FLOWave SAW flowmeter

- No obstacles inside the measuring tube, compact, lightweight and low energy consumption
- Conforms to hygienic requirements, CIP/SIP compatible
- Ideal for liquids with low or no conductivity, for example water for injection (WFI)
- Digital communication (Bürkert system bus (büS)/CANopen, industrial communication over Modbus TCP, PROFINET, EtherNet/IP, EtherCAT® or IO-Link), parameterisation via Communicator, display
- Optional: ATEX/IECEx (II 3G/D), ATEX/IECEx/NEPSI or hazardous locations (HazLoc) certifications

Product variants described in the data sheet may differ from the product presentation and description.

Can be combined with

Type 8802
Continuous control valve systems ELEMENT – overview

Type 8619
multiCELL – multi-channel/ multi-function transmitter/ controller

Type 8647
AirLINE SP – electropneumatic automation system

Type ME43
Fieldbus gateway

Type ME63
Industrial EtherNet gateway, IP65/ IP67/ IP69k

Type 8922
Activation of software functions

Type description

The Type 8098 flowmeter is part of the FLOWave product range. It is based on SAW (Surface Acoustic Waves) technology and is mainly designed for applications with the highest hygienic demands. This is achieved by using suitable stainless steel materials, a measuring tube completely free of any internal parts and an ideal outer hygienic design.

FLOWave offers a range of integrated functions including the advantages of flexibility, ease of cleaning, compact dimensions, lightweight, easy installation and handling, and is compliant with numerous standards.

Optimal measurement results can be achieved with homogeneous liquids, free of air and solid particles. For liquids with high viscosity, an integrated viscosity compensation can be activated. Gas and steam cannot be measured; however, their flow does not have any negative effect on the device or its operation and other liquids flowing through afterwards are measured correctly as before.

Beside volume flow, a density measurement optional feature is available. With this option, the mass flow is calculated based on volume flow and density measurements. Special functions derived from further process values (differentiation factor (DF), acoustic transmission factor and concentration) offer additional information about the particular liquid in use (for details, see chapter "8.2. Special functions" on page 29).

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

Table of contents

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

1. General technical data

1.1. About the device

The flowmeter Type 8098 consists of:

- either a flow sensor Type S097 and a FLOWave L transmitter (variant FLOWave L flowmeter)

- or a flow sensor Type S097 and a FLOWave S transmitter (variant FLOWave S flowmeter).

See chapter "1.3. FLOWave L flowmeter" on page 8 or chapter "1.4. FLOWave S flowmeter" on page 10 for more information.

1.2. All variants

Note:

- The following data applies to all variants mentioned above.
- In the following table, the term "full scale" refers to full scale of volume flow rate, i.e. the flow rate corresponding to 10 m/s flow velocity.

Product properties	
Material	
Make sure the device materials are compatible with the fluid you are using. Further information can be found in chapter "3.1. Bürkert resistApp" on page 15. Further information on the materials can be found in chapter "3.2. Material specifications" on page 16.	
Surface quality	
Measurement tube (inner surface)	• Ra < 0.8 µm (0.76 µm = 30 µin., ASME BPE SF3) or • Ra < 0.4 µm electro-polished according to ISO 4288 (0.38 µm = 15 µin., ASME BPE SF4)
Dimensions	Further information can be found in chapter "4. Dimensions" on page 18.
Measuring element	Interdigital transducers
Measurement principle	Based on SAW (Surface Acoustic Waves)
Measuring range	
Volume flow rate measurement	0...1.7 m^3/h up to 0...200 m^3/h Further information can be found in chapter "6.2. Measuring range table" on page 25 .
Flow velocity measurement	0...10 (full scale) m/s (bidirectional flow measurement)
Density measurement [1.)]	0.8...1.3 g/cm^3 (inactive by default, selectable upon request)
Mass flow rate measurement [1.)]	0...1 360 kg/h up to 0...260 000 kg/h (inactive by default, selectable upon request)
Temperature measurement	- 20...+ 140 °C (- 4...+ 284 °F)
Special function	Active by default, deselectable upon request. • ATF: acoustic transmission factor • DF: differentiation factor Further information can be found in chapter "8.2. Special functions" on page 29.

Performance data

Reference conditions measurement

Under reference conditions i.e. measurement fluid = water free from gas bubbles and solids, ambient and water temperature = 23 °C ± 1 °C (73.4 °F ± 1.8 F), pressure < 5 bar (72 psig), and short refresh time (see chapter "6.3. Refresh time table" on page 25), **while maintaining turbulent flow profile,** with the minimum inlet (40 x DN) and outlet (1 x DN) distances and the appropriate internal diameter of the pipes. Deviations from reference conditions can be adjusted using the built-in adjustment procedures (see chapter "7.1. Installation notes" on page 25 and user manual **Type 8098** ▶). Contact your Bürkert sales office for advices especially on specifications beyond the stated conditions.

Volume flow rate measurement

Measurement deviation	• ≥ 1 m/s to full scale: ± 0.4 % of the measured value • < 1 m/s: typically ± 0.08 % of full scale Further information can be found in chapter "6.2. Measuring range table" on page 25.
Repeatability	• ≥ 1 m/s to full scale: ± 0.2 % of the measured value • < 1 m/s: typically ± 0.04 % of full scale
Mass flow rate measurement	**As an option** [1.]
Measurement deviation	• Standard K-factor: – ≥ 1 m/s to full scale: ± 2.4 % of the measured value – < 1 m/s: ± (2 % of the measured value + typically ± 0.08 % of full scale) • After teach-in: – ≥ 1 m/s to full scale: ± 1.4 % of the measured value at teach-in density and mass flow rate values – < 1 m/s: ± (1 % of the measured value + typically ± 0.08 % of full scale) at teach-in density and mass flow rate values Further information can be found in chapter "6.2. Measuring range table" on page 25.
Repeatability	• ≥ 1 m/s to full scale: ± 1.2 % of the measured value • < 1 m/s: ± (1 % of the measured value + typically ± 0.04 % of full scale)
Density measurement	**As an option** [1.]
Measurement deviation	• Standard product adjustment: ± 2 % of the measured value • After teach-in: ± 1 % of the measured value (at teach-in density value)
Repeatability	± 1 % of the measured value
Temperature measurement	
Measurement deviation	• For T° ≤ 100 °C (+ 212 °F): ± 1 °C (+ 1.8 °F) • For 100 °C (+ 212 °F) < T° < 140 °C (+ 284 °F): ± 1.5 %

Original gravity measurement (degree Plato)	As an option [1.]

Under reference conditions, with flowing barley beer wort free from gas bubbles and solids, measured in the conditions stated below. See the **supplement to operating instructions for concentration measurement Type 8098** ▶ for more information.

Performance / **Measurement use case**	**Outlet section of the lauter tun**	**Outlet section of the kettle**	**Outlet section of wort chiller**
Measuring range	0...25°P	8...25°P	5...25°P
Fluid temperature	65...80 °C	70...100 °C	5...25 °C
Measurement deviation	± 0.5°P	± 0.5°P	± 0.5°P
Repeatability	± 0.2°P	± 0.2°P	± 0.2°P
Resolution	0.01°P	0.01°P	0.01°P

As the medium used to measure the degrees Plato differs from water, volumetric flow performances may vary from previously mentioned (see "Volume flow rate measurement" on page 5). In this case, adjust the measurements to the process conditions, using the teach-in adjustments.

Electrical data

Operating voltage	12...35 V DC, filtered and regulated Connection to main supply: permanent
Power source (not supplied)	• Limited power source according to IEC 62368-1, appendix Q or • Limited energy circuit according to IEC 61010-1, paragraph 9.4 or • SELV (Safety Extra Low Voltage)/PELV (Protective Extra Low Voltage) with UL-approved overcurrent protection designed according to IEC 61010-1, Table 18
DC reverse polarity protection	Yes
Connection cable	Further information on connection cable for CANopen/büS communication can be found on our website under the "User Manuals" heading in **Cabling Guide | büS/EDIP** ▶.

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

Medium data	
Fluid	The liquids should be non-dangerous, homogeneous, free of air or gas bubbles, free of suspended solids [2.] and must comply with article 4, paragraph 1 of 2014/68/EU directive. Further information can be found in chapter "2.4. Pressure Equipment Directive (PED)" on page 13. By default, the FLOWave flowmeter is set for a fluid with a sound velocity [3.] • between 1000 m/s and 2000 m/s for pipe size DN 08, ⅜" and ½" • between 800 m/s and 2300 m/s for pipe size DN ≥ 15 or ≥ ¾"
Fluid temperature	• - 20...+ 110 °C (- 4...+ 230 °F). The maximum fluid temperature can be restricted by the ambient operating temperature. • Max. conditions for sterilisation process: up to + 140 °C (+ 284 °F) (+ 130 °C (+ 266 °F) for ATEX/IECEx/NEPSI variant) for max. 60 min • Maximum temperature gradient: 10 °C/s (18 °F/s) (measured by the integrated sensor on the device)
Fluid pressure	• The wetted parts are capable of withstanding an absolute pressure of 25 mbar in the inner measurement tube for vacuum drying applications. • PN = Nominal pressure (in bar) according to EN 61010-1:2011, paragraph 11.7

DN / **Pipe standard**	**DIN 11850**	**ISO 1127**	**ASME BPE**	**SMS 3008**
DN 08, ⅜", ½"	PN 25	PN 25	PN 25	–
DN 15, ¾", DN 25, 1", 1½"	PN 25	PN 25	PN 25	PN 25
DN 40	PN 25	PN 16	–	PN 25
DN 50, 2"	PN 16	PN 16	PN 16	PN 16
DN 65, 2½", DN 80, 3"	PN 10	PN 10	PN 10	–

Product connections	
Process connection size / pipe size [4.] according to	
DIN 32676 series A / DIN 11850	Clamp: DN 08, DN 15, DN 25, DN 40, DN 50, DN 65 and DN 80
DIN 32676 series B / ISO 1127	Clamp: DN 08, DN 15, DN 25, DN 40, DN 50, DN 65 and DN 80
DIN 32676 series C / ASME BPE	Clamp: ⅜", ½", ¾", 1", 1½", 2", 2½" and 3"
DIN 11864-2 form A series A / DIN 11850	Aseptic collar flange (BF) [5.]: DN 15, DN 25, DN 40, DN 50, DN 65 and DN 80
DIN 11864-2 form A series B / ISO 1127	Aseptic collar flange (BF) [5.]: DN 08, DN 15, DN 25, DN 40, DN 50, DN 65 and DN 80
DIN 11864-2 form A series C / ASME BPE	Aseptic collar flange (BF) [5.]: ½", ¾", 1", 1½" and 2"
DIN 11864-3 form A series A / DIN 11850	Aseptic collar clamp ferrule (BKS) [5.]: DN 15, DN 25, DN 40 and DN 50
DIN 11864-3 form A series B / ISO 1127	Aseptic collar clamp ferrule (BKS) [5.]: DN 08, DN 15, DN 25, DN 40 and DN 50
DIN 11864-3 form A series C / ASME BPE	Aseptic collar clamp ferrule (BKS) [5.]: ½", ¾", 1", 1½" and 2"
SMS 3017 / SMS 3008	Clamp: DN 25, DN 40 and DN 50
DIN 11851 series A / DIN 11850	Thread: DN 65 and DN 80
Device status	LED light ring according to NAMUR NE 107
Approvals and conformities	
Directives	
CE directive	Further information on the CE Directive can be found in chapter "2.3. Standards" on page 12.
Pressure equipment directive	Complying with article 4, paragraph 1 of 2014/68/EU directive Further information on the pressure equipment directive can be found in chapter "2.4. Pressure Equipment Directive (PED)" on page 13.
Explosion protection	On request: • ATEX/IECEx • ATEX/IECEx/NEPSI (China) Further information on explosion protection can be found in chapter "2.5. Explosion protection" on page 13.
North America (USA/Canada)	On request: • UL Listed (see chapter "2.6. North America (USA/Canada)" on page 14). • CRN 0C21751 declaration [6.]

Foods and beverages/Hygiene	• 3-A (28-06) Sanitary Standards Inc. • EHEDG (Type EL CLASS I) 7.) • FDA declaration of conformity • On request: – USP class VI declaration – EC 1935/2004 declaration – EC 2023/2006 declaration – GB 4806.1-2016 declaration – GB 4806.9-2023 declaration
Materials	• Inspection certificate 3.1 – for DN 08, DN 65 and DN 80, ⅜", ½", 2½" and 3": the sensor is machined in one piece. – for DN 15...DN 50 and ¾"...2": the 2 process connections are welded to the measurement tube (up to 3 heat numbers). • Certification of compliance ASME BPE • On request: – Certification of conformity for the surface quality DIN 4762, EN ISO 4287, EN ISO 4288 – Certification of conformity for passivation and electro-polishing processes
Others	• Fluidic test report (test regarding volumetric flow rate or volume and mass flow rates, if density and mass flow rate option chosen) • On request: – Calibration certificate (volumetric flow rate, volume and mass flow rates and density) – Test report 2.2 – MTBF (Mean Time Between Failures) manufacturer declaration
Environment and installation	
Ambient temperature	• Operation: depends on the fluid temperature. Further information can be found in chapter "6.1. Medium temperature diagram" on page 24. • Storage: - 20...+ 70 °C (- 4...+ 158 °F)
Relative air humidity	≤ 85 %, without condensation
Height above sea level	Max. 2000 m
Operating condition	Continuous
Equipment mobility	Fixed device
Application range	Indoor and outdoor Protect the device against electromagnetic interference, ultraviolet rays and, when installed outdoors, against the effects of climatic conditions. The FLOWave is well-suited for WFI/PW (Water For Injections / Purified Water) applications, and compatible with CIP/SIP (Clean / Sterilizing In Place).
Degree of protection	• IP65, IP67 (according to IEC/EN 60529) 8.)10.) • NEMA 4X (according to NEMA250) 9.)10.)
Installation category	Category I according to UL/EN 61010-1
Pollution degree	Degree 2 according to UL/EN 61010-1

1.) Only for a flowmeter with a process connection size of DN 08...DN 80 or ½"...3"
2.) For fluids beyond this range, either check signal availability and stability under the target DN and process conditions, or contact your Bürkert sales office.
3.) Customer specific setting on request. Contact your Bürkert sales office.
4.) See dimension tables in chapters "4.4. Flowmeter with clamp connection" on page 19, "4.5. Flowmeter with aseptic collar flange connection (BF)" on page 21, "4.6. Flowmeter with aseptic collar clamp connection (BKS)" on page 22, and "4.7. Flowmeter with thread connection" on page 23.
5.) In German: BF = Bundflansch, BKS= Bundklemmstutzen
6.) Only for a flowmeter with a ASME BPE process connection
7.) The EHEDG compliance for :
- clamp connection according to DIN 32676 is only valid if used in combination with EHEDG-compliant seals from Combifit International B.V.
- threaded connection according to DIN 11851 is only valid if used in combination with EHEDG-compliant seals from
  1. Kieselmann GmbH, Germany (ASEPTO-STAR k-flex upgrade seals) or
  2. Siersema Komponenten Service (S.K.S.) B.V. (Netherlands SKS seal set DIN 11851 EHEDG with EPDM or FKM inner seal).

8.) Not evaluated by UL, only IP64 is evaluated by the ATEX notified body, by the IECEx certified body and by the NEPSI certified body.
9.) Only the device with UL HazLoc approval is evaluated by UL.
10.) Under the following conditions for:
- FLOWave L: when the product is wired, the cable glands are tightened, the connectors are plugged in, and the transmitter, the covers and/or the display module are locked. Unused cable glands must be sealed with the stopper seals provided (mounted upon delivery of the product). An unused M12 fixed connector must be protected by the screwed plug.
- FLOWave S: when the M12 connector is connected or the protective cap is screwed on and the transmitter is locked

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

1.3. FLOWave L flowmeter

The FLOWave L flowmeter is available in four stainless-steel transmitter variants, with a selectable display and up to three outputs (configurable AO and/or DO), or with industrial communication:

- with nickel plated brass cable glands and M12 male connector
- with stainless steel cable glands and M12 male connector (full stainless steel and ATEX/IECEx/NEPSI variants)
- with stainless steel M12 female and male connectors and industrial communication (Ethernet variant)

All variants

Note:
The following data applies to all variants mentioned above (unless otherwise stated).

Product properties							
Display	• 2.4", monochrome graphic (240 × 160 pixels) • Languages: German, English, French						
Weight	**(approx. in kg)**						
Pipe connection / **DN**	**DN 08, ⅜", ½"**	**DN 15, ¾"**	**DN 25, 1"**	**DN 40, 1½"**	**DN 50, 2"**	**DN 65, 2½"**	**DN 80, 3"**
Clamp	2.1	2	2.2	3	3.2	5.4	5.5
Flange	2.3	2.4	2.7	3.6	3.8	6	6.2
Thread (dairy thread)	–	–	–	–	–	5.7	6.1
Performance data							
Frequency resolution	0.05 Hz over 0...10 kHz range						
4...20 mA output uncertainty	± 0.04 mA						
4...20 mA output resolution	0.8 µA						
Electrical data							
Power consumption	Without any consumption of output • For device with 2 x M20 × 1.5 cable glands and 1 × 5-pin M12 male connector: max. 5 W • For device with 2 × 4-pin M12 female connectors and 1 × 5-pin M12 male connector, Ethernet variant: max. 8 W • For device with 2 × 4-pin M12 female connectors and 1 × 5-pin M12 male connector, Ethernet variant, with display module: max. 9 W						
Output	**Valid for non-Ethernet variants only**						
Number of outputs	3 (1 digital, 1 analogue and 1 configurable: digital or analogue)						
Digital output (DO)	Overload information (through software diagnostics function) Transistor: • Type: NPN or PNP (wiring dependent), open collector, galvanically isolated • Operating modes: pulse (by default), On/Off, threshold, frequency (user configurable) • 10 kHz, 5...35 V DC, max. 700 mA, max. pulse duration: 2 s, selectable limits: – 0.0001...10 000 pulses/litre or 0.0001...9 999.99 litres/pulse – 0.0001...10 000 pulses/kg or 0.0001...9 999.99 kg/pulse [1.)] • Protected against polarity reversals of DC and overloads						
Analogue output (AO)	Open loop detection (through software diagnostics function) Current: • Type: Source or Sink (wiring dependent), galvanically isolated • 4...20 mA • 3.6 mA or 22 mA to indicate an error (only if 4...20 mA scale selected) • Max. loop impedance: 1 300 Ω at 35 V DC, 1 000 Ω at 30 V DC, 700 Ω at 24 V DC, 450 Ω at 18 V DC						

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

Connection cable	
For cable gland	• 0.2...1.5 mm² cross-section • In nickel plated brass: – Cable with maximum operating temperature greater than + 80 °C (+ 176 °F) – 5...14 mm diameter, shielded cable • In stainless steel: – Cable with maximum operating temperature greater than + 80 °C (+ 176 °F) – 6...13 mm diameter, shielded cable
For 5-pin M12 male connector (A-coded)	• Cable with maximum operating temperature greater than + 80 °C (+ 176 °F) • 3...6.5 mm diameter, shielded cable, • 0.75 mm² cross-section to connect to 5-pin M12 female connector (A-coded, not supplied)
Product connections	
Electrical connection	2 x M20 × 1.5 cable glands and 1 × 5-pin M12 male connector (A-coded) for non-Ethernet variants only Further information on electrical connection for Ethernet variant can be found in chapter "With industrial communication (Ethernet variant)" on page 9.
Data transfer	External communication through büS (Bürkert system bus, CANopen protocol)
Environment and installation	
Ambient temperature	Operation: • For device with 2 x M20 × 1.5 cable glands and 1 × 5-pin M12 male connector: – - 10...+ 70 °C (+ 14...+ 158 °F) or - 10...+ 40 °C (+ 14...+ 104 °F) for ATEX/IECEx/NEPSI variant, if - 20 °C (4 °F) ≤ fluid temperature ≤ 80 °C (176 °F), – At a fluid temperature > 80 °C (176 °F), the maximum ambient temperature decreases linearly from 70 °C (158 °F) up to 40 °C (104 °F) or from 40 °C (104 °F) up to 30 °C (86 °F) for ATEX/IECEx/NEPSI variant. • For device with 2 × 4-pin M12 female connectors and 1 × 5-pin M12 male connector, Ethernet variant: - 10...+ 55 °C (+ 14...+ 131 °F) Further information can be found in chapter "6.1. Medium temperature diagram" on page 24.

1.) Only if option density and mass flow is activated.

With industrial communication (Ethernet variant)

Electrical data	
Connection cable	
For 4-pin M12 female connector (D-coded)	• Cable with maximum operating temperature greater than + 80 °C (+ 176 °F) • 5e / CAT-5 min. category, 100 m max. length, shielded conductor with minimum STP • To connect to 4-pin M12 male connector (D-coded, not supplied)
Product connections	
Electrical connection	2 × 4-pin M12 female connectors (D-coded) and 1 × 5-pin M12 male connector (A-coded)
Industrial Communication	
Supported network protocol	• Modbus TCP • PROFINET • EtherNet/IP • EtherCAT® 1.)
Modbus TCP protocol	
Protocol	Internet protocol, version 4 (IPv4)
IP configuration	• Static IP address • Not supported: BOOTP (Bootstrap Protocol), DHCP (Dynamic Host Configuration)
Transmission speed	10 or 100 MBit/s
PROFINET protocol	
PROFINET IO specification	V2.3
Network management	• LLDP (Link Layer Discovery Protocol) • SNMP V1 (Simple Network Management Protocol) • MIB (Management Information Base)

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

IP configuration	• DCP (Discovery and Configuration Protocol) • Manual (Device naming and IP setting)
Transmission speed	100 MBit/s full duplex
Maximum supported conformance class	CC-B
Media Redundancy (for ring topology)	MRP client is supported
GSDml file	See **Device Description Files Type 8098** ▶ on the website under the "Software" heading.
EtherNet/IP protocol	
Protocol	Internet protocol, version 4 (IPv4)
IP configuration	• Static IP address • BOOTP (Bootstrap Protocol) • DHCP (Dynamic Host Configuration Protocol)
Transmission speed	10 or 100 MBit/s
Duplex mode	Half duplex, full duplex, auto-negotiation
MDI mode (Medium Dependant Interface)	Auto-MDIX
Predefined standard objects	Identity, Message Router, Assembly, Connection Manager, DLR, QoS, TCP/IP Interface, EtherNet Link object
EDS file	See **Device Description Files Type 8098** ▶ on the website under the "Software" heading.
EtherCAT® protocol 1.)	
Industrial Ethernet interface X1, X2	X1: EtherCAT® IN, X2: EtherCAT® OUT
Maximum number of cyclic input/output data	512 bytes in total
Maximum number of cyclic input data	1024 bytes
Maximum number of cyclic output data	1024 bytes
Acyclic communication (CoE)	• SDO • SDO master-slave • SDO slave-slave (depends on master capacity)
Transmission speed	100 Mbit/s
Approvals and conformities	
Others	Further information on network protocols can be found in chapter "2.8. Others" on page 15.

1.) EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH.

1.4. FLOWave S flowmeter

The FLOWave S flowmeter is available in the following variants of the transmitter:

- Stainless steel transmitter with 5-pin M12 male connector
  - büS communication with no output and with or without an ATEX/IECEx/NEPSI or HazLoc certification
  - büS communication with no output or IO-Link communication, one configurable output AO/DO and with or without an HazLoc certification
- Stainless steel transmitter with 8-pin M12 male connector and service büS only, with 2 configurable outputs AO/DO:
  - with or without an ATEX/IECEx/NEPSI or HazLoc certification

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

Product properties

Weight	**(approx. in kg)**						
Pipe connection / **DN**	**DN 08, ⅜", ½"**	**DN 15, ¾"**	**DN 25, 1"**	**DN 40, 1½"**	**DN 50, 2"**	**DN 65, 2½"**	**DN 80, 3"**
Clamp	1.7	1.6	1.8	2.6	2.8	5.0	5.1
Flange	1.9	2.0	2.3	3.2	3.4	5.6	5.8
Thread (dairy thread)	–	–	–	–	–	5.3	5.7

Electrical data

Power consumption: Max. 2.5 W without any consumption of output

Output

Number of outputs
- Device with 5-pin M12 male connector:
  - büS communication: no output
  - IO-Link communication: 1 output, configurable as AO/DO, pre-wired as sourcing (AO) or PNP non isolated (DO)
- Device with 8-pin M12 male connector: 2 outputs, each configurable as AO/DO

Digital output (DO)

Overload information (through software diagnostics function)
Transistor:
- Type: NPN or PNP (wiring dependent), open collector, galvanically isolated
- Operating modes: pulse (by default), On/Off, threshold, frequency (user configurable)
- 10 kHz, 5...35 V DC, max. 700 mA, max. pulse duration: 2 s, selectable limits:
  - 0.0001...10 000 pulses/litre or 0.0001...9 999.99 litres/pulse
  - 0.0001...10 000 pulses/kg or 0.0001...9 999.99 kg/pulse [1.)]
- Protected against polarity reversals of DC and overloads

Analogue output (AO)

Open loop detection (through software diagnostics function)
Current:
- 4...20 mA
- Sourcing or sinking (wiring dependant), galvanically isolated
- 3.6 mA or 22 mA to indicate an error (only if 4...20 mA scale selected)
- Max. loop impedance: 1300 Ω at 35 V DC, 1000 Ω at 30 V DC, 700 Ω at 24 V DC, 450 Ω at 18 V DC

Connection cable

For 5- or 8-pin M12 male connector (A-coded)
- Shielded cable with maximum operating temperature greater than + 80 °C (+ 176 °F)
  - Device without output (5-pin M12) or with 2 outputs (8-pin M12):
    - 3...6.5 mm diameter
    - 0.75 mm² cross-section to connect to 5- or 8-pin M12 female connector (A-coded, not supplied)
  - Device with IO-Link communication (5-pin M12):
    - Standard IO-Link installation cable is sufficient
    - 20 m max. length
- For variant with HazLoc certification
  To be compliant, a hazardous location-approved shielded cable with a 5- or 8-pin M12 female connector from Turck (eurofast® cordset) in combination with the locking device from Turck (lokfast® guard) is needed. Further information can be found on our website under the "User Manuals" heading in **Supplement Type 8098 FLOWave S | UL Listed for use in hazardous locations** ▶.

Product connections

Electrical connection
- 1 × 5-pin M12 male connector (A-coded) for device with büS communication only (no output) and with büS or IO-Link communication (1 output)
- 1 × 8-pin M12 male connector (A-coded) for device with 2 outputs

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

Data transfer	
Digital communication: büS	• Device with büS communication only (no output): communication through büS (Bürkert system bus, CANopen protocol) • Device with büS (no output) and IO-Link communication (1 output): communication through büS (Bürkert system bus, CANopen protocol) • Device with 2 outputs: büS connection only to the Bürkert Communicator for configuration and software update of the device. Due to the missing CAN shield the conventional büS/CANopen communication is not recommended.
Digital communication: IO-Link	
Communication interface	IO-Link device V1.1.3
SIO mode	No
Transmission speed (baud rate)	COM 3 (230.4 kBaud)
Type of ports	Class A
Cycle time	Min. 5 ms
Process data width	219 Input bits, 8 Output bits
IO-Link data storage	Yes
Block configuration	No
IO device description (IODD)	The device description is available in the operating instructions which can be found on our website under the "User Manuals" heading for **Type 8098** ▶. Alternatively, see "Device Description Files" under the "Software" heading for **Type 8098** ▶ or at **https://ioddfinder.io-link.com**
Cyclic data configuration	The device can be set according to different configurations of cyclic process values.
Approvals and conformities	
North America (USA/Canada)	On request: UL HazLoc (explosion protection), see chapter "2.6. North America (USA/Canada)" on page 14.)
Environment and installation	
Ambient temperature	Operation: • All variants except ATEX/IECEx/NEPSI and HazLoc variants: – - 10...+ 70 °C (+ 14...+ 158 °F) if - 20 °C (4 °F) ≤ fluid temperature ≤ 80 °C (176 °F) – at a fluid temperature > 80 °C (176 °F), the maximum ambient temperature decreases linearly from 70 °C (158 °F) up to 40 °C (104 °F). • ATEX/IECEx/NEPSI and HazLoc variants: – - 10...+ 60 °C (+ 14...+ 140 °F) if - 20 °C (4 °F) ≤ fluid temperature ≤ 100 °C (212 °F) – at a fluid temperature > 100 °C (212 °F), the maximum ambient temperature decreases linearly from 60 °C (140 °F) up to 45 °C (136 °F). Further information can be found in chapter "6.1. Medium temperature diagram" on page 24.

1.) Only if option density measurement and mass flow rate measurement is activated
2.) For not equipped optional feature, value will be 0.

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

2. Approvals and conformities

2.1. General notes

- The approvals and conformities listed below must be stated when making enquiries. This is the only way to ensure that the product complies with all required specifications.
- Not all available variants of the device can be supplied with the below mentioned approvals or conformities.

2.2. Conformity

In accordance with the Declaration of Conformity, the product is compliant with the EU Directives.

2.3. Standards

The applied standards which are used to demonstrate compliance with the EU Directives are listed in the EU-Type Examination Certificate and/or the EU Declaration of Conformity.

2.4. Pressure Equipment Directive (PED)

The device conforms to article 4, paragraph 1 of the Pressure Equipment Directive (PED) 2014/68/EU under the following conditions:

Device used in a pipe

Note:

- The data in the table is independent of the chemical compatibility of the material and the fluid.
- PS = maximum admissible pressure (in bar), DN = nominal diameter of the pipe

Type of fluid	Conditions
Fluid group 1, Article 4, Paragraph 1.c.i	DN ≤ 25
Fluid group 2, Article 4, Paragraph 1.c.i	DN ≤ 32 or PS*DN ≤ 1000
Fluid group 1, Article 4, Paragraph 1.c.ii	DN ≤ 25 or PS*DN ≤ 2000
Fluid group 2, Article 4, Paragraph 1.c.ii	DN ≤ 200 or PS ≤ 10 or PS*DN ≤ 5000

2.5. Explosion protection

Note:
Further information on explosion protection for the USA and Canada can be found in the chapter "2.6. North America (USA/Canada)" on page 14.

<table>
<tr><th>Approval</th><th>Description</th></tr>
<tr><td></td><td>
Optional: Explosion protection [1.)]
As a category 3 device suitable for zone 2/22 (optional).

Ex marking of the components according to the following table:
<table>
<tr><th>FLOWave L flowmeter</th><th>FLOWave S flowmeter [2.)]</th></tr>
<tr><td>ATEX
• II 3G Ex ec IIC T4 Gc
• II 3D Ex tc IIIC T110 °C Dc or T130 °C Dc

IECEx
• Ex ec IIC T4 Gc
• Ex tc IIIC T110 °C Dc or T130 °C Dc

NEPSI
• Ex ec IIC T4 Gc
• Ex tc IIIC T110 °C Dc or T130 °C Dc</td><td>ATEX
• II 3G Ex ec IIC T4 Gc
• II 3D Ex tc IIIC T130 °C Dc

IECEx
• Ex ec IIC T4 Gc
• Ex tc IIIC T130 °C Dc

NEPSI
• Ex ec IIC T4 Gc
• Ex tc IIIC T130 °C Dc</td></tr>
</table>
Measures to comply with ATEX/IECEx/NEPSI requirements: refer to the
• Supplement Type 8098 | FLOWave L with ATEX/IECEx/NEPSI certification ▶ or
• Supplement Type 8098 | FLOWave S with ATEX/IECEx/NEPSI/ Hazardous Location certification ▶
under the "User Manuals" heading.

The Ex certification is only valid if the Bürkert device is used as described in the supplement ATEX/IECEx/NEPSI. If unauthorized changes are made to the device, the Ex certification becomes invalid.
</td></tr>
</table>

1.) Applies only to ATEX/IECEx/NEPSI variants.
2.) Does not apply to the IO-Link variant or to HazLoc-certified flowmeters.

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

2.6. North America (USA/Canada)

Approval	Description
c UL us LISTED	**Optional: UL Listed for the USA and Canada** [1.)] The products are UL Listed for the USA and Canada according to: • UL 61010-1 (ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE – Part 1: General Requirements) • CAN/CSA-C22.2 No. 61010-1 Certificate number: E237737
c UL us LISTED Measuring equipment for use in hazard-ous locations	**Optional: UL Listed with HazLoc for the USA and Canada** Marking of the components according to the following table: **FLOWave S flowmeter** [1.)] • Class I, Division 2, Group A, B, C and D, T4 • Class II, Division 2, Group F and G, T130 °C • Class III, Division 1 and 2 Measures to comply with HazLoc requirements: refer to the **Supplement Type 8098 | FLOWave S with ATEX/IECEx/** NEPSI/ Hazardous Location **certification** ▶ under the "User Manuals" heading. The hazardous locations certification is only valid if the Bürkert device is used as described in the supplement UL Listed for use in hazardous locations. If unauthorized changes are made to the device, the HazLoc certification becomes invalid. Certificate number: E539024

1.) Does not apply to ATEX/IECEx/NEPSI-certified flowmeters.

Approval	Description
CRN	**Canadian Registration Number (CRN) – Technical Standards and Safety Act, Boilers and Pressure Vessels Regulation, and CSA Standard B51** Flowmeters with ASME BPE process connection comply with CRN requirements, as specified in the certificate. Registration number Canada: 0C21751

2.7. Foods and beverages/Hygiene

Approval	Description
3-A	**3-A Sanitary Standards Inc.** The products comply with 3-A Sanitary Standards Inc (3-A SSI) as per certificate. Certificate authorization number: 1178
CERTIFIED EHEDG TYPE EL CLASS I	**EHEDG (European Hygienic Engineering and Design Group) (Type EL CLASS I)** The EHEDG compliance is only valid • if the flowmeter with clamp connection according to DIN 32676 is used in combination with seals from Combifit International B.V. • if the flowmeter with threaded connection according to DIN 11851 is used in combination with seals from – Kieselmann GmbH, Germany (ASEPTO-STAR k-flex upgrade seals) or – Siersema Komponenten Service (S.K.S.) B.V. (Netherlands SKS seal set DIN 11851 EHEDG with EPDM or FKM inner seal)

Conformity	Description
FDA	**FDA – Code of Federal Regulations** The devices are compliant in their composition with the Code of Federal Regulations published by the FDA (Food and Drug Administration, USA) according to the manufacturer's declaration.
USP	**United States Pharmacopeial Convention (USP)** All wetted materials are biocompatible according to USP or ISO according to the manufacturer's declaration.
	EC Regulation 1935/2004 of the European Parliament and of the Council All wetted materials are compliant with EC Regulation 1935/2004 and manufactured according to EC Regulation 2023/2006, according to the manufacturer's declaration.

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

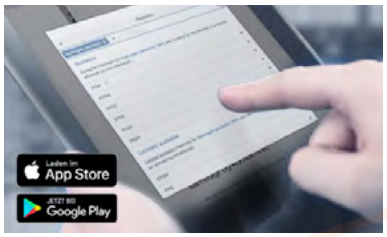
2.8. Others

Network protocol

Approval	Description
PROFINET	**PROFINET** Certificate number: Z12446
EtherNet/IP	**EtherNet/IP** Document number: 11839
EtherCAT	EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH.
IO-Link	**IO-Link** Document number: DIS1000657455

3. Materials

3.1. Bürkert resistApp



Bürkert resistApp – Chemical resistance chart

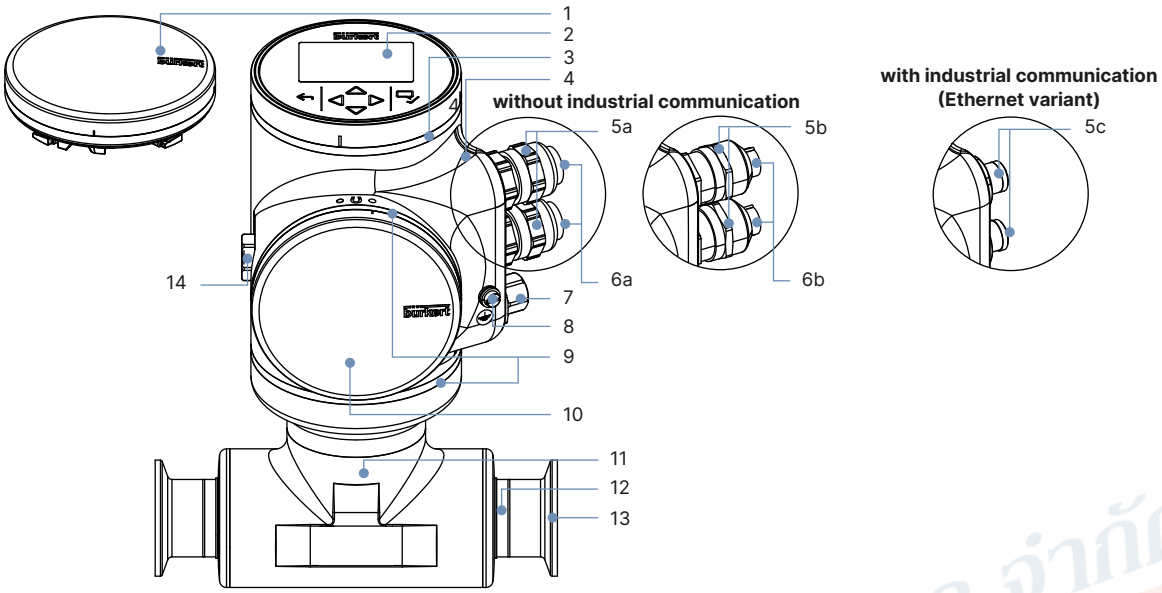
You want to ensure the reliability and durability of the materials in your individual application case? Verify your combination of media and materials on our website or in our resistApp.

Start chemical resistance check

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

3.2. Material specifications

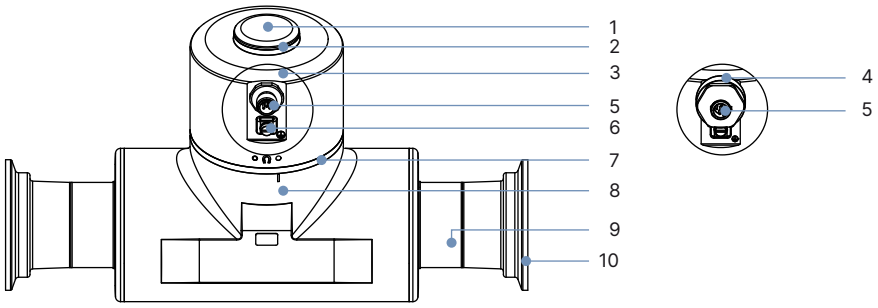
FLOWave L flowmeter



No.	Element	Material
1	Blind cover	Stainless steel 304/1.4301
2	Display module	Float glass, stainless steel 304/1.4301 and EPDM (ethylene propylene diene monomer) seal
3	Multi-colour LED behind seal (used for e.g. to indicate the status of the product, based on the NAMUR NE 107 standard)	VMQ silicone (methyl vinyl silicone)
4	Transmitter housing	Stainless steel 304/1.4301
5a	Cable glands	Body in nickel plated brass and seal in TPE (thermoplastic elastomer)
5b	Cable gland (full stainless steel or ATEX/IECEx/NEPSI variant)	Body in stainless steel 316L/1.4404 and seal in EPDM
5c	4-pin M12 female connectors with screwed plug	Body in stainless steel 304L/1.4307, contact support in PBT GF30 (polybutylene terephthalate 30 % glass fibre reinforced), seal in EPDM and screwed plug in stainless steel 316L/1.4404
6a	Blind plug	POM (polyoxymethylene, black)
6b	Blind plug (full stainless steel or ATEX/IECEx/NEPSI variant)	PA (polyamide, black) or PA6 (polyamide, red)
7	5-pin M12 male connector (wired to büS) with screwed plug	• Body in stainless steel 316L/1.4404, seal in NBR (nitrile butadiene rubber) if equipped with 5b (full stainless steel variant) or with 5c (Ethernet variant) or in VMQ silicone if equipped with 5b (ATEX/IECEx/NEPSI variant) and screwed plug in stainless steel 316L/1.4404 or • Body in nickel plated brass, seal in NBR if equipped with 5a and screwed plug-in nickel-plated brass
8	Functional earth	Cylinder screw, washer, washer spring in stainless steel A4 and blind rivet nut in stainless steel 1.4578/A4
9	Seal	VMQ silicone
10	Blind cover	Stainless steel 304/1.4301
11	Sensor housing	For sensor with process connection: • ≤ DN 50/2": stainless steel 304/1.4301 • > DN 50/2": stainless steel 316L/1.4435
12	Sensor measurement tube	Stainless steel 316L/1.4435 with low delta ferrite content
13	Process connection (either clamp connections or flange connections)	Stainless steel 316L/1.4435 with low delta ferrite content (machined in one piece with the measurement tube for DN 08, DN 65, DN 80, ⅜", 2½" and 3" and welded to the measurement tube for DN 15...DN 50 and ½"...2")
14	Pressure compensating element	Diaphragm in ePTFE (expanded polytetrafluoroethylene), O-ring in silicone 60 Shore A and body in stainless steel (316L/1.4404)

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

FLOWave S flowmeter



No.	Element	Material
1	Cover	Stainless steel 304/1.4301
2	Light guide for status display behind seal (used for e.g. indicating the status of the product, based on the NAMUR NE 107 standard)	PC (polycarbonate) and O-ring in EPDM (ethylene propylene diene monomer)
3	Transmitter housing	Stainless steel 304/1.4301
4	Adapter (HazLoc variant)	Stainless steel 304/1.4301 and O-ring between transmitter housing and adapter in EPDM
5	5-pin M12 male connector (wired to büS) or 8-pin M12 male connector (wired to büS as service interface [1.)] and 2 x AO/DO), with screwed plug	• Stainless steel 316L/1.4404 or 303/1.4305, seal between transmitter housing and M12 male connector in EPDM and screwed plug in plastic • HazLoc variant: stainless steel 316L/1.4404, seal between adapter and M12 male connector in NBR (nitrile butadiene rubber) and screwed plug stainless steel 316L/1.4404
6	Functional earth	• Cylinder screw, washer, washer spring: stainless steel A4 • Jumper of the ground terminal: stainless steel 304L
7	Seal	VMQ silicone (methyl vinyl silicone)
8	Sensor housing	For sensor with process connection: • ≤ DN 50/2": stainless steel 304/1.4301 • > DN 50/2": stainless steel 316L/1.4435
9	Sensor measurement tube	Stainless steel 316L/1.4435 with low delta ferrite content
10	Process connection (either clamp connections or flange connections)	Stainless steel 316L/1.4435 with low delta ferrite content (machined in one piece with the measurement tube for DN 08, DN 65, DN 80, ⅜", 2½"and 3" and welded to the measurement tube for DN 15...DN 50 and ½"...2")

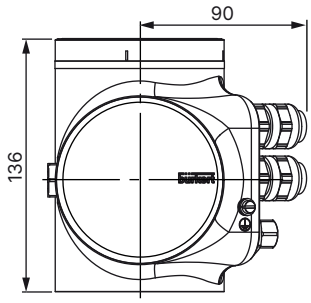
1.) A service büS connection is recommended for configuring the device with the Bürkert Communicator and not for the process.

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

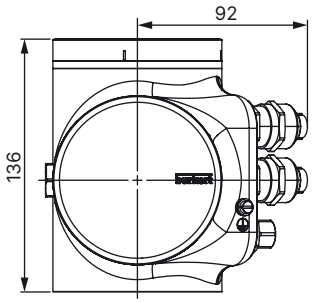
4. Dimensions

4.1. Transmitter of the FLOWave L flowmeter without industrial communication

Note:
Dimensions in mm, unless otherwise stated



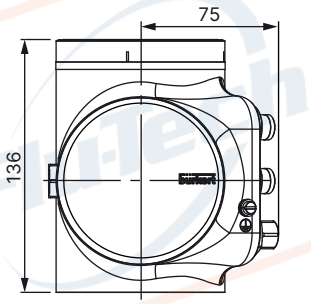
With 2 x M20 x 1.5 cable glands
in nickel plated brass
and 1 x 5-pin M12 male connector



With 2 x M20 x 1.5 cable glands
in stainless steel
and 1 x 5-pin M12 male connector
full stainless steel and ATEX/IECEx/NEPSI variants

4.2. Transmitter of the FLOWave L flowmeter with industrial communication (Ethernet variant)

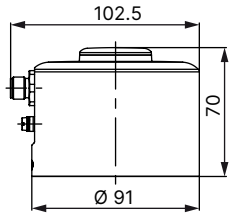
Note:
Dimensions in mm, unless otherwise stated



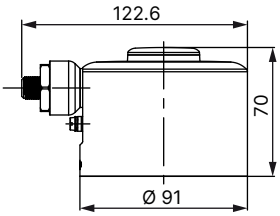
Ethernet variant
with 2 x 4-pin M12 female connectors
and 1 x 5 pin M12 male connector

4.3. Transmitter of the FLOWave S flowmeter

Note:
Dimensions in mm, unless otherwise stated



With 1 x 5- or 8-pin
male connector



With 1 x 5- or 8-pin
male connector
UL HazLoc variant

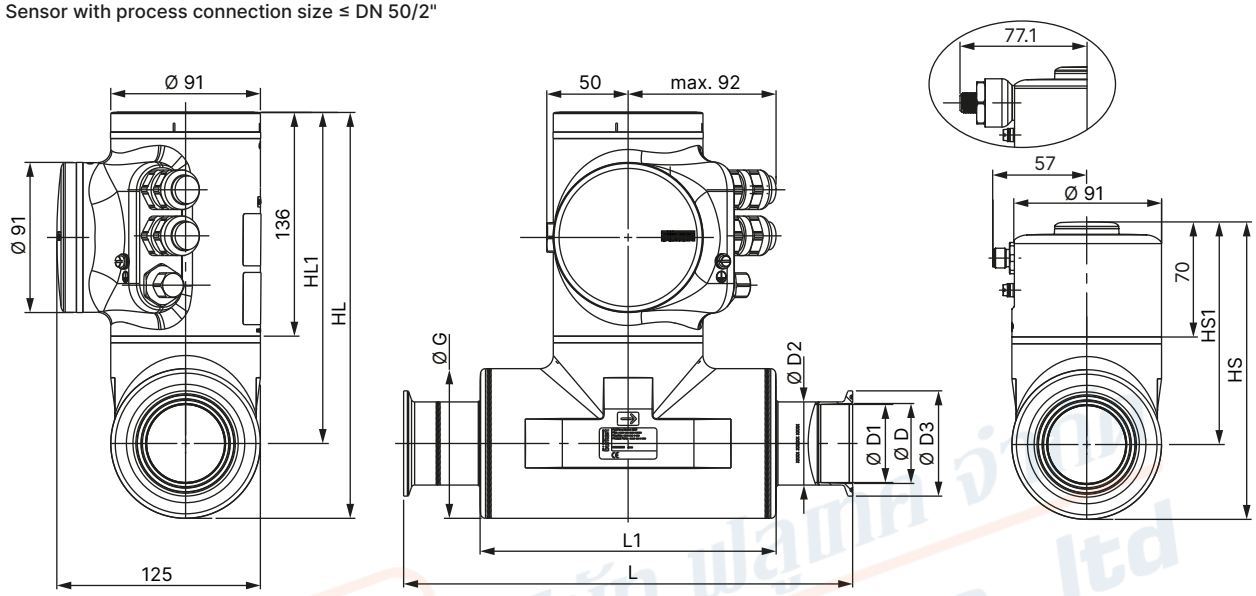
DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

4.4. Flowmeter with clamp connection

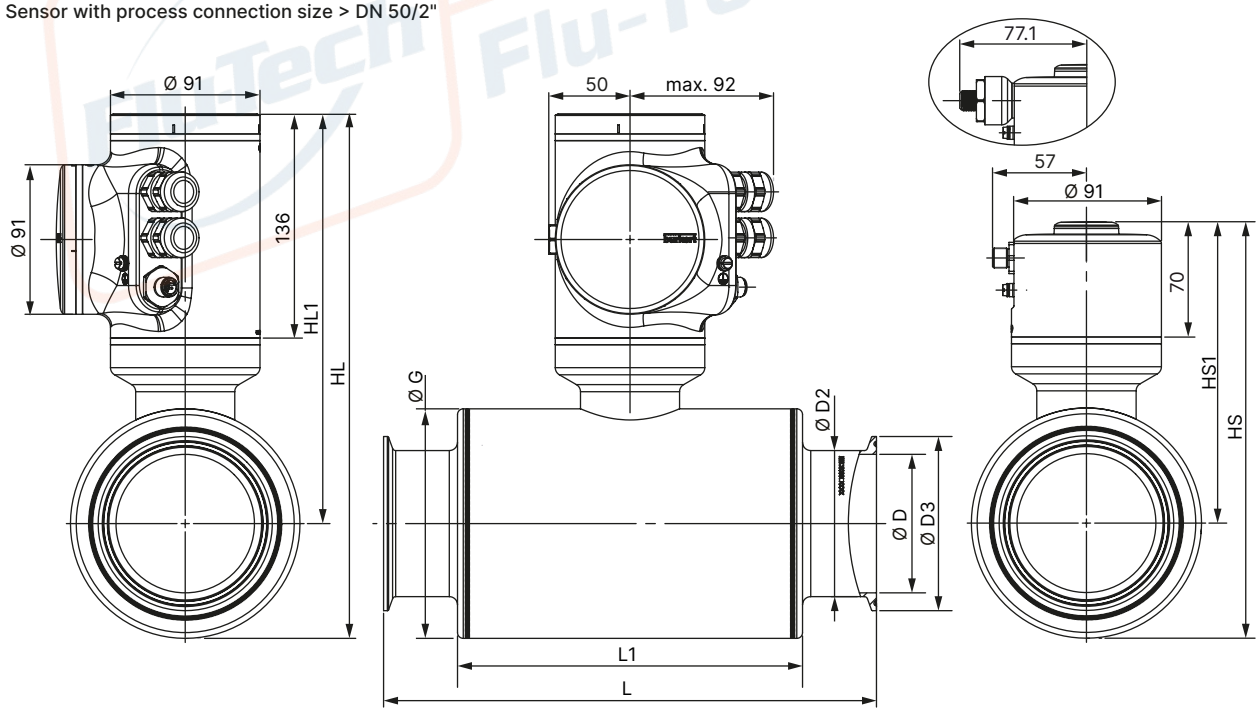
Note:

- Dimensions in mm, unless otherwise stated
- Clamp connection according to DIN 32676 series A, B or C, or SMS 3017

Sensor with process connection size ≤ DN 50/2"



Sensor with process connection size > DN 50/2"



Process connection and pipe size		HL	HS	HL1	HS1	L	L1	ØD	ØD1	ØD2	ØD3	ØG
[mm]	[inch]											
Clamp according to DIN 32676 series A and process pipe according to DIN 11866 series A (DIN 11850)												
08	–	250	184	220	154	158	105	10	10	14	34	60.3
15 1.)	–	250	184	220	154	166	105	16	15.75	19.05	34	60.3
25 1.)	–	250	184	220	154	236	105	26	22.1	25.4	50.5	60.3
40 1.)	–	250	184	200	134	326	180	38	34.8	38.1	50.5	91
50 1.)	–	250	184	200	134	306	180	50	47.5	50.8	64	91
65	–	321	255	251	185	300	210	66	66	70	91	139.7
80	–	321	255	251	185	300	210	81	81	85	106	139.7
Clamp according to DIN 32676 series B and process pipe according to DIN 11866 series B (ISO 1127)												
08	–	250	184	220	154	158	105	10.3	10.3	14	25	60.3
15	–	250	184	220	154	168	105	18.1	18.1	21.3	50.5	60.3
15 2.)	–	250	184	220	154	168	105	18.1	18.1	21.3	34	60.3
25	–	250	184	220	154	175	120	29.7	29.7	33.7	50.5	60.3
40	–	250	184	200	134	273	180	44.3	44.3	48.3	64	91
50	–	250	184	200	134	273	180	56.3	56.3	60.3	77.5	91
65	–	321	255	251	185	300	210	72.1	72.1	76.1	91	139.7
80	–	321	255	251	185	300	210	84.3	84.3	88.9	106	139.7
Clamp according to DIN 32676 series C and process pipe according to DIN 11866 series C (ASME BPE)												
–	⅜	250	184	220	154	158	105	7.75	7.75	14	25	60.3
–	½	250	184	220	154	158	105	9.4	9.4	14	25	60.3
–	¾	250	184	220	154	143	105	15.75	15.75	19.05	25	60.3
–	1	250	184	220	154	143	105	22.1	22.1	25.4	50.5	60.3
–	1½	250	184	200	134	273	180	34.8	34.8	38.1	50.5	91
–	2	250	184	200	134	273	180	47.5	47.5	50.8	64	91
–	2½	321	255	251	185	300	210	60.2	60.2	63.5	77.5	139.7
–	3	321	255	251	185	300	210	72.9	72.9	76.2	91	139.7
Clamp according to SMS 3017 and process pipe according to SMS 3008												
25 1.)	–	250	184	220	154	143	105	22.6	22.1	25.4	50.5	60.3
40 1.)	–	250	184	200	134	273	180	35.6	34.8	38.1	50.5	91
50 1.)	–	250	184	200	134	273	180	48.6	47.5	50.8	64	91

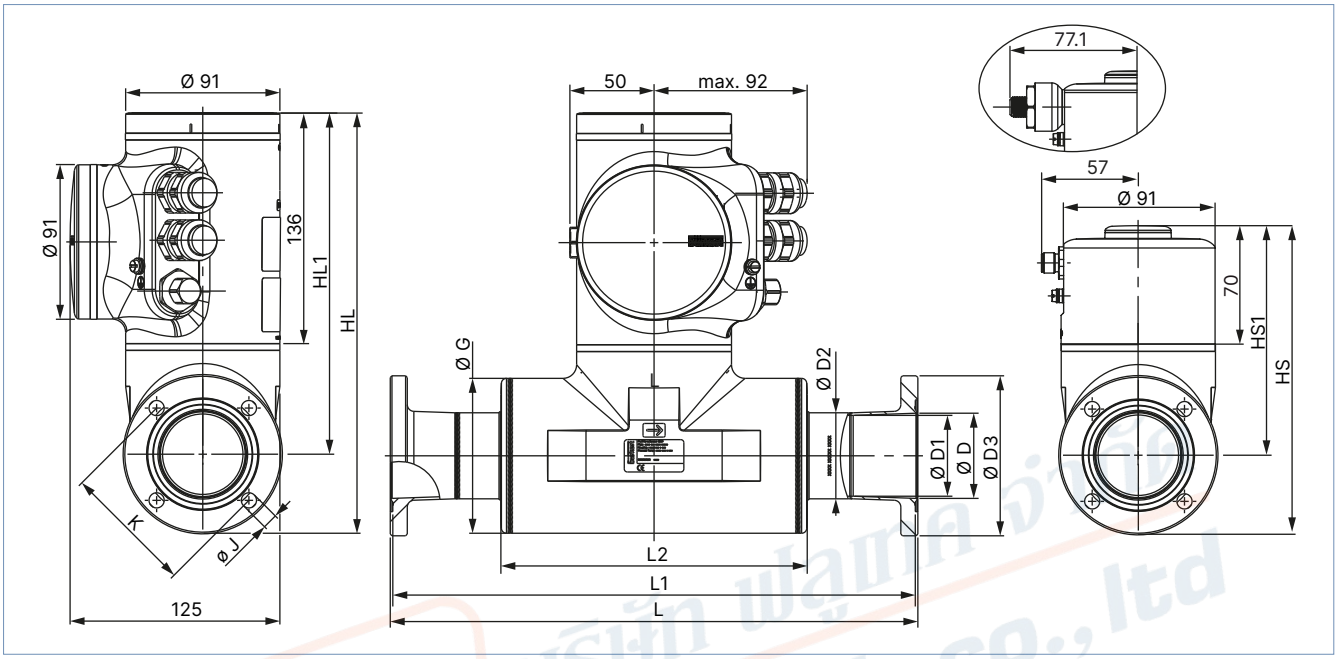
1.) DIN 32676 series A and SMS 3017 based on ASME BPE measurement tube sizes with adapted concentric clamp connection, design according to EHEDG DOC8 guidelines
2.) Similar to DIN 32676 series B, but with clamp connection 34.0 mm

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

4.5. Flowmeter with aseptic collar flange connection (BF)

Note:

- Dimensions in mm, unless otherwise stated
- Aseptic collar flange connection (BF) according to DIN 11864-2 form A series A, B or C



Process connection and pipe size		HL	HS	HL1	HS1	L	L1	L2	ØD	ØD1	ØD2	ØD3	ØG	ØJ	K
[mm]	[inch]														
Flange according to DIN 11864-2 series A and process pipe according to DIN 11866 series A (DIN 11850)															
15 [1.)]	–	250	184	220	154	166	163	105	16	15.75	19.05	59	60.3	9	42
25 [1.)]	–	250	184	220	154	240	237	105	26	22.1	25.4	70	60.3	9	53
40 [1.)]	–	250	184	200	134	330	327	180	38	34.8	38.1	82	91	9	65
50 [1.)]	–	250	184	200	134	310	307	180	50	47.5	50.8	94	91	9	77
65	–	321	255	251	185	300	297	210	66	66	70	113	139.7	9	95
80	–	350	283	265	199	300	297	210	81	81	85	133	168.3	11	112
Flange according to DIN 11864-2 series B and process pipe according to DIN 11866 series B (ISO 1127)															
08	–	250	184	220	154	158	155	105	10.3	10.3	14	54	60.3	9	37
15	–	250	184	220	154	173	170	105	18.1	18.1	21.3	62	60.3	9	45
25	–	250	184	220	154	190	187	120	29.7	29.7	33.7	74	60.3	9	57
40	–	250	184	200	134	278	275	180	44.3	44.3	48.3	88	91	9	71
50	–	250	184	200	134	265	262	180	56.3	56.3	60.3	103	91	9	85
65	–	350	283	265	199	300	29	210	72.1	72.1	76.1	125	168.3	11	104
80	–	350	283	265	199	300	197	210	84.3	84.3	88.9	137	168.3	11	116
Flange according to DIN 11864-2 series C and process pipe according to DIN 11866 series C (ASME BPE)															
–	½	250	184	220	154	158	155	105	9.4	9.4	14	54	60.3	9	37
–	¾	250	184	220	154	171	168	105	15.75	15.75	19.05	59	60.3	9	42
–	1	250	184	220	154	168	165	105	22.1	22.1	25.4	66	60.3	9	49
–	1½	250	184	200	134	278	275	180	34.8	34.8	38.1	79	91	9	62
–	2	250	184	200	134	278	275	180	47.5	47.5	50.8	92	91	9	75

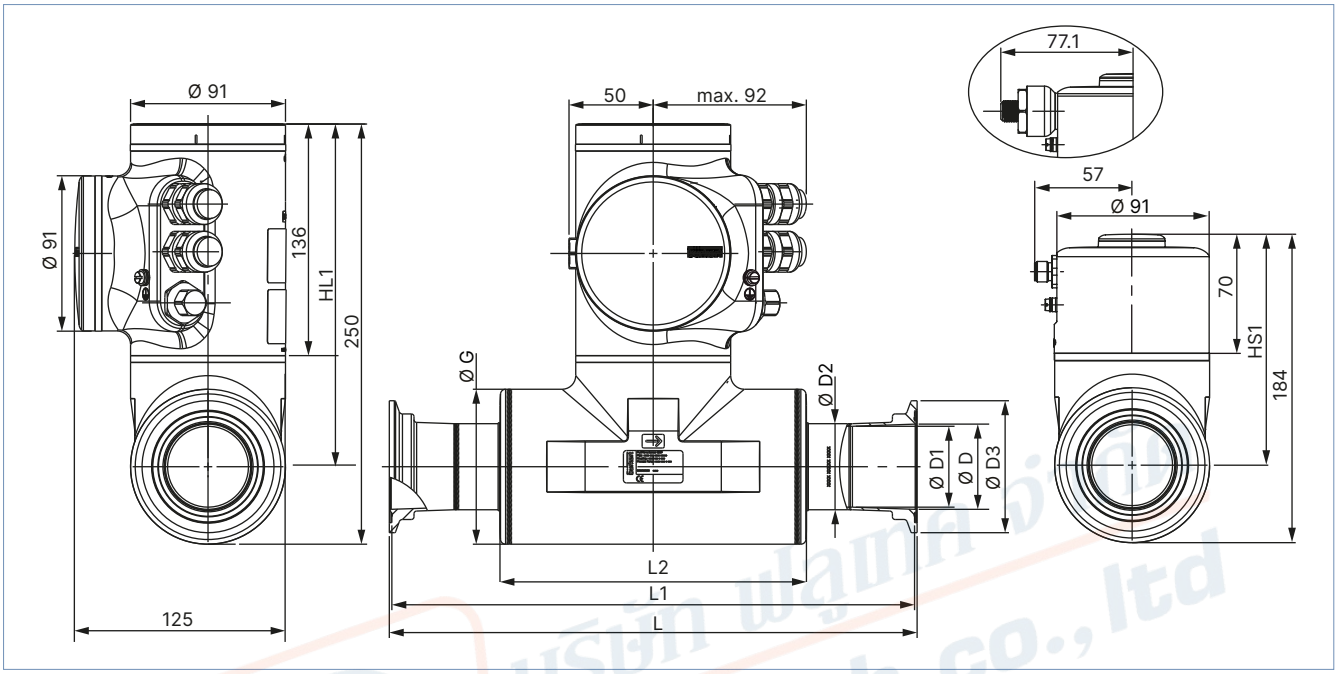
1.) DIN 11864-2 series A based on ASME BPE measurement tube sizes with adapted concentric flange connection, design according to EHEDG DOC8 guidelines

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

4.6. Flowmeter with aseptic collar clamp connection (BKS)

Note:

- Dimensions in mm, unless otherwise stated
- Aseptic collar clamp connection (BKS) according to DIN 11864-3 form A series A, B or C



Process connection and pipe size		HL1	HS1	L	L1	L2	ØD	ØD1	ØD2	ØD3	ØG
[mm]	[inch]										
Clamp according to DIN 11864-3 series A and process pipe according to DIN 11866 series A (DIN 11850)											
15 [1.)]	-	220	154	166	163	105	16	15.75	19.05	34	60.3
25 [1.)]	-	220	154	240	237	105	26	22.1	25.4	50.5	60.3
40 [1.)]	-	200	134	330	327	180	38	34.8	38.1	64	91
50 [1.)]	-	200	134	310	307	180	50	47.5	50.8	77.5	91
Clamp according to DIN 11864-3 series B and process pipe according to DIN 11866 series B (ISO 1127)											
08	–	220	154	158	155	105	10.3	10.3	14	34	60.3
15	-	220	154	169	166	105	18.1	18.1	21.3	34	60.3
25	-	220	154	190	187	120	29.7	29.7	33.7	50.5	60.3
40	-	200	134	280	277	180	44.3	44.3	48.3	64	91
50	-	200	134	271	268	180	56.3	56.3	60.3	91	91
Clamp according to DIN 11864-3 series C and process pipe according to DIN 11866 series C (ASME BPE)											
–	½	220	154	158	155	105	9.4	9.4	14	34	60.3
–	¾	220	154	167	164	105	15.75	15.75	19.05	34	60.3
–	1	220	154	164	161	105	22.1	22.1	25.4	50.5	60.3
–	1½	200	134	278	275	180	34.8	34.8	38.1	64	91
–	2	200	134	279	276	180	47.5	47.5	50.8	77.5	91

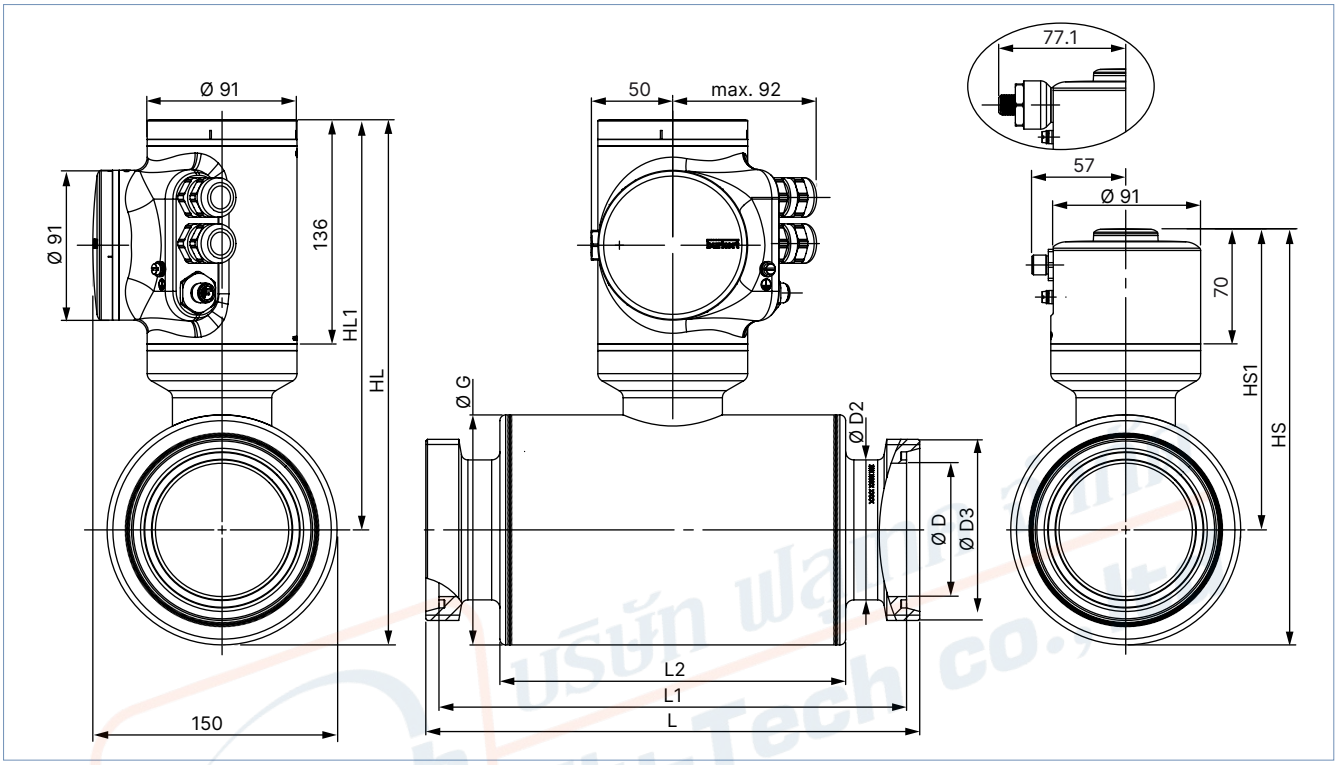
1.) DIN 11864-3 series A based on ASME BPE measurement tube sizes with adapted concentric clamp connection, design according to EHEDG DOC8 guidelines

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

4.7. Flowmeter with thread connection

Note:

- Dimensions in mm, unless otherwise stated
- Thread connection according to DIN 11851 series A



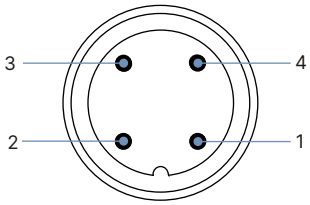
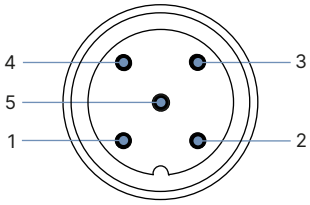
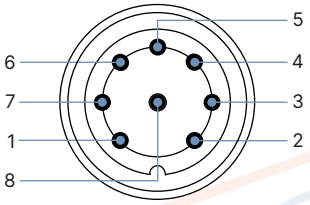
Process connection and pipe size [mm]	HL	HS	HL1	HS1	L	L1	L2	ØD	ØD2	ØD3 1.)	ØG
Thread according to DIN 11851											
65	321	255	251	185	300	284	210	66	70	Rd 95 x 1/6	139.7
80	321	255	251	185	300	284	210	81	85	Rd 110 x 1/4	139.7

1.) Thread according to DIN 405-1

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

5. Product connections

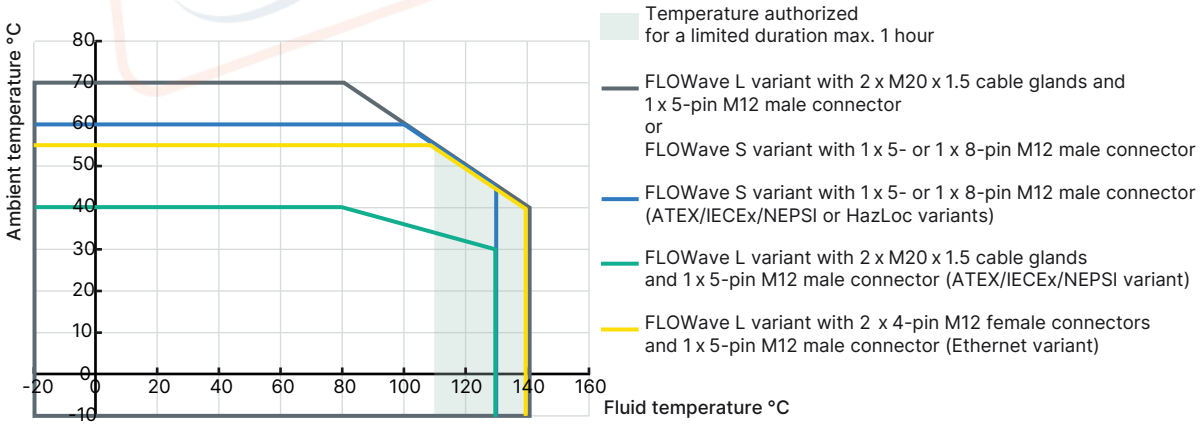
5.1. Electrical connection

Connector type	Connection definition		
4-pin M12 female connector (D-coded)	**Pin**	**Ethernet**	
	**1**	Transmit +	
	2	Receive +	
	3	Transmit -	
	4	Receive -	
5-pin M12 male connector (A-coded)	**Pin**	**Bürkert system bus (büS)**	**IO-Link**[1.]
	**1**	CAN shielding	L + (24 V DC, system supply)
	2	+ 24 V DC (12...35 V DC)	AO/DO (analogue or digital output)
	3	GND / CAN_GND	L - (0 V (GND), system supply)
	4	CAN_H	C/Q (IO-Link communication)
	5	CAN_L	Not connected
8-pin M12 male connector (A-coded)	**Pin**	**Service büS only and 2 configurable outputs AO/DO**	
	**1**	+ 24 V DC (12...35 V DC)	
	2	GND	
	3	CAN_L	
	4	CAN_H	
	5	1AO/DO - (analogue, digital or disabled output)	
	6	1AO/DO + (analogue, digital or disabled output)	
	7	2AO/DO - (analogue, digital or disabled output)	
	8	2AO/DO + (analogue, digital or disabled output)	

1.) Either a 4-wire or 5-wire cable can be used with a 5-pin M12 female connector (A-coded).

6. Performance specifications

6.1. Medium temperature diagram



DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

6.2. Measuring range table

Note:
In the following table, the term "full scale" refers to full scale of volume flow rate, i.e. the flow rate corresponding to 10 m/s flow velocity.

DN	Pipe standard	Flow velocity in sensor tube			
		in [m/s] in % of full scale	0.1 1	1 10	10 100
⅜"	ASME BPE	Volume flow rate range [m³/h]	0.017	0.17	1.7
½"	ASME BPE		0.025	0.25	2.5
08	DIN 11850		0.028	0.28	2.8
	ISO 1127		0.03	0.3	3.0
¾"	ASME BPE		0.07	0.7	7.0
15	DIN 11850		0.073	0.73	7.3
	ISO 1127		0.093	0.93	9.3
1"	ASME BPE		0.14	1.4	14
25	SMS 3008		0.14	1.4	14
	DIN 11850		0.19	1.9	19
	ISO 1127		0.25	2.5	25
1½"	ASME BPE		0.34	3.4	34
40	SMS 3008		0.36	3.6	36
	DIN 11850		0.41	4.1	41
	ISO 1127		0.56	5.6	56
2"	ASME BPE		0.64	6.4	64
50	SMS 3008		0.67	6.7	67
	DIN 11850		0.71	7.1	71
	ISO 1127		0.90	9.0	90
2½"	ASME BPE		1.02	10.2	102
65	DIN 11850		1.23	12.3	123
	ISO 1127		1.47	14.7	147
3"	ASME BPE		1.50	15.0	150
80	DIN 11850		1.85	18.5	185
	ISO 1127		2.00	20.0	200

6.3. Refresh time table

The refresh time is the minimum time needed to update a measurement value. The refresh time has no effect on the damping of the measured values. The refresh time of the temperature values is a constant but the refresh time of the other measurement values can be adapted to the process.

Selectable mode	Volume flow rate	Mass flow rate	Density	Temperature
Very short	~ 25 ms	~ 25 ms	1 s	~ 0.1 s
Short	~ 40 ms	~ 40 ms	1 s	
Long	~ 75 ms	~ 75 ms	150 ms	

7. Product installation

7.1. Installation notes

Flow measurement

Note:
The device is not suitable for use in gaseous media and steam. However, their flow does not have any negative effect on the device or its operation. Other liquids flowing through again afterwards are measured correctly as before.

The factory calibration of the FLOWave is done under reference conditions with inlet (40 x DN) and outlet (1 x DN) distances and the appropriate internal diameter of the pipes.
The deviations from reference conditions can be adjusted using the built-in adjustment procedures (K factor adjustment, teach-in procedure, etc.). For example, under the condition of an inlet length of 10 x DN after an elbow, a special correction K factor can be applied to the

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

FLOWave flow meter to achieve a measurement deviation of ±1% of the measured value for flow velocities ≥ 1 m/s to full scale. We can support you, if necessary, do not hesitate to contact us.
The device can be installed into either horizontal, inclined or vertical pipes. For optimal operation, the flowmeter is best installed in a vertical pipe to prevent air or gas bubbles in the measurement pipe. **For proper operation always ensure a totally filled measurement tube.**

Conformity to 3-A and EHEDG requires an angle of at least 5° (for SMS or series A connections) or 3° (all others available connections) against horizontal to ensure complete draining, however, this not necessary for proper operation of the FLOWave.

Further information on the installation can be found in the operating instructions available on our website under the "User Manuals" heading for **Type 8098** ▸.

The suitable pipe size can be selected using the diagram for selecting the nominal diameter of the pipe. See chapter "6.2. Measuring range table" on page 25.

7.2. Selection of the nominal diameter

The following graph is used to determine the appropriate DN of the pipe and fitting for the application, according to the flow velocity and the flow rate. On the chart, the intersection of flow velocity and flow rate gives the appropriate diameter.

Example 1:
Flowmeter with process connection according to DIN 32676 series B (pipe ISO 1127) or DIN 11864-2 form A series B (pipe ISO 1127)

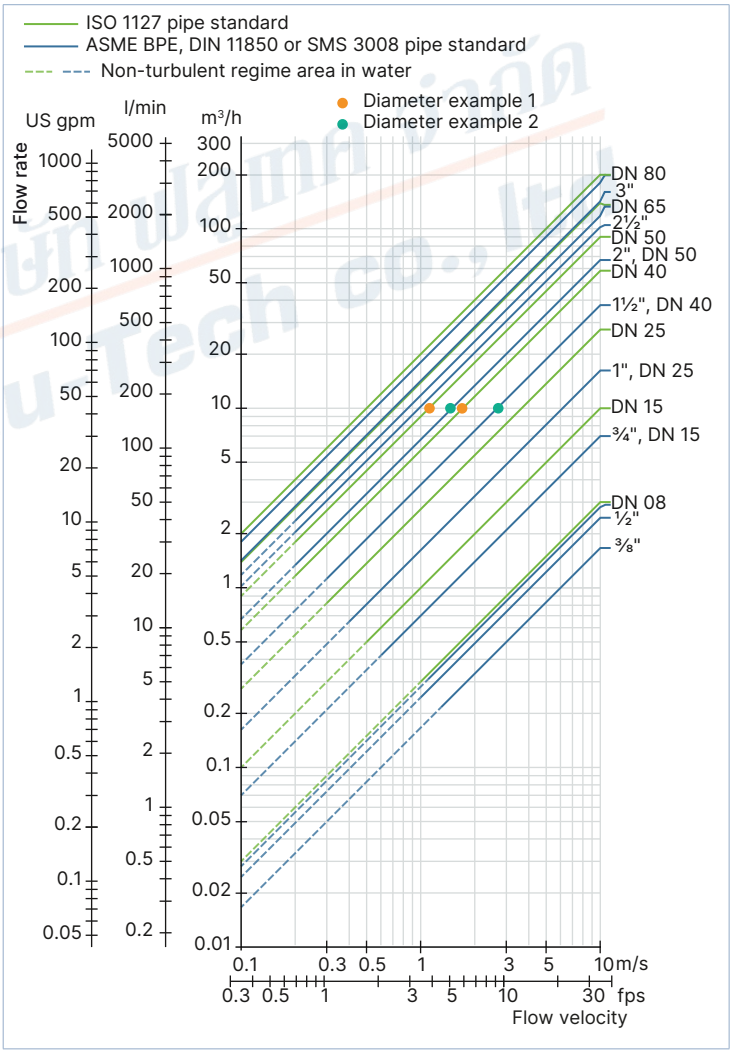
- Nominal flow: 10 m³/h
- Optimal flow velocity: 1...3 m/s

Result: select a pipe size of DN 40 or DN 50.

Example 2:
Flowmeter with process connection according to DIN 32676 series A (pipe DIN 11850) or DIN 11864-2 series A (pipe DIN 11850)

- Nominal flow: 10 m³/h
- Optimal flow velocity: 1...3 m/s

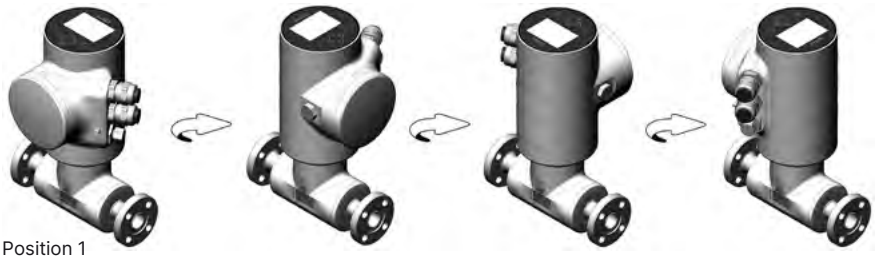
Result: select a pipe size of DN 40 or DN 50.



7.3. Mounting options

FLOWave L flowmeter

The product is delivered as described in position 1 in the picture below. The position of the transmitter can be changed in 90° steps. The position of the display module and the blind cover can also be changed in steps of 90°both on the top of the unit and on the front face.



Position 1

For safety reasons the display module and blind cover on the top or front are locked. The display module and blind cover can be unlocked with a magnetic key which is included in the delivery of each device.

FLOWave S flowmeter

The product is delivered as described in position 1 in the picture below. The position of the transmitter can be changed in 90° steps. For safety reasons the transmitter is locked. The transmitter can be unlocked with a magnetic key which is included in the delivery of each device.

Position 1

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

8. Product operation

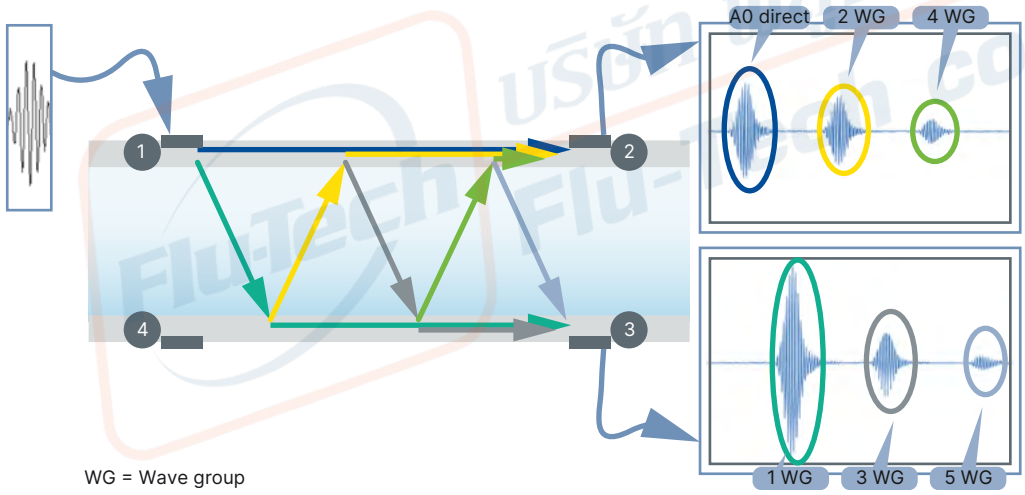
8.1. Measurement principle

The technology used is based on SAW (Surface Acoustic Waves). These waves are similar to the sound waves used in sonar or mobile phone filtering technology, where waves propagate along a surface and can couple into a fluid to detect or analyze objects.
To visualize the propagation phenomenon, refer to our "FLOWave SAW Industrial Animation" video, which you can find on our website under the "Videos" heading **Type 8098** ▶.

In the case of FLOWave it is a miniaturized signal, not running on the surface of the earth but on a measurement tube. FLOWave uses so called interdigital transducers which are placed on flattened areas of the tube surface. Each one acts as emitter as well as receiver. Two of them (nos. 1 and 4) emit forward, in the direction of the liquid flow, the others (nos. 2 and 3) backwards, i.e. in the opposite direction to the direction of flow. The propagation time is measured from emitter to receiver. The difference between the forward and backward propagation time of the waves is proportional to the volume flow rate.

The high-performance measurement is achieved by the following aspects:

- Each emitter sends multiple signals that are received on two other receivers
- The results are based on the reception of the signals that pass through the liquid one or more times.
- Several measurements can be performed based on the collected information. Many properties of the liquid can be derived, including the flow velocity, the fluid density, the fraction of the transmitted signal (acoustic transmission factor), and the so-called differentiation factor (see following), as well as information about the presence of gas bubbles or solid parts.
- Mass flow is calculated from fluid density and volume flow.
- Mass flow and density measurements are an option on standard FLOWave flowmeters, which requires adjustment and calibration during manufacture. It is therefore necessary to specify whether or not the device is to be equipped with these features when ordering the device.



WG = Wave group

This figure shows, as an example, the reception signals when interdigital transducer 1 is transmitting.
The emitter excitation produces the SAW with a frequency of more than 1 MHz.

As a result of the emission of these waves, the following effects occur:

- A wave propagates along the surface of the tube (see blue line).
- A wave is emitted (see teal green line) and passes through the liquid towards the opposite side of the tube at a certain angle, which depends mainly on the speed of propagation on the surface of the tube and in the liquid.
- Upon reaching the opposite side of the tube, two effects take place.
  - A wave is triggered in the tube and propagates (see green line) to receiver 3
  - A wave is triggered in the liquid (see yellow line) and passes through it again to the opposite wall of the tube. The analysis of the transmitted and received waves allows deriving the process values (velocity, density, flow rates).

These effects are repeated and thus generate the many signals received, which are differentiated in the image with different colours.

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

8.2. Special functions

Note:
DF, ATF, density, mass flow and concentration features must be selected upon initial order of device.

For the detection of gas bubbles and solid particles the device (from firmware version 01.05.00) includes a so called acoustic transmission factor (ATF) with a measuring range of 0...120 %, whose value is constantly recorded and directly influenced by the presence of gas bubbles and solid particles. Only stable ATF signals ranging above typically 10% are accepted as valid for the computation of the other process values.
A differentiation factor (DF), with a measuring range of 0.8...1.3, is available for the detection and differentiation of liquids. This continuously measured value, which uses water as a reference fluid, is temperature-compensated and so its value is representative in a tight value range for each liquid. The changes in value of this process measurement enable differentiation between different liquids.
Beer wort extract concentration measurement ("°Plato" i.e. original gravity measurement) requires the activation of DF and ATF, on which it is based.
Before SW version 05.00.00, the differentiation factor was named density factor. As the density option has been added, the name has been changed to avoid confusion.

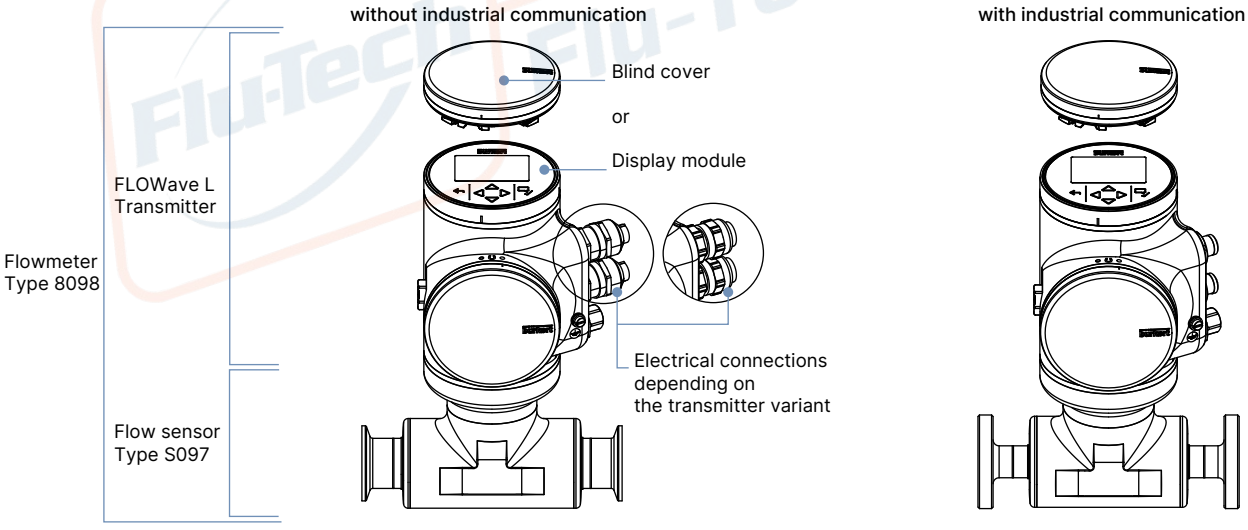
9. Product design and assembly

9.1. Product assembly

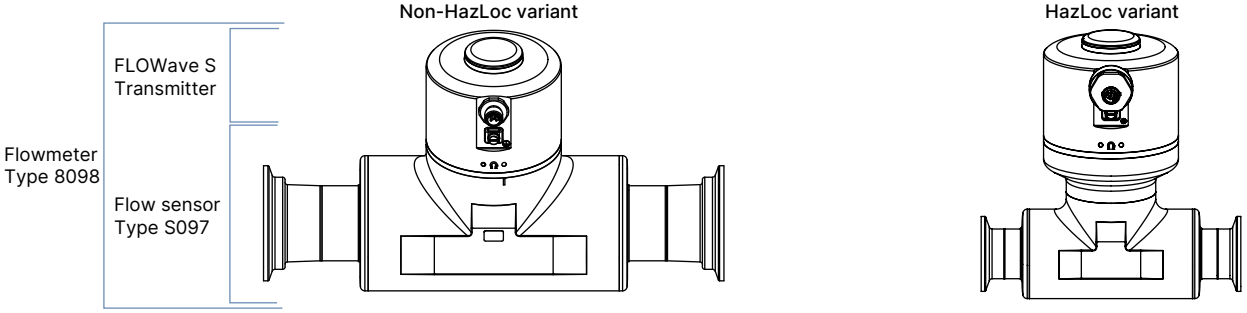
The 8098 flowmeter consists of a S097 flow sensor and a FLOWave L transmitter (variant FLOWave L flowmeter) or FLOWave S transmitter (variant FLOWave S flowmeter).
The flow sensor includes the measurement tube equipped with interdigital transducers, the sensor housing and the process connections in accordance to the standards ISO, ASME BPE, DIN, SMS. At present the sensor size ranges from DN 08 to DN 80 or from ⅜" to 3".

The FLOWave L flowmeter is available with or without display. The high-resolution display includes a capacitive working keypad for all interactive user actions, guided by a user friendly menu system. The output signals include one analogue output and one digital output, while a third output signal can be switched between analogue and digital through parametrisation. Electrical connection is done on push-in connectors via two cable glands and/or one M12 connector.
The FLOWave S flowmeter is only available without display. The electrical connection is made via an M12 male connector.

FLOWave L flowmeter



FLOWave S flowmeter



10. Product accessories

10.1. USB-büS interface set Type 8923

Note:
To configure a device without a display, use the USB-büS interface set Type 8923 and the Bürkert Communicator software Type 8920. For the FLOWave S with 2 outputs, the büS adapter cable, Article no. 773286, is also required.

See "11.7. Ordering chart accessories" on page 34 for ordering information and **Software manual Type 8920** ▸ for more information.

Accessories	No.	Description
USB-büS interface set 1  	**1**	Quick-Start
	2	Power supply: 100...240 V AC/24 V DC 1 A and adapters for power supply worldwide use
	3	büS terminating resistor on büS Y-splitter
	4	5-pin M12 male connector wired on free end cable, cable length: 0.2 m
	5	büS connection cable with 5-pin M12 male connector, micro USB B plug, cable length: 0.3 m
	6	büS adapter with 5-pin M12 male connector, A-coded to 5-pin M12 male connector, A-coded
	7	büS stick (USB to büS/CANopen adapter)
	8	büS service cable with 5-pin M12 female connector, mini USB plug and circular female connector for power supply, cable length: 0.7 m
	9	Magnetic key
USB-büS interface set 2  		The Bürkert Communicator software can be downloaded from our website under the "Software" heading of **Type 8920** ▸.

11. Ordering information

11.1. Bürkert eShop

Bürkert eShop – Easy ordering and quick delivery

You want to find your desired Bürkert product or spare part quickly and order directly? Our online shop is available for you 24/7. Sign up and enjoy all the benefits.

Order online now

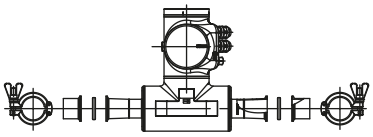
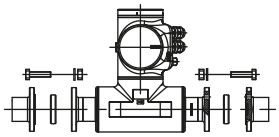
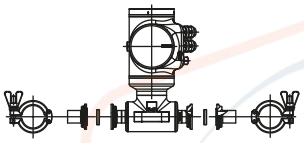
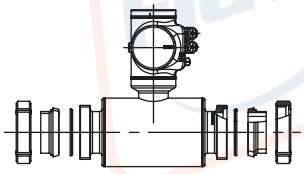
DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

11.2. Recommendation regarding product selection

Note:

- The installation of the flowmeter in a pipe requires the use of counter-connection, seals, fixing elements, etc. depending on the used norm.
- The drawings show the installation with a FLOWave L variant of the flowmeter. The installation is also valid for the FLOWave S variant.

For instance, with middle-sized devices:

Connection	Description
	**With clamp connection according to DIN 32676 series A** To insert a FLOWave DN 40 with clamp connections according to DIN 32676 series A (with Ra < 0.8 µm) to a pipe according to DIN 11866 series A (DIN 11850), the **correct adapters to be selected and separately ordered** are for instance • 2 x **BBS-25** clamp ferrules, Article no. 747237, see **data sheet Type BBS-25** ▸ for more information • 2 x the appropriate seals (not provided) • 2 x the corresponding clamps, Article no. 731164
	**With aseptic collar flange (BF) according to DIN 11864-2 form A** To insert a FLOWave DN 40 with collar flanges according to DIN 11864-2 series B (with Ra < 0.8 µm) to a pipe according to DIN 11866 series B (ISO 1127), the **correct adapters to be selected and separately ordered** are for instance • 2 x **BBS-06** aseptic groove flange, Article no. 731860, see **data sheet Type BBS-06** ▸ for more information • 2 x the appropriate seals (not provided) • 8 x the corresponding screws, flat washers and nuts (please refer to the DIN 11864-2 standard)
	**With aseptic collar clamp (BKS) according to DIN 11864-3 form A** To insert a FLOWave 1" with hygienic collar clamps according to DIN 11864-3 series C (with Ra < 0.8 µm) to a pipe according to DIN 11866 series C (ASME BPE), the **correct adapters to be selected and separately ordered** are for instance • 2 x **BBS-05** aseptic groove clamp, Article no. 730272, see **data sheet Type BBS-05** ▸ for more information • 2 x the appropriate seals (not provided) • 2 x the corresponding clamps, Article no. 731164
	**With thread according to DIN 11851** To insert a FLOWave with thread according to DIN 11851 series A to a pipe according to DIN 11850, suitable adapters (not available from Bürkert) are required, for instance • 2 x the conical ferrule • 2 x the appropriate DIN 11851 seal • 2 x the corresponding round slotted nut

11.3. Bürkert product filter

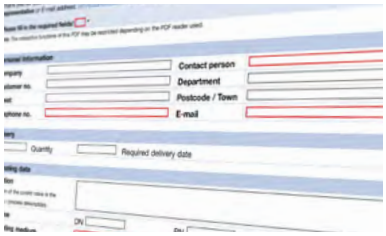
Bürkert product filter – Get quickly to the right product

You want to select products comfortably based on your technical requirements?
Use the Bürkert product filter and find suitable articles for your application quickly and easily.

Try out our product filter

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

11.4. Bürkert Product Enquiry Form



Bürkert Product Enquiry Form – Your enquiry quickly and compactly

Would you like to make a specific product enquiry based on your technical requirements? Use our Product Enquiry Form for this purpose. There you will find all the relevant information for your Bürkert contact. This will enable us to provide you with the best possible advice.

Fill out the form now

11.5. Bürkert 3D Model

Bürkert 3D Model - Interactive Animation

3D Model and Interactive Animation are available on the website of the flowmeter Type 8098.

See **website of the Type 8098** ▸ under "Applications and Tools".

11.6. Ordering chart

Note:

- The articles listed in the table below represent a selection of the available variants.
  - Requesting a product according to your requirements is described in the section "Further variants on request" on page 33.
  - Alternatively, you can also select products as shown under "Options for selecting/filtering a product" on page 33.
- The variants listed are equipped with clamp connection according to DIN 32676 series C for pipe according to DIN 11866 series C (ASME BPE), the special functions ATF (acoustic transmission factor) and DF (differentiation factor).

Diameter 1.)	Maximal flow rate	Dimensions 2.) D2 x s; D3	Surface quality		Approval and conformity			Article no.
			Housing, outer surface of measurement tube	Inner surface of measurement tube				
[inch]	[m³/h]	[mm]	[µm]	[µm]	3-A (28-06)	EHEDG 3.)	UL	
FLOWave L variant with display (2 cable glands M20 ×1.5 made of nickel plated brass and 1 × 5-pin M12 male connector)								
1	14	25.4 × 1.65; 50.5	Ra < 1.6	Ra < 0.4	Yes	Yes	No	566212
FLOWave S variant (1 × 5-pin M12 male connector)								
1	14	25.4 × 1.65; 50.5	Ra < 1.6	Ra < 0.8	Yes	Yes	No	573086
FLOWave S variant (1 × 8-pin M12 male connector)								
1	14	25.4 × 1.65; 50.5	Ra < 1.6	Ra < 0.8	Yes	Yes	No	571801

1.) Diameter = process connection size and pipe size

2.) Dimensions of clamp connection: D2 = external diameter (sensor housing side), s = wall thickness, D3 = external diameter (clamp connection side), see chapter "4.4. Flowmeter with clamp connection" on page 19.

3.) The EHEDG compliance is only if used in combination with seals from Combifit International B.V.

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

Further variants on request

Process connection [1.)]
- For pipe DIN 11850:
  - Clamp DIN 32676 (DN 08...DN 80)
  - Clamp DIN 11864-3 (DN 15...DN 50)
  - Flange DIN 11864-2 (DN 15...DN 80)
  - Thread DIN 11851 (DN 65...DN 80)
- For pipe ISO 1127:
  - Clamp DIN 32676 (DN 08...DN 80)
  - Clamp DIN 11864-3 (DN 08...DN 50)
  - Flange DIN 11864-2 (DN 08...DN 80)
- For pipe ASME BPE:
  - Clamp DIN 32676 (⅜...3 inch)
  - Clamp DIN 11864-3 (½...2 inch)
  - Flange DIN 11864-2 (½...2 inch)
- For pipe SMS 3008: SMS 3017 (DN 25...DN 50)

Material
- With inner surface of measurement tube
  - Ra < 0.8 µm (0.76 µm = 30 µin., ASME BPE SF3)
  - Ra < 0.4 µm (0.38 µm = 15 µin., ASME BPE SF4) according to ISO 4288, electro-polished

Additional
- Display
- Density and mass flow measurement
- Differentiation factor (DF)
- Acoustic transmission factor (ATF)
- Original gravity measurement (degree Plato)
- EtherNet/IP, PROFINET, Modbus TCP, EtherCAT®
- IO-Link

Orifice
- 08...80 mm
- ⅜...3 inch

Approval
- ATEX/IECEx or ATEX/IECEx/NEPSI
- UL Listed
- UL Listed for use in hazardous locations (HazLoc)
- CRN 0C21751 declaration [2.)]

Electrical connection
- Cable gland in stainless steel
- Cable gland in nickel plated brass
- 1 × 5-pin M12 male connector
- 1 × 8-pin M12 male connector

1.) Only for the available combinations of pipe standards, process connections, and DN/orifice sizes as detailed in the chapter "4. Dimensions" on page 18.
2.) Only for a flowmeter with a process connection size of ⅜"...3" according to ASME BPE pipe norm.

Options for selecting/filtering a product
- Check the available article no. listed in the Bürkert eShop, see chapter "11.1. Bürkert eShop" on page 30
- Use the Bürkert product filter , see chapter "11.3. Bürkert product filter" on page 31 or
- Use the product enquiry form, see chapter "11.4. Bürkert Product Enquiry Form" on page 32.

DTS 1000270652 EN Version: AE Status: RL (released | freigegeben | valide) printed: 14.01.2026

11.7. Ordering chart accessories

Description		Article no.
Type ME31 display module		265468
Blind cover in stainless steel 304/1.4301		265467
 Magnetic key for unlocking		690309
System Connect		
Type ME63 Gateway/Interface		
Industrial Ethernet gateway		346845
Type ME43 Gateway/Interface		
Industrial Ethernet gateway (PROFINET IO, EtherNet/IP, Modbus TCP, EtherCAT®)		307390
PROFIBUS gateway (PROFIBUS DPV1)		307393
Type ME61 Display		
FieldConnect 3.5" display (8.9 cm)		368544
EDIP Accessories		
USB-büS interface set		
 USB-büS interface set 1 (Type 8923) Further information can be found in chapter "10. Product accessories" on page 30.		772426
USB-büS interface set 2 (Type 8923) Further information can be found in chapter "10. Product accessories" on page 30.		772551
Connectors		
büS M12 female connector [1.], 5-pin, straight, A-coded		772416
büS M12 male connector [1.], 5-pin, straight, A-coded		772417
büS M12 female connector [1.], 5-pin, angled, A-coded		772418
büS M12 male connector [1.], 5-pin, angled, A-coded		772419
büS Y-distributor [2.] (M12 female connector, 5-pin to M12 male and female connectors, 5-pin)		772420
büS Y-distributor [2.] with power interrupt (M12 female connector, 5-pin to M12 male and female connectors, 5-pin)		772421
büS adapter [2.] (M12 male connector, 5-pin, A-coded to M12 male connector, 5-pin, A-coded)		772867
büS terminating resistor [2.] 120 Ω, M12 male connector, 5-pin		772424
büS terminating resistor [2.] 120 Ω, M12 female connector, 5-pin		772425
Connectors with cable		
Adapter cable with M12 female connector, 8-pin to M12 male connector, 5-pin	0.5 m	773286
M12 female connector [2.], 5-pin, angled, moulded on büS cable, with open leads	0.7 m	772626
M12 female connector [2.], 5-pin, straight, moulded on büS cable, with open leads	1 m	772409
	3 m	772410
	5 m	772411
	10 m	772412
M12 male connector [2.], 5-pin straight and micro USB connector, moulded on büS cable	0.3 m	773254
M12 female connector, 8-pin, straight, moulded on büS cable, with open leads	2 m	919061
Extensions		
 M12 female and male connectors [2.], 5-pin, straight, moulded on büS cable, shielded	0.1 m	772492
	0.2 m	772402
	0.5 m	772403
	1 m	772404
	3 m	772405
	5 m	772406
	10 m	772407
	20 m	772408
Power supply unit for standard rail Type 1573		
100...240 V AC / 24 V DC, 1 A (Class 2 according to NEC)		772361
100...240 V AC / 24 V DC, 2 A (Class 2 according to NEC)		772362
100...240 V AC / 24 V DC, 3.8 A (Class 2 according to NEC)		772898
100...240 V AC / 24 V DC, 10 A		772698

1.) The connector is also suitable for IO-Link communication.
2.) The accessory is not suitable for IO-Link communication.

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