Sensors of the series SONOFLOW CO.56/xxx – designed as clamp-on-sensors – measure the flow rate of liquids and detect bubbles in plastic tubes of different diameters or materials within a few milliseconds.

The flow-bubble sensors have no contact to the medium or product and are suitable for applications in fields with strict hygienic standards e.g. the medical industry. The ultrasonic sensors with complete built-in electronics can be easily integrated into machines or apparatuses.

In addition to our standard sensors, we also manufacture customer-specific solutions regarding housing materials, colors, mechanical dimensions, output specifications and parameter settings.

Overview sensors

Type SONOFLOW	Order-No.	Max. flow range	Measuring channel (☐ CH = CW)	Dimensions (L × W × H)	Weight
CO.56/035	200 04 0009	3 000 ml/min	3.5 mm	44 × 44 × 28 mm	120 g
CO.56/044	200 04 0010	5 000 ml/min	4.4 mm	44 × 44 × 30 mm	125 g
CO.56/060	200 04 0011	6 000 ml/min	6.0 mm	44 × 44 × 32 mm	130 g
CO.56/080	200 04 0012	8 000 ml/min	8.0 mm	44 × 44 × 34 mm	135 g
CO.56/120	200 04 0013	12 000 ml/min	12.0 mm	44 × 44 × 36 mm	140 g
CO.56/140	200 04 0014	14 000 ml/min	14.0 mm	44 × 44 × 38 mm	145 g

Tubing properties

The selection of the right sensor depends on tubing dimensions as well as on tubing properties. If possible, please provide us with a tubing sample (minimum length 50 cm).

Type SONOFLOW	Tubing OD	Tubing ID	Material and product ID of tube manufacturer
CO.56/035	4.0 mm	3.0 mm	PVC, 3500304 [1]
CO.56/044	5.0 mm	3.0 mm	PVC, 702101031099 [2]
CO.56/060	7.0 mm	5.0 mm	PVC, 702101051099 [2]
CO.56/080	9.0 mm	6.0 mm	PVC, 702101061599 [2]
CO.56/120	14.0 mm	10.0 mm	PVC, 702101102050 [2]
CO.56/140	16.0 mm	12.0 mm	PVC, 702101122050 [2]

Manufacturer:
1) Deutsch & Neumann GmbH, 10585 Berlin (Germany) | 2) ESSKA.de GmbH, 20537 Hamburg (Germany);

Other materials and diameters upon request. Contact our service.

Calibration and conditions of use

Parameter	Specifications
Calibration	Sensors are factory calibrated under the following conditions: ▪ PVC tubing as listed in table above (Tubing properties) ▪ Water at 23 °C ± 2 °C ▪ Warm up: at least 30 min (to compensate thermal effects) ▪ Zero calibration just before measurement procedure ▪ Normal pressure Calibration to customer tubing, fluid, flow range, temperature, etc. on request.
Media	Water, saline, human blood or other acoustically transparent liquids ⚠ **NOTE**: SONOTEC does not operate with blood within the company premises. With respect to calibration, the difference between water and saline solution is negligible. For applications with blood some special factors/settings can be modified after calibration (→ observe the instruction in the next chapter.) ⚠ **CAUTION:** If the sensor is applied to measure the flow of sensitive liquids, like human blood, the maximum flow velocity of fluid inside the tubing and inside the measuring channel shall be considered carefully. The blood cells could be harmed or damaged if transported at high velocities. It is the responsibility of the manufacturer of medical device to assess if there is a potential risk.
Conditions of use	⚠ **CAUTION:** The sensors need to be adjusted individually to special operating conditions ▪ in case of operation with tubing not listed in the table ‘Tubing properties’, because the accuracy of flow measurement and bubble detection can be affected and ▪ if the sensor is intended to measure with human blood at normally 37 °C and hemoglobin between 6 g/dl to 12 g/dl. Contact our service for details! ⚠ **NOTE:** Generally, the sensors are able to measure liquids in an extended operating temperature range of +1 to +50 °C and to measure blood within the ranges of Hb = 0 to 6 g/dl or Hb = 12 to 18.5 g/dl, but with limited accuracy only.

Flow accuracy

Type SONOFLOW	Flow measurement accuracy after 30 min sensor warm-up, no thermal gradients, trained staff for removing / insertion of tubing.	
CO.56/035	< 300 ml/min: **± 15 ml/min**	≥ 300 ml/min: **± 5 %** [3]
CO.56/044	< 500 ml/min: **± 25 ml/min**	≥ 500 ml/min: **± 5 %** [3]
CO.56/060	< 600 ml/min: **± 30 ml/min**	≥ 600 ml/min: **± 5 %** [3]
CO.56/080	< 800 ml/min: **± 40 ml/min**	≥ 800 ml/min: **± 5 %** [3]
CO.56/120	<1 200 ml/min: **± 60 ml/min**	≥ 1 200 ml/min: **± 5 %** [3]
CO.56/140	< 1 400 ml/min: **± 70 ml/min**	≥ 1 400 ml/min: **± 5 %** [3]

3) of reading

Accuracy depends on tubing properties, flow regime, temperature, fluid properties and other conditions, e. g. type of pumps. Absolute accuracy is influenced by zero stability, resolution and zero offset effects.
Note: Ethylene oxide sterilization, electron beam sterilization or gamma sterilization of the tubing may impact its material properties, potentially affecting sensor readings. Recalibration may be required after tubing sterilization.

Bubble detection and sensitivity

If air bubbles sizes larger than the set threshold are detected a bubble alarm is generated. The set threshold depends on the sensor type. The bubble sensitivity depends on the actual application, e.g. tube properties, mounting position, etc.

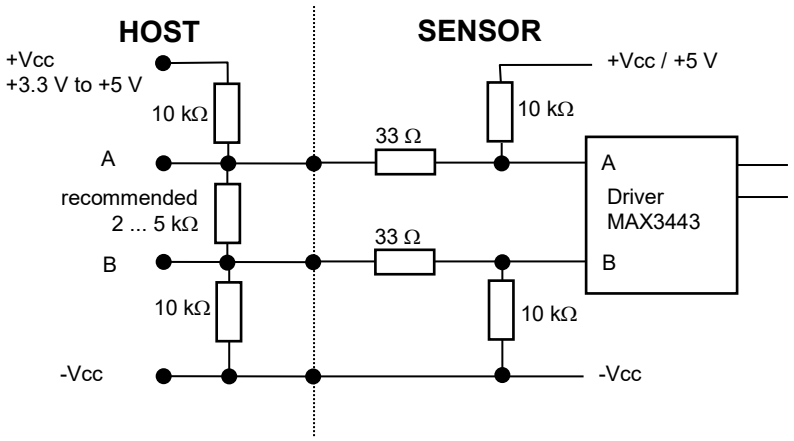
Parameter	Specifications
Bubble sensitivity	Bubbles whose size exceeds the alarm threshold are detected. Larger amounts of foam in the liquid will be detected as air.
Reaction time	Internal evaluation of bubbles within intervals of max. 1.6 ms
Response time	< 10 ms; faster response time possible if needed

Sensor type	Threshold alarm [mm]
CO.56/035	2.0 [4]
CO.56/044	2.0 [4]
CO.56/060	3.5
CO.56/080	4.0
CO.56/120	6.0
CO.56/140	7.0

[4] *Values valid in limited flow range of max. 900 ml/min. Higher flow rates on request.*

Technical data

Parameter	Specifications
Measuring method	Ultrasonic transit time difference measurement in transmission with two redundant measurement paths, dry coupling, no couplant required
Mounting	Fixed installation: 4 fixing holes M4, 8 mm deep
Tube insertion	▪ Tube must be put in manually without tools. Lid must be closed. ▪ No couplant (e.g. gel) permitted. ▪ Prevent excessive bending or tube compressing close to sensor (10 × inner tube diameter before and 5 × inner tube diameter behind the sensor)
Sensor materials	Measuring channel: PMMA black Housing: aluminum, anodized grey/red Hinge: stainless steel 1.4301 Potting compound (not accessible after mounting): PUR (blue)
Labeling	Laser engraving: ▪ arrow on lid indicating flow direction ▪ on side of housing (sensor type, hardware version, serial number, manufacturer with address); others upon request
Operating voltage	5 VDC +0.5/-0.1 VDC Internal suppressor diode to protect the sensor: Type: SMBJ5.0A | nom. 5 V | 600 W peak pulse power dissipation Inverse-polarity protection: In case of inverse polarity, the sensor is protected by the diode. A high short-circuit current flows.
Current consumption	Typically, approx. 100 mA, max. 180 mA ⚠ **Consider for the power supply circuit:** The current can temporarily reach higher values of up to 180 mA when the supply voltage is switched on and increases. If the voltage is at 5 V, the current typically drops to approx. 100 mA. The supply voltage must be raised as quickly as possible. Power supply of the sensor needs a current limiter, e.g. a fuse (minimize risk of a heating / fire as consequence of short-circuit) ⚠ **ATTENTION**: Current must be limited externally to max. 250 mA (e.g. fuse, slow reaction)

RS-485 interface (SONOTEC protocol)	Half-duplex operation / 115 200 Bd / 8 bit data / 1 stop bit / no parity bit / no handshaking Dialog mode (on demand): Machine is intended to ask results cyclically, sensor does not have an own alarm equipment) Query cycle: 20 … 200 ms (typically) ⚠ **NOTE:** Description of the serial protocol for details upon request.  Recommended electrical connection of the RS-485 interface
RS-485 bus operation	Bus operation supported up to 12 subscribers, default address is #01 (can be changed with the help of SONOFLOW Monitor, permitted are addresses from #01 … #12)
Maintenance	Maintenance-free
Ambient temperature	+10 … +50 °C (see also section ‘Calibration and conditions of use’)
Media temperature	+10 … +45 °C, other temperatures available on request
Storage / Transportation temperature	-20 ... + 60 °C
Humidity	10 … 95 % relative. humidity (not condensing)
Atmospheric pressure	620 hPa … 1060 hPa
Degree of protection	IP67
Scope of supply	▪ SONOFLOW CO.56/xxx sensor ▪ User documentation
Optional accessories	▪ Calibration report
	SONOFLOW Monitor Software for setting parameters, recording measurements and update of sensor software consisting of ▪ USB Data Converter (type 012), for the connection to a computer ▪ USB cable, type A-B, length 2 m • Software SONOFLOW Monitor and driver for Windows

Directives and standards

Parameter	Specifications
Medical safety	Medical safety: IEC 60601-1 3rd edition
Electrical safety	For MEANS OF PATIENT PROTECTION (MOPP) according to IEC 60601-1: The protection from SECONDARY CIRCUITS requires an installation of a SELV (Safety Extra-Low Voltage) converter prior to connecting the sensor onto the medical device. This ensures that no higher voltage than 60 V can occur at the sensor under any circumstances. Internal insulation of inner electronic to metallic housing with > 1000 VAC. It applies 2 × MOPP, secondary circuit, according to IEC 60601-1, Table 6. The classification as Applied Part “CF” in combination with the medical device and tubing is possible, depending on the application.
Electromagnetic compatibility	EMC tests must be performed by manufacturer of medical device after built-in. Precondition for EMC is the safe, functional earthing of housing by means of screws or connection line. Pretests have been performed by SONOTEC acc. IEC 60601-1-2, 4th edition. ▪ IEC 61000-4-3 (electromagnetic immunity) 10 V/m | 80 MHz to 2.7 GHz | 80 % AM at 1 kHz ▪ IEC 61000-4-3 (electromagnetic immunity, wireless frequencies) Section 8.10 ▪ IEC 61000-4-8 (magnetic fields) 30 A/m | 50 Hz und 60 Hz ▪ IEC 55011 class B / CISPR 11 (electromagnetic emission), tests according to IEC 55016: 30 … 1000 MHz | 30 dBµV @ 10 m ▪ IEC 61000-4-2 (electrostatic discharges) ± 8 kV direct and indirect contact | ± 15 kV air ▪ IEC 61000-4-4/ IEC 61000-4-5/ IEC 61000-4-6: not applicable Rationale: Sensor does not provide a patient-coupled line and the cable length is below 3 m.
Further standards	▪ Software development: DIN EN 62304, class C ▪ RoHS: 2011/65/EU, exception: III 7cl/ IV 15, RoHS (EU) 2015/863 ▪ Acoustic emission: IEC 61157, suitable for use on human blood

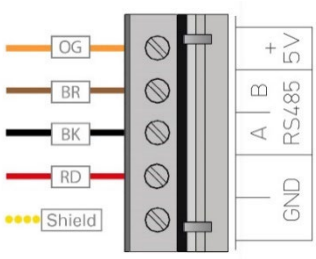
Use in medical devices and safety

The manufacturer of the medical device is responsible for the medical approval. SONOTEC as component supplier supports the approval process and shares documents with a notified body (3rd party).

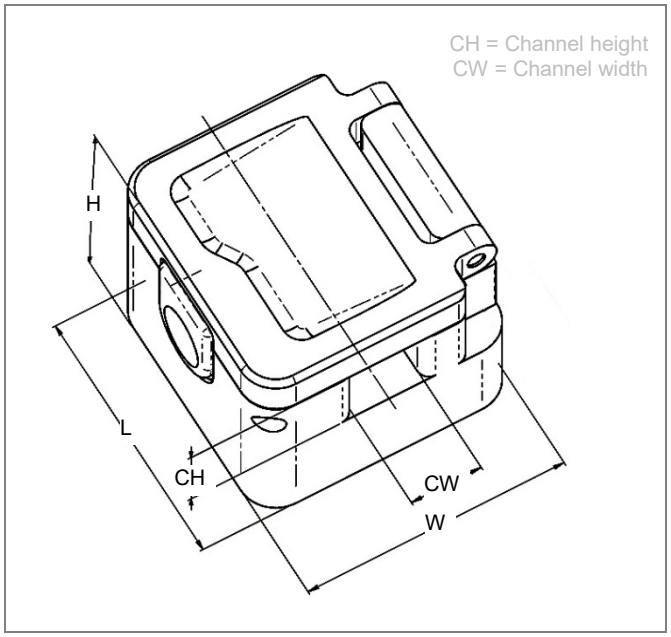
Parameter	Specifications
Medical safety	▪ PESS (Programmable Electrical Sub System) according to the IEC 60601. ▪ One-channel architecture / Fail Safe ▪ Cyclical self-tests of safe functionality of all essential components ▪ Output secured by watchdog: in case of major errors (for example software crashes), the output will be blocked ▪ After power on or software reset: initial test procedure (check of output circuit, watchdog functionality and locking of output)
Self-test	FTT: 0.7 s (cycle time of self-test), MFTT: 24 h (tests after power on or restart only; sensor must be restarted within the defined period)
Settings	Each sensor is calibrated by the manufacturer. Each sensor has individual settings regarding zero adjustment and characteristics of flow and the sensor specific identification character (e.g. serial number of the sensor, type codes).
Use in medical applications	⚠ **CAUTION:** Sensors are normally delivered in a state that is **NOT FOR CLINICAL USE**, because the settings are not protected against any changes. Proper settings of the sensor are essential for medical safety. All settings must be adjusted and verified carefully according to the medical application. The settings must be protected against unintentional changes. Hence, the appropriate self-test routines must be enabled. Please contact our staff to ensure a delivery of sensors with specified, verified settings!
Special applications	⚠ **ATTENTION**: The sensors are not suitable to be applied in immediate proximity to operating surgical devices using high energized pulses e.g. electrosurgical knifes (radio frequency cautery). The sensors might be destroyed, the values of flow could be affected or the sensor could raise false bubble alarm due to the strong radiation along the tubing. Customized sensors with additional protection are available.

Electrical Connection

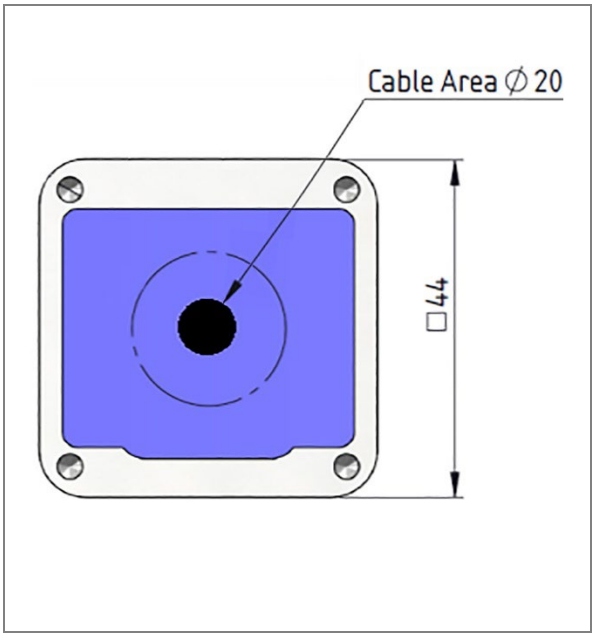
Parameter	Specifications		
Type	UL-LifYDY / 5 x 0.08 mm² / shielded / Ø 3.5 ± 0.1 mm		
Length	2.5 m ± 10 cm		
Connector	WECO terminal block		
Assignment	**Color**	**Connection**	**WECO Terminal**
	Orange	VCC	1
	Brown	RS485-B	2
	Black	RS485-A	3
	Red	GND	4
	Shield / Yellow	Housing of sensor	5
Grounding	⚠ **NOTE:** The metallic part of the housing of sensor must be connected to ground of machine by means of mounting or by shielded connection line! Metallic front of machine: Grounding by mounting screws | Plastic front of machine: Grounding by connecting the shield of connection line to ground.		



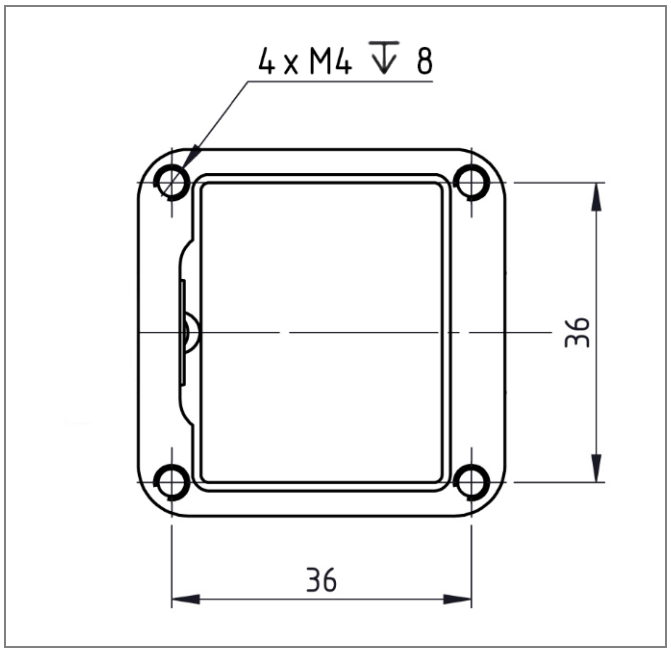
Technical drawings



Dimensions SONOFLOW CO.56/xxx



Rear side of sensor



Dimensions of drill holes for mounting

Drawings are not to scale. Dimensions in mm, unless otherwise specified. Information is subject to change without notice!
Registration according to ElektroG: WEEE Reg. No. DE 22125904. SONOTEC is a registered trademark.

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