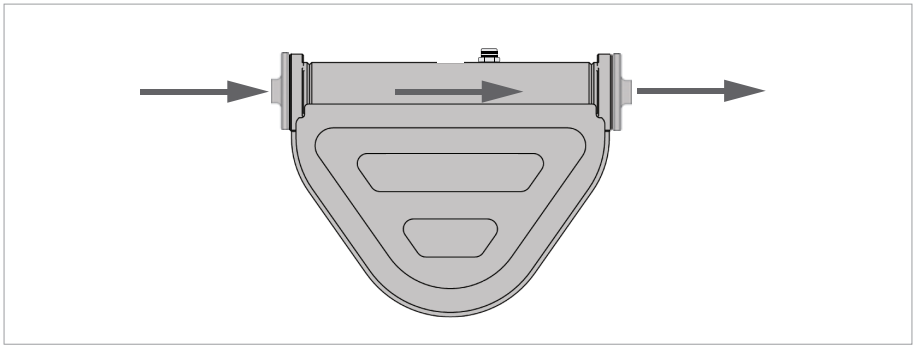
① Mount the meter vertically to allow self-draining.
② If you are installing at an angle, the maximum offset angle for the meter to be self-draining is 12°.
③ DO NOT install the meter with an offset angle greater than 12°. This will prevent the meter from self-draining.

To satisfy the sanitary requirements of the European Hygienic Engineering and Design Group, when installing this meter you MUST give consideration to:

- Installation - install the meter at an angle to allow self-draining (see illustration).
- Cleaning fluids - cleaning fluids should flow uphill with a velocity rate greater than 1.5 m/s / 5 ft/s. If the process flow is downhill, install a flow restrictor downstream of the meter. This will make sure that the meter is completely filled with the cleaning fluid.
- Process connections and seals MUST be in accordance with EHEDG documentation.

The manufacturer also recommends that you refer to EHEDG (www.ehedg.org) document number 8 "HYGIENIC EQUIPMENT DESIGN CRITERIA".

3.3.4 Flow direction

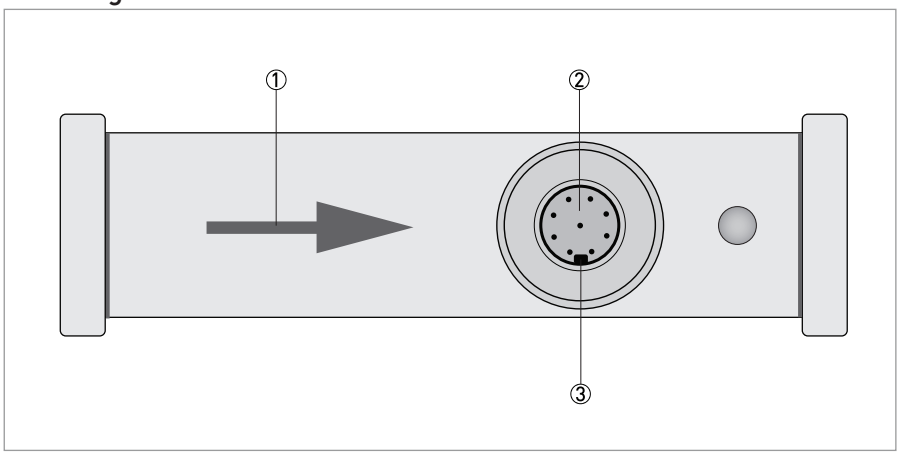


With the orientation of the meter as shown in the illustration (Lumberg® connector offset to the right) the factory set flow direction is left to right.

If the meter has been intalled with the process flow running from right to left, the flow direction can be changed through the supplied software **Toolbox**. Please see the **START-UP** section.

3.3.5 Lumberg® connector

Lumberg® connector orientation



① Flow direction
② Lumberg® connector
③ Keyway

4.1 Safety instructions

DANGER!
All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

DANGER!
Observe the national regulations for electrical installations!

DANGER!
For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

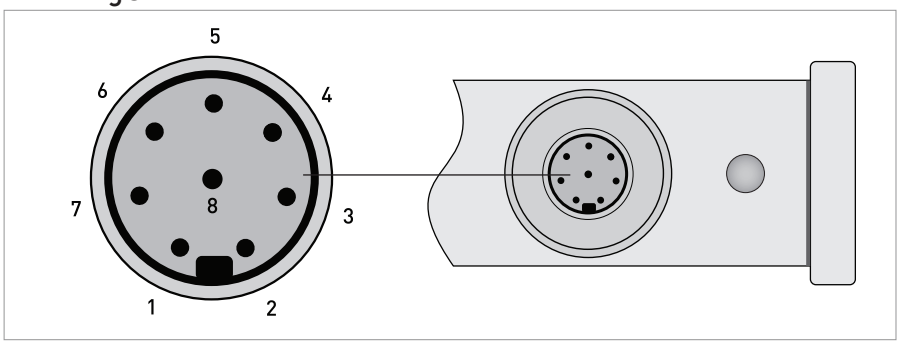
WARNING!
Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

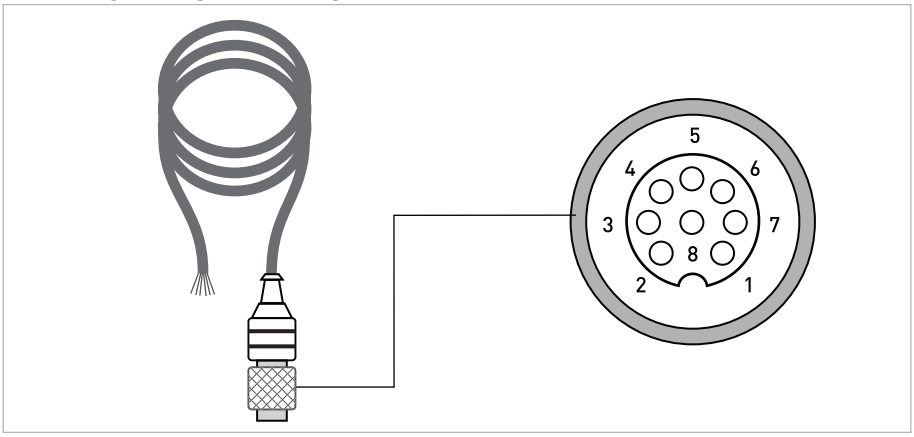
4.2 Lumberg connections

Electrical and signal connections to the flowmeter are through an 8 pin Lumberg® connector. To connect to the flowmeter, use a Lumberg® RKT 8-282/2 M (straight) or RKWT 8-282/2 M (90° elbow) plug and flying lead. An alternative plug connector with the same pin / keyway configuration, can also be used.

Lumberg® connector



Lumberg® plug and flying lead

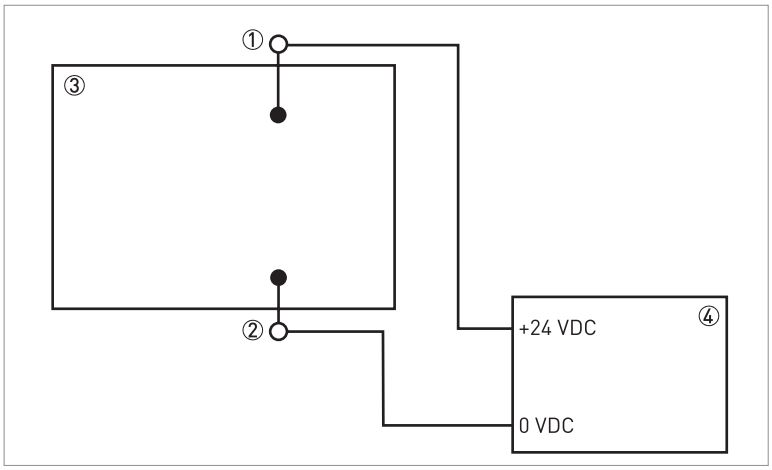


Plug / pin connections

Pin	Function	Colour
1	PSU + 24 V	White
2	RS485 A	Brown
3	RS485 B	Green
4	PSU + 0 V	Yellow
5	Pulse +	Grey
6	Pulse -	Pink
7	N / C	Blue
8	N / C	Screen

The pin / colour configurations shown in the table, are for the Lumberg® flying lead. Other manufacturers might use a different pin / colour configuration. If you are not using the Lumburg® flying lead, use the first two columns in the table to assign the correct function to each pin.

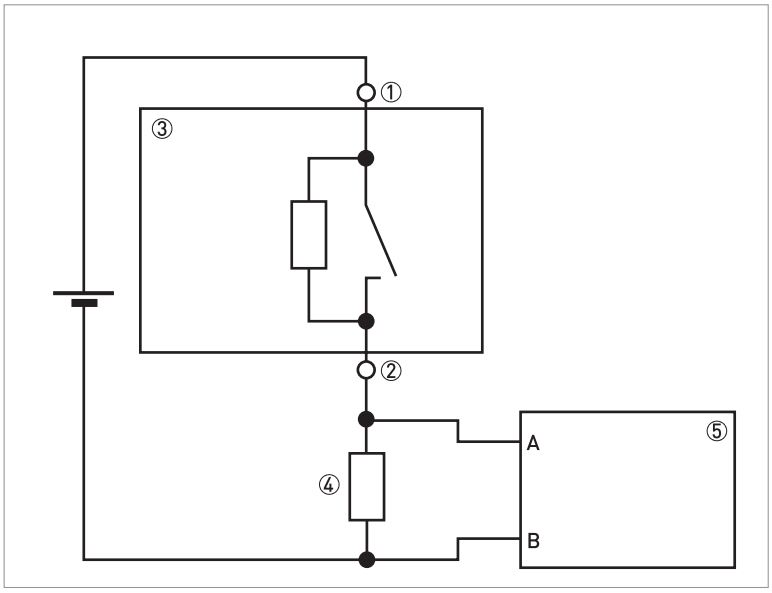
4.3 Power supply



① Connection plug pin 1
② Connection plug pin 4
③ Meter
④ Protected extra-low voltage (PELV) power supply

4.4 Schematic layout (pulse output)

Sink input



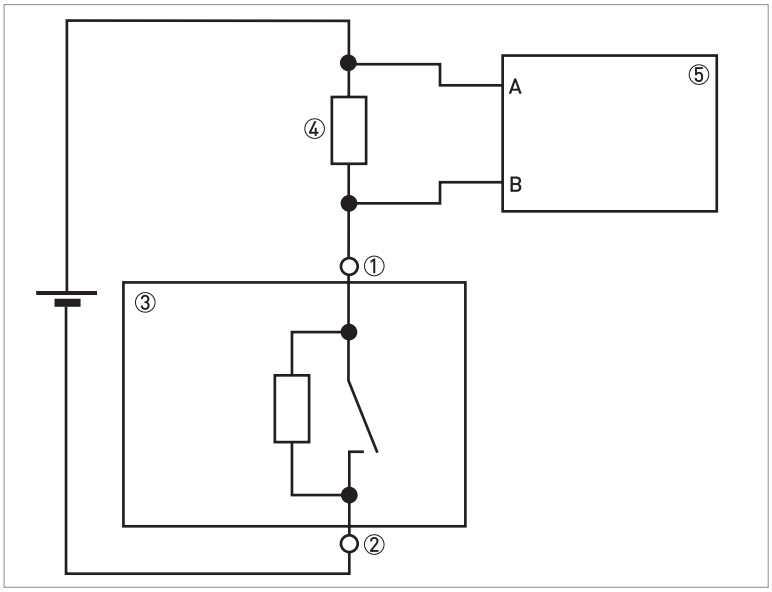
A Input
B Ground

① Connection plug pin 5
② Connection plug pin 6
③ Galvanically isolated pulse output of the meter
④ Load resistor. See table for typical values
⑤ Batch processor or PLC sink input with an impedance greater than 10 kΩ

Typical load resistor values

Input	Load resistor
5 V TTL input	330 Ω
10...24 V input	1 kΩ

Source input 10...24 V



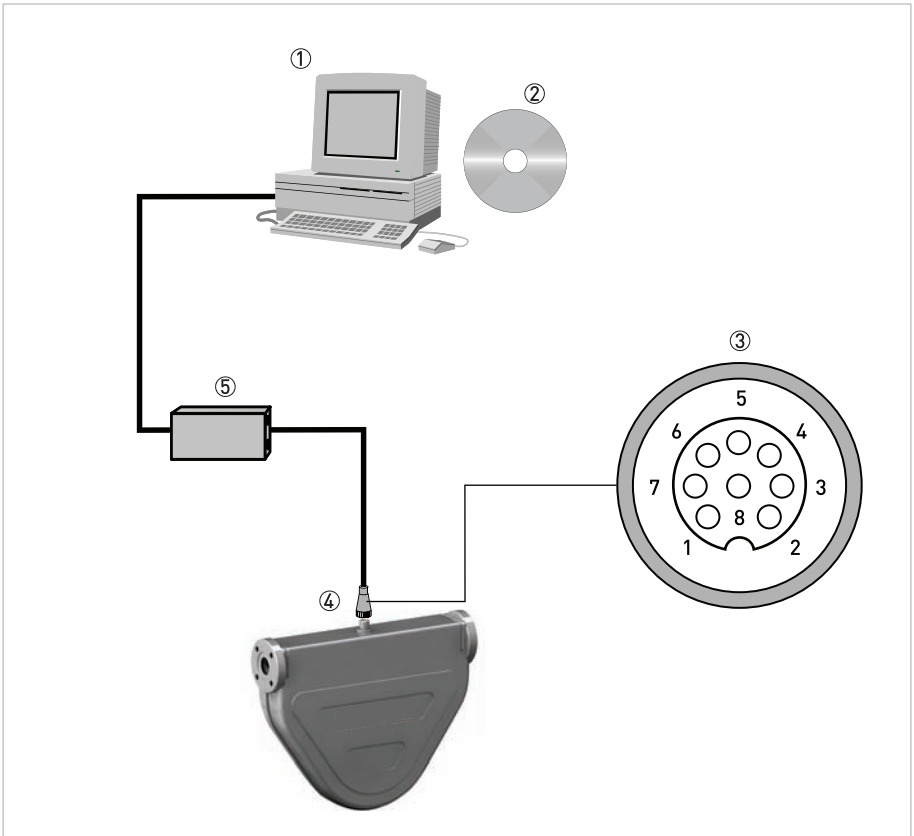
A V+
B Input

① Connection plug pin 5
② Connection plug pin 6
③ Galvanically isolated passive pulse output of the meter
④ Load resistor. Typical value is 1 kΩ
⑤ PLC source input with an impedance greater than 10 kΩ

5.1 Configuration with Toolbox

The meter can be configured using the supplied software and adaptor, which allows connection to a personal computer (PC) or a laptop.

INFORMATION!
When the meter is in configuration mode, the pulse output is not available.

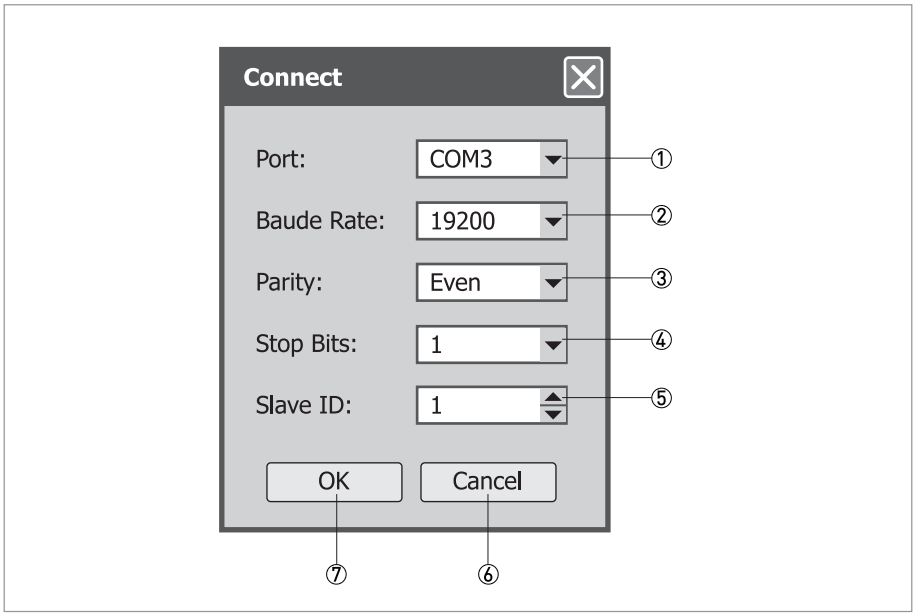


① Personal computer or laptop
② Toolbox software CD
③ Connection plug
④ Mass flowmeter
⑤ RS458 to USB converter

Connection with Toolbox

- Connect the meter to a personal computer or laptop using the converter.
- Launch Toolbox but DO NOT try to connect to the meter.
- Connect the meter to the power supply.
- Select either Connection > Connect or Connection > Auto Connect to connect Toolbox to the meter. This MUST be done within 10 seconds of energising the meter.

5.1.1 Manual connection



① Connection Port
② Baud Rate
③ Parity
④ Stop Bits
⑤ Slave ID
⑥ Cancel button
⑦ OK button

- Press <F3> or select Connection > Auto Connect.

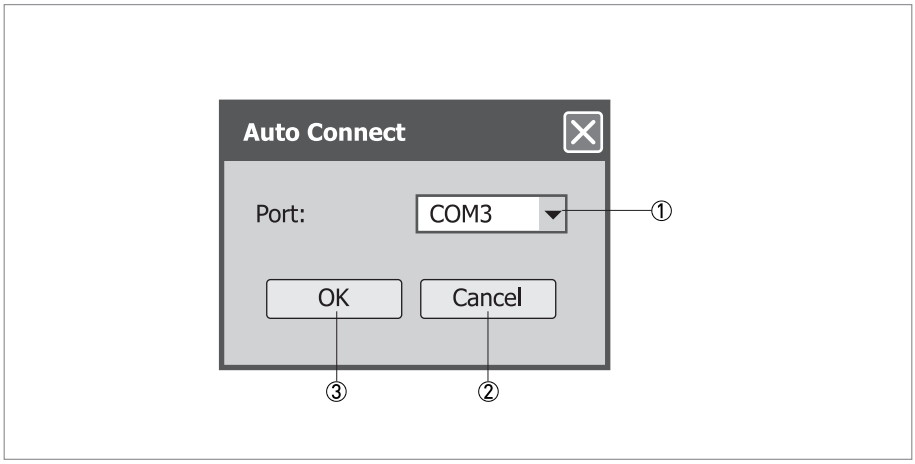
➲ The Connect dialogue box will open.

- Select the Port you wish to connect through. The default values for: Baud Rate, Parity, Stop Bits and Slave ID are shown.
- Select OK or Cancel

➲ Toolbox will connect to the meter.

5.1.2 Automatic connection

An automatic connection can be made with a single meter on a point-to-point basis.



① Connection port
② Cancel button
③ OK button

- Press F5 or select: Connection > Auto Connect.

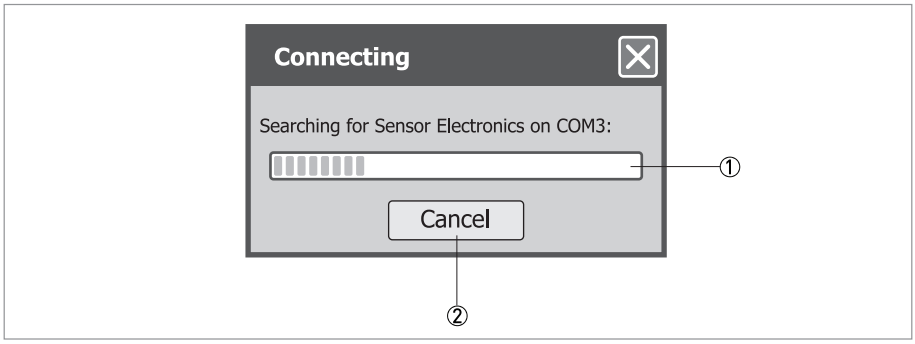
➲ The Auto Connect dialogue box opens.

- Select the Port you wish to connect through.
- Select OK or Cancel

➲ Toolbox will connect to the meter.

5.1.3 Connection dialogue

While Toolbox is connecting to the meter, the dialogue box will show the progress.

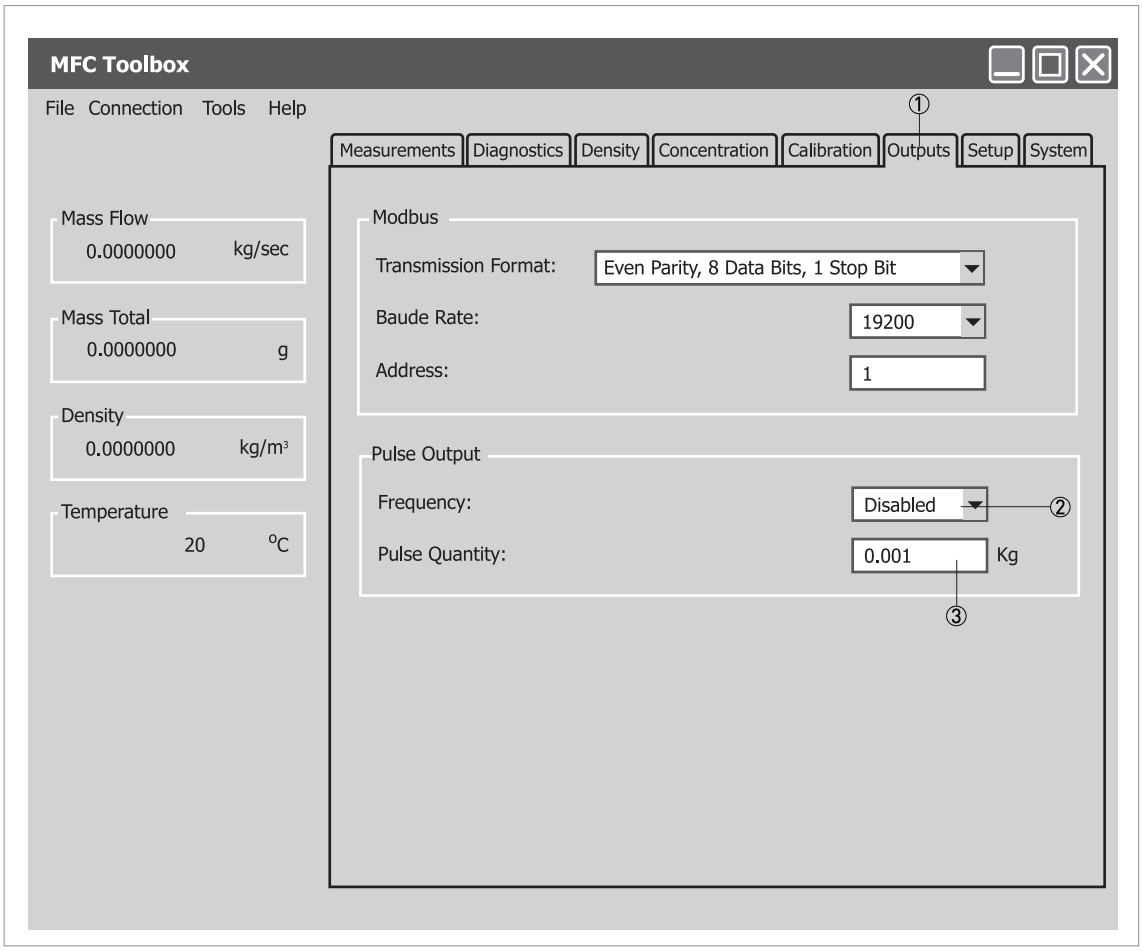


① Connection progress
② Cancel button

If you want to stop the connection process, use the **Cancel** button. When the connection has been made, the dialogue box will close.

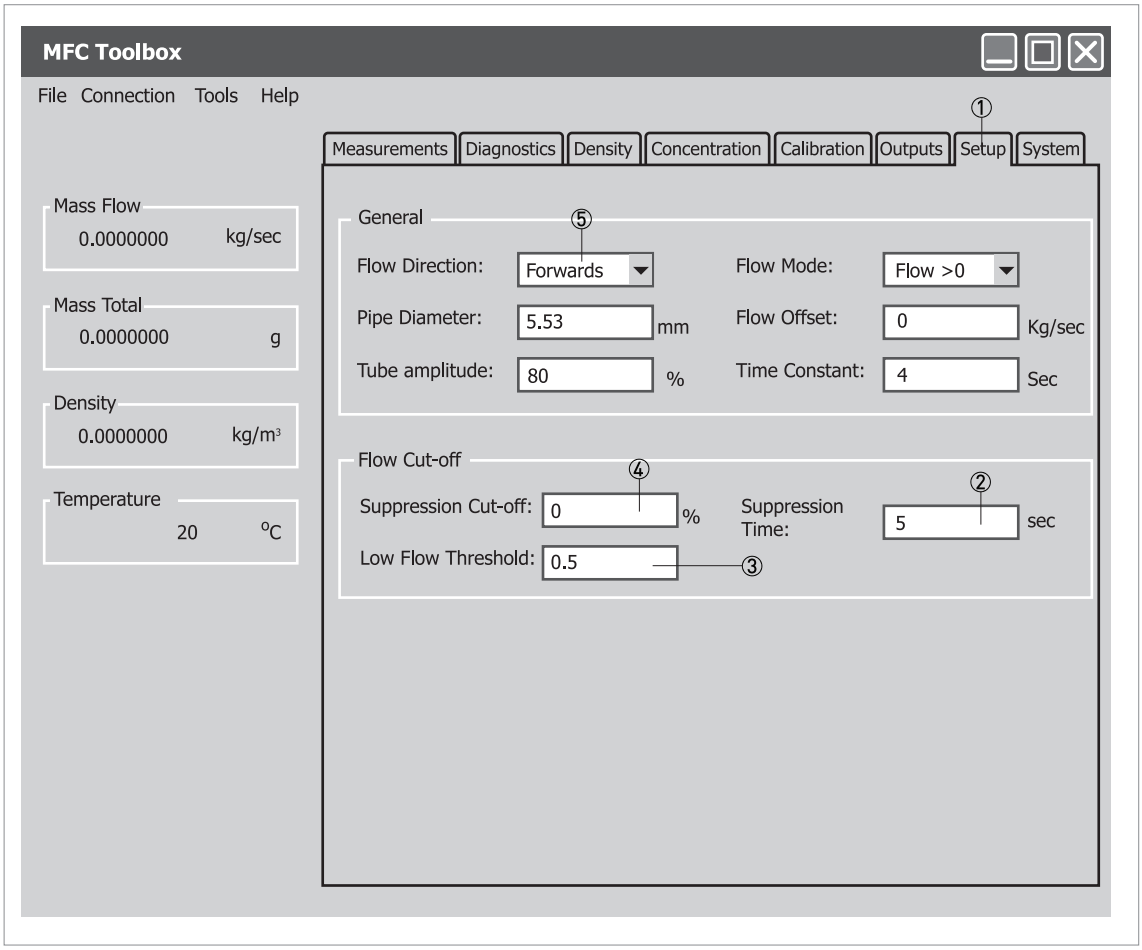
5.1.4 Outputs

The meter is pre-configured according to the customer's order. If it is necessary to change output parameters, it is recommended that only Frequency and Pulse Quantity are changed.



① Output tab
② Frequency - sets the maximum pulse frequency to 1 kHz or 10 kHz / mass or volume
③ Pulse Quantity - sets the quantity of each pulse. The units are the same as for Mass Total

5.1.5 Setup

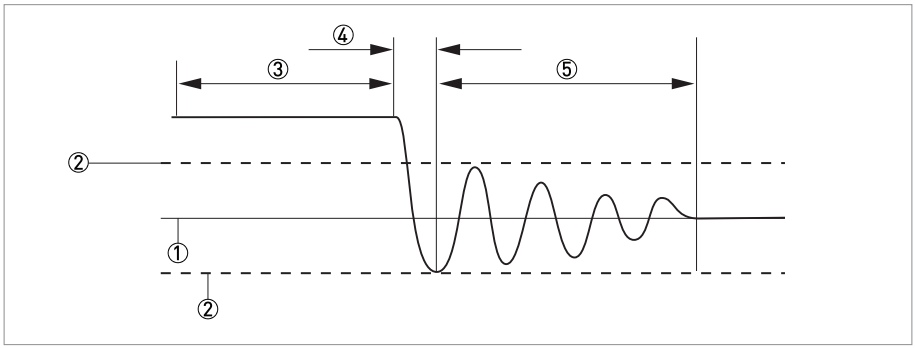


① Setup tab
② Suppression time
③ Low Flow Threshold
④ Suppression Cut-Off
⑤ Flow Direction

Ringing

High-speed valves can cause unwanted tube vibrations that result in surges in the signal amplitude. This effect is refered to as "ringing".

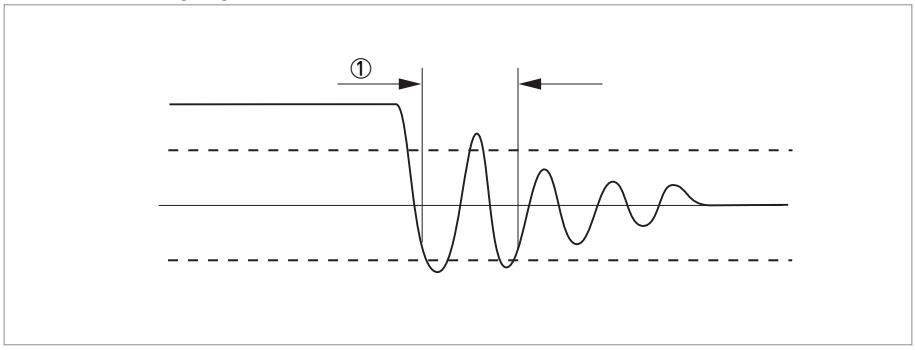
Low Flow Threshold



① Zero line
② Low Flow Threshold
③ Mass flow
④ Valve shut off
⑤ Ringing

For most applications, the Low Flow Threshold will stop ringing affecting the mass flow measurement.

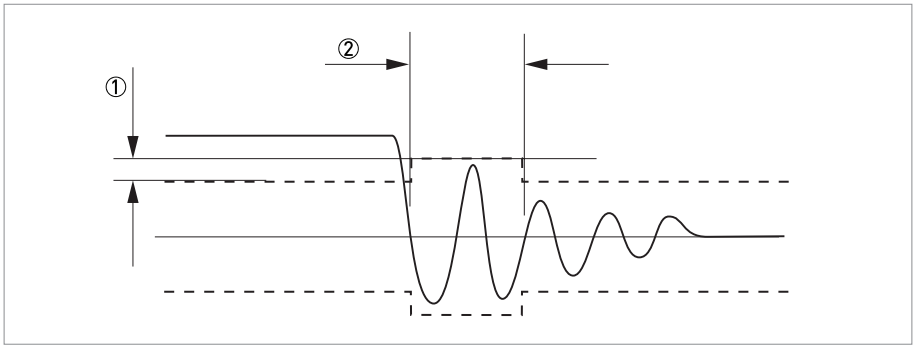
Excessive ringing



① Ringing above Low Flow Threshold

In some applications, the ringing might be above the Low Flow Threshold.

Suppression Cut Off



① Suppression Cut Off
② Suppression Time

In these applications, use the Suppression Cut Off and Suppression Time parameters to temporarily adjust the Low Flow Threshold. This will stop the ringing from affecting the mass flow measurement.

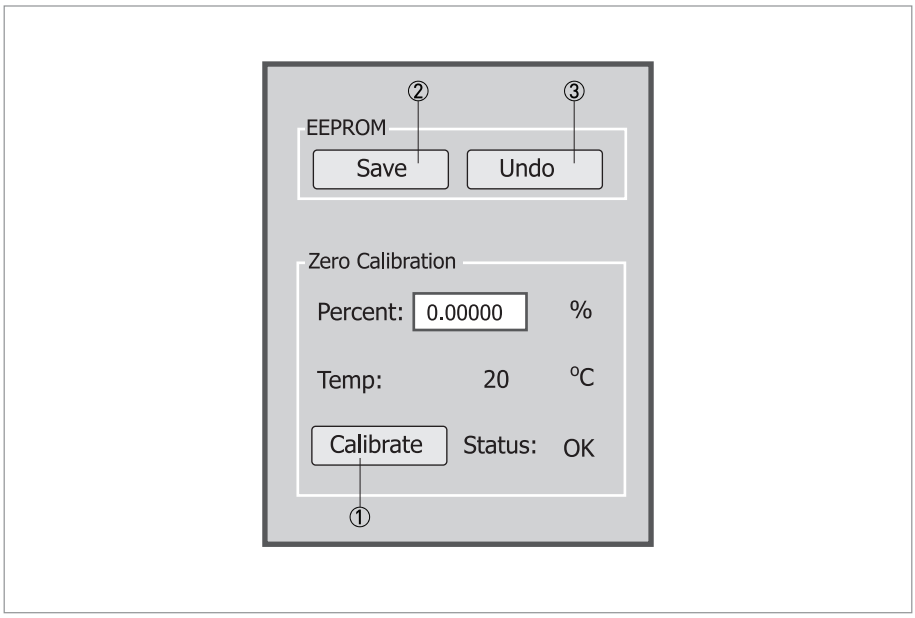
Flow Direction

The factory default flow direction is left to right. The **Flow Direction** parameter shows the flow as running **Forwards**. If the meter has been installed with the flow running in the opposite direction, the **Flow Direction** parameter can be changed to **Backwards**.

5.1.6 Zero calibration

The meter is supplied with a factory set zero calibration but in certain circumstances it might be necessary to re-set the zero calibration. These might be:

- where the highest accuracy is required with very low flow rates
- extreme process conditions (for example where the meter is being used to measure high viscosity liquids).



① Zero calibration button
② Save button
③ Undo button

Zero calibration procedure

- Flush the process fluid through the meter
- Close the downstream valve
- Maintain the process pressure
- Select Calibrate. This will start the zero calibration procedure
- When the zero calibration has been set, select Save to store the calibration data

6.1 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

6.2 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

INFORMATION!
For more precise information, please contact your local representative.

6.3 Returning the device to the manufacturer

6.3.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

CAUTION!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

CAUTION!
If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralizing, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that is safe to handle and stating the product used.*

6.3.2 Form (for copying) to accompany a returned device

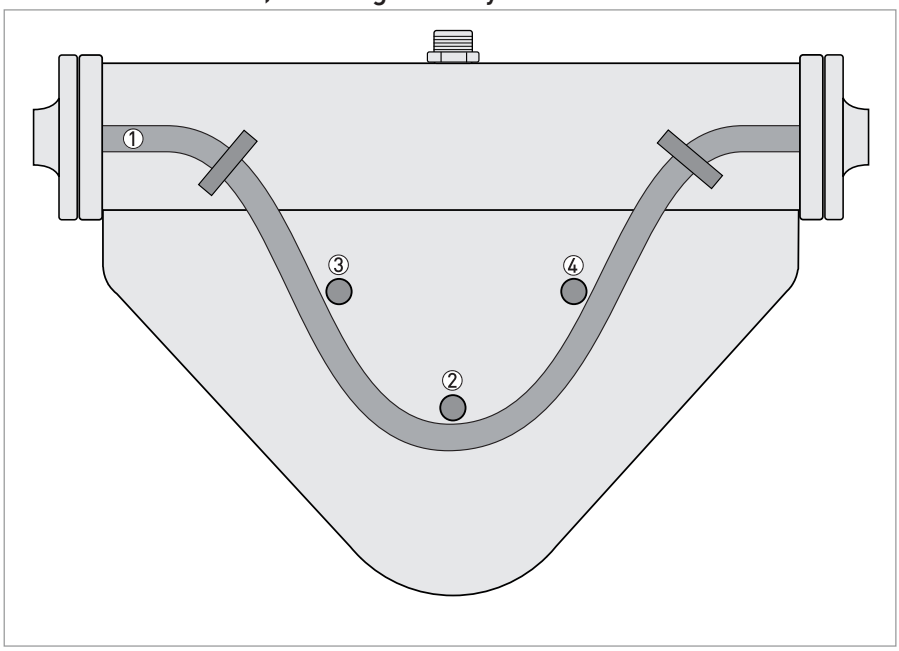
Company:		Address:
Department:		Name:
Tel. no.:		Fax no.:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:	☐	water-hazardous
	☐	toxic
	☐	caustic
	☐	flammable
	☐	We checked that all cavities in the device are free from such substances.
	☐	We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

6.4 Disposal

CAUTION!
Disposal must be carried out in accordance with legislation applicable in your country.

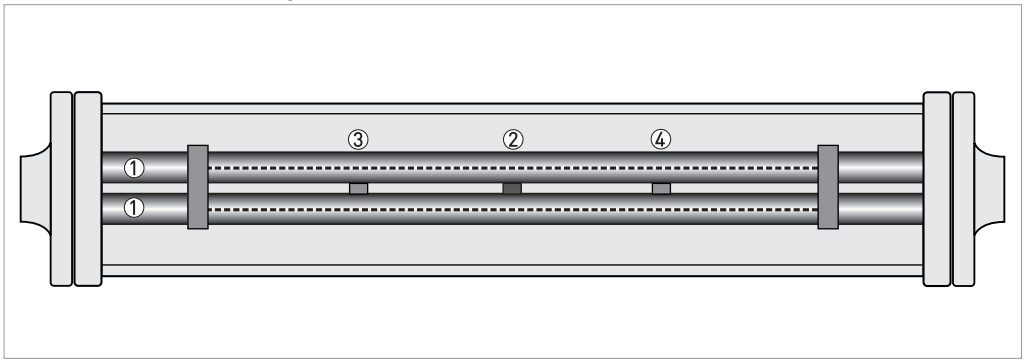
7.1 Measuring principle

Meter from the side, showing tube layout



① Measuring tubes
② Drive coil
③ Sensor 1
④ Sensor 2

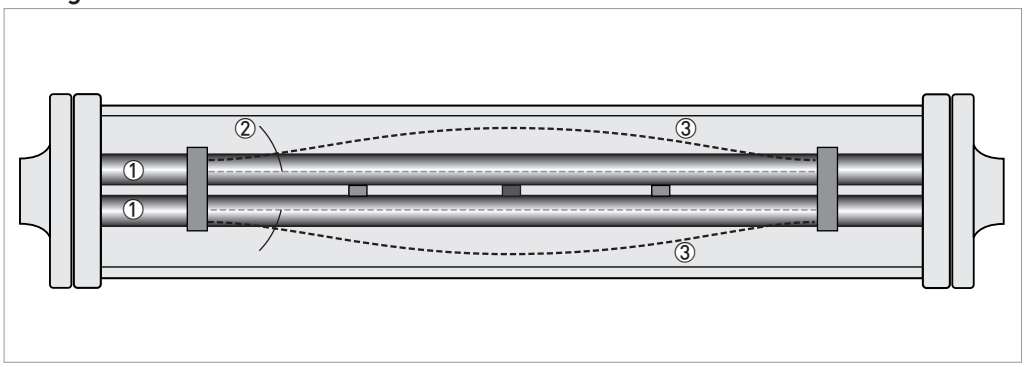
Static meter not energised and with no flow



① Measuring tubes
② Drive coil
③ Sensor 1
④ Sensor 2

A Coriolis twin-tube mass flowmeter consists of two measuring tubes (①) a drive coil (②) and two sensors (③ and ④) that are positioned either side of the drive coil.

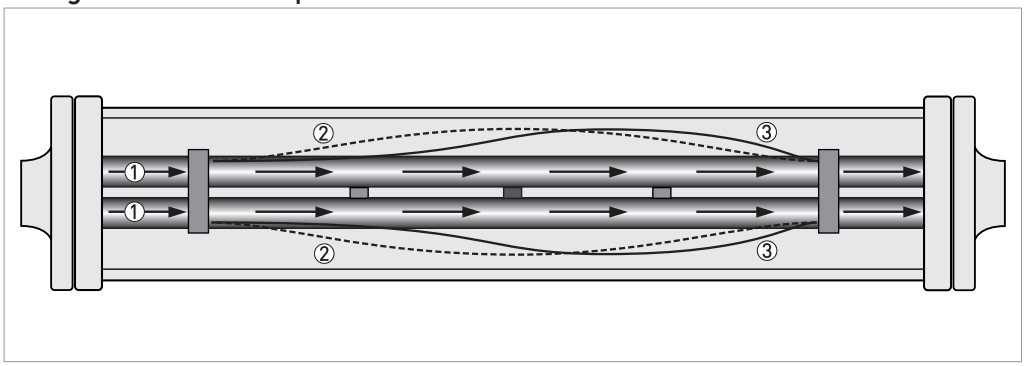
Energised meter



① Measuring tubes
② Direction of oscilation
③ Sine wave

When the meter is energised, the drive coil vibrates the measuring tubes causing them to oscillate and produce a sine wave (③). The sine wave is monitored by the two sensors.

Energised meter with process flow



① Process flow
② Sine wave
③ Phase shift

When a fluid or gas passes through the tubes, the Coriolis effect causes a phase shift in the sine wave that is detected by the two sensors. This phase shift is directly proportional to the mass flow.

Density measurement is made by evaluation of the frequency of vibration and temperature measurement is made using a Pt500 sensor.

7.2 Technical data

INFORMATION!

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local representative.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).*

Measuring system

Measuring principle	Coriolis mass flow
Application range	Measurement of liquids in batching and filling machines
Measured values	Mass
Calculated values	Volume

Design

Basic	System consists of a measuring sensor with integral converter to process the output signal
Features	Fully welded maintenance- free sensor with twin U-shaped measuring tube
Variants	
Compact version	Integral converter

Measuring accuracy

Mass	
Q_{nom} x 0.1 ≤ Q	±0.15% of actual measured flow rate
Q < Q_{nom} x 0.1	±0.1% of actual measured flow rate + zero stability
Volume	
Q_{nom} x 0.1 ≤ Q	±0.2% of actual measured flow rate
Q < Q_{nom} x 0.1	±0.15% of actual measured flow rate + zero stability
Zero stability	
Stainless Steel	0.005% of nominal flow
Repeatability (at reference condtions)	
Filling time	Standard deviation
1.5 s < Filling time ≤ 3 s	0.13%
3 s < Filling time ≤ 5 s	0.07%
5 s < Filling time	0.04%
Reference conditions	
Warm-up time	15 min
Product	Water
Temperature	+20°C / +68°F
Operating pressure	1 barg / 14.5 psig
Accreditation	UKAS to EN17025

Operating conditions

Nominal flow rates	
S08	10 kg/min / 22 lb/min
S10	22 kg/min / 48.4 lb/min
S15	72 kg/min / 158.4 lb/min
Ambient temperature	
Compact version	-40...+55°C / -40...+131°F
Process temperature	
Operating temperature	0...+100°C / 32...+212°F
SIP/CIP	Maximum +120°C / +248°F
	Maximum 1h duration
Nominal pressure at 20°C / 68°F	
Measuring tube	
Stainless Steel	-1...40 barg / -14.5...580 psig
Fluid properties	
Permissible physical condition	Liquids
Permissible gas content (volume)	Contact manufacturer for information.
Permissible solid content (volume)	Contact manufacturer for information.
Protection category (acc. to EN 60529)	IP 67, NEMA 6

Installation conditions

Inlet runs	None required
Outlet runs	None required

Materials

Stainless Steel meter	
Measuring tube	Stainless Steel 316L (1.4404)
Surface finish (wetted parts)	Standard Ra 0.8 µm
	Optional Ra 0.5 µm
Process connections	Stainless Steel 316L (1.4404)
Outer casing	Stainless Steel 316 (1.4401), hermetically sealed as standard
	Optional polishing of all externals

Process connections

Hygienic	
Tri-clover	½...1"
Tri-clamp DIN 32676	DN10...25
Tri-clamp ISO 2852	1"
Clamp IDF	10...15A
DIN 11864-2 Form A	DN20
Male thread DIN 11851	DN10...25
Male thread SMS	1"
Male thread RJT	1"

Electrical Connection

Connection	
Electrical connections	Micro (M12) male, 8 pole (Lumberg PRSFM 8/0.5M)
Power Supply	
Voltage	24 VDC ±20%
Power consumption	3 W
Power supply type	Protected extra-low voltage (PELV)
Pulse/Frequency Output	
Pulse rate for Q = 100%	Maximum 10 kHz
	Factory set according to customer requirements
Pulse width	Selectable 1 kHz or 10 kHz symmetrical pulse
	Factory set according to customer requirements
Connection	External voltage: $U_{ext} \leq 30$ VDC / ≤ 24 VAC
	Load rating: $I_{max} = 20$ mA

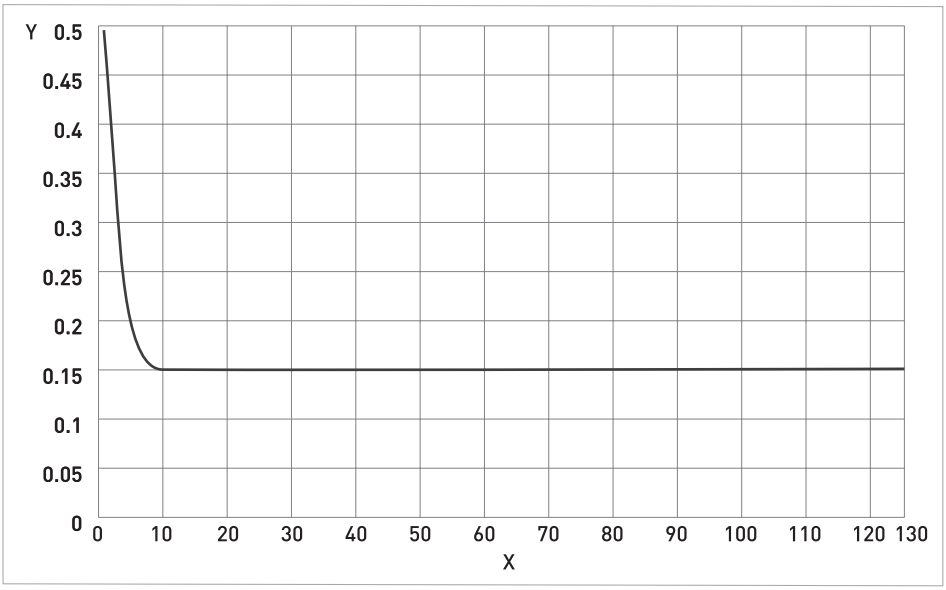
Configuration

Function	MODBUS connection for programming and configuration of full process parameters using software supplied
	Note: MODBUS and pulse / frequency output can not be used simutaneously
Type	RS485 Modbus RTU

Approvals

Mechanical	
Electromagnetic compatibility (EMC) acc. to CE	Namur NE 21/5.95
	2004/108/EC (EMC)
	2006/95/EC (Low Voltage Directive)
Hygienic	3A 28-03
	ASME BPE 2005
	Conforms with FDA guidelines
	EHEDG
Vibration	IEC 60068-2-6

7.3 Measuring accuracy



X Flow rate [%]
Y Measuring error [%]

Measuring error

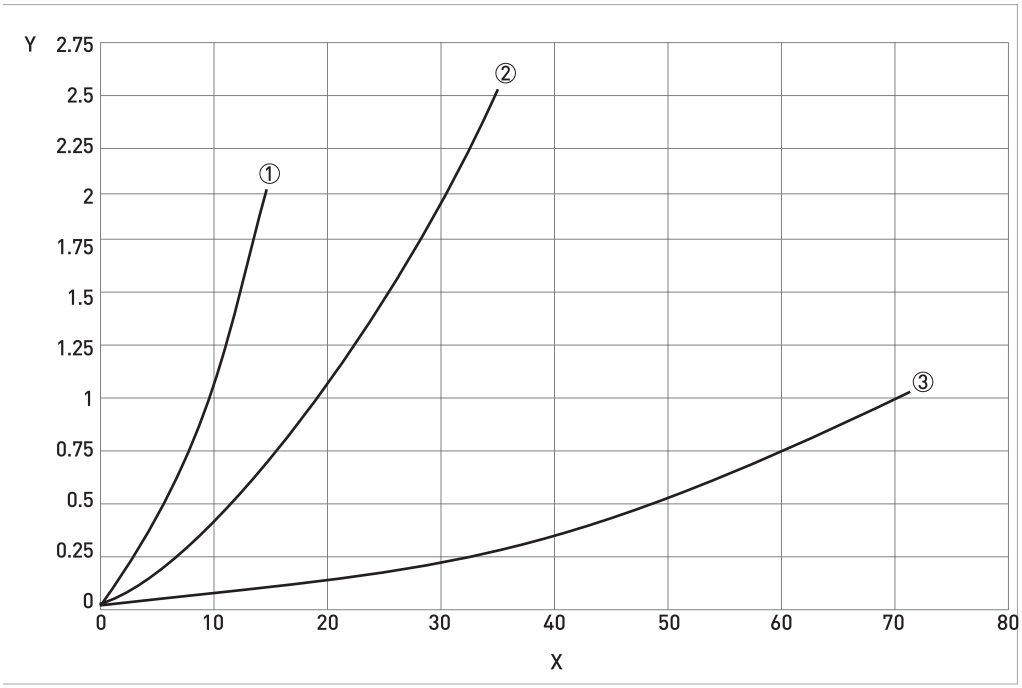
The measuring error is obtained from the combined effects of accuracy and zero stability.

Reference conditions

Product	Water
Temperature	+20°C / +68°F
Operating pressure	1 barg / 14.5 psig

7.4 Pressure drop

Metric

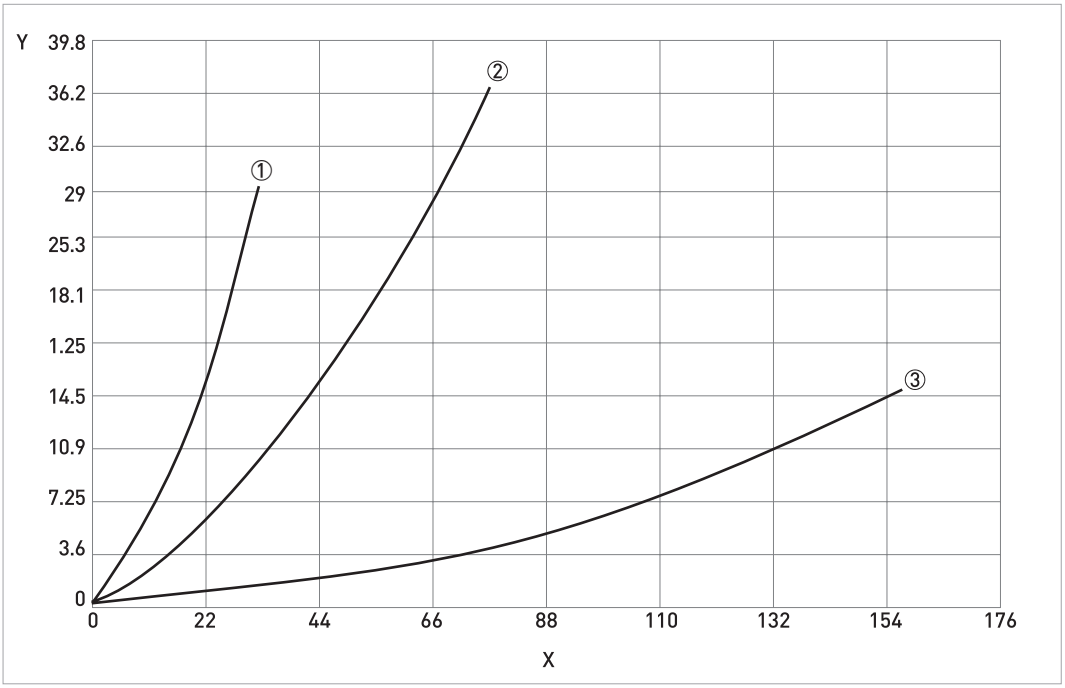


X Mass flow [kg / min]
Y Pressure [barg]
① S08
② S10
③ S15

Reference conditions

Meter	Product	Temperature
OPTIBATCH S08	Water	20ºC
OPTIBATCH S10		
OPTIBATCH S15		

Imperial



X Mass flow [lb / min]
Y Pressure [psig]
① S08
② S10
③ S15

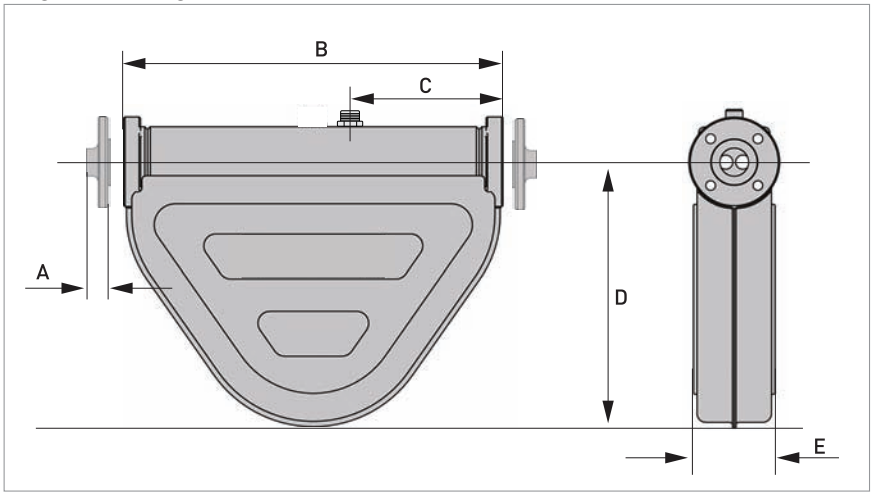
Reference conditions

Meter	Product	Temperature
OPTIBATCH S08	Water	68ºF
OPTIBATCH S10		
OPTIBATCH S15		

7.5 Dimensions and weights

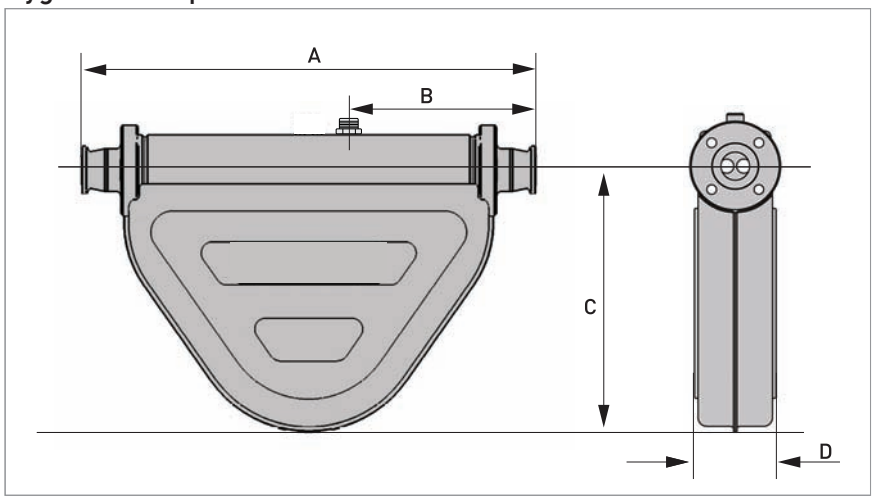
7.5.1 Dimensions

Hygienic flange



Meter	S08		S10		S15	
Connection	DN20 DIN11864-2		DN20 DIN11864-2		DN20 DIN11864-2	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
A	15	0.59	15	0.59	15	0.59
B	270	10.6	270	10.6	270	10.6
C	112	4.4	112	4.4	112	4.4
D	189	7.44	189	7.44	189	7.44
E	59.5	2.34	59.5	2.34	59.5	2.34

Hygienic clamp



Meter	S08 / S10				S15								
Connection	DN10 Clamp DIN32676	DN15 Clamp DIN32676	DN10 IDF Clamp (A type)	DN15 Tri-Clover	DN15 Clamp DIN32676	DN20 Clamp DIN32676	DN25 Clamp DIN32676	DN15 IDF Clamp (A type)	DN20 Tri-Clover	DN25 Tri-Clover	DN25 Clamp ISO2852	DN25 RJT	DN25 SMS
[mm]													
A	333				333								
B	144				144								
C	189				189								
D	59.5				59.5								
[inches]													
A	13.1				13.1								
B	5.7				5.7								
C	7.44				7.44								
D	2.34				2.34								

7.5.2 Weights

Meter	S08		S10		S15	
	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]
	2.9	6.38	2.9	6.38	2.9	6.38