



Technical manual BA 0317



Filling level

Hydrocont M

Hydrostatic filling level sensor – Ø 22mm

for continuous measurement
of filling levels and temperatures in liquid medias

High accuracy and long term stable filling level measurement

Ceramic highly overload resp. pressure blow resistive membrane

Food- and drinking water suitable materials

ATEX II 1/2 G Ex ia IIC T4 Ga/Gb resp. ATEX II 2 G Ex ib IIC T4 Gb

Certificated for the use in explosive hazardous areas

Integrated evaluation electronic

- 2-wire with current signal 4...20 mA
- 3-wire with voltage signal 0...10 V

Integrated over voltage protection

Integrated temperature measurement with Pt100

Customer specific adjustment

ACS-CONTROL-SYSTEM
know how mit system



Lauterbachstr. 57 – 84307 Eggenfelden – Germany
Tel: +49 8721/9668-0 – Fax: +49 8721/9668-30
info@acs-controlsystem.de – www.acs-controlsystem.de

Index

1.	Application	3
2.	Function	3
3.	Safety notes	4
4.	Installation	5
5.	Electrical connection	6
6.	Operation	8
7.	Maintenance	8
8.	Repair	8
9.	Technical data	9
10.	Dimension drawings	12
11.	Order code	14

1. Application

The device is a compact transmitter with integrated analogue evaluation electronic for continuous measuring of fill levels and temperatures in liquid media at hydrostatic pressures from 0 up to 20 bar within pressure less container, also in explosive hazardous areas, at process temperatures from – 20°C to +70°C.

The use of a capacitive measuring sensor with ceramic membrane, allows the use in nearly all fields of industry resp. of the water industry, like e.g. the measurement of levels in reservoirs, clarification basins, deep wells etc., but also the fill level measurement in closed containers.

Application fields are e.g. water, waste water, solvents, oil, sludge, fat, cleaning liquids, etc.

For hygienic applications, where food or drink water suitability is necessary, a corresponding variant can be ordered where only suitable materials are used.

The excellent characteristics like highest strength against pressure and pressure blows, high resistance against chemicals and corrosion, very good insensitiveness against temperature shocks and EM interference, highest accuracy and long term stability and also low influence of temperature makes it possible to use the sensor in various applications with liquid media like water, waste water, solvents, oil, sludge, grease, cleaning agents, etc.

2. Function

The device is sunken down into the medium by the carrying cable and a suitable fastening, e.g. clamp fixing, screw plug or terminal enclosure with process connection.

Measuring principle

The device is used for filling level measurement by measuring the hydrostatic pressure.

The height of the liquid column over the measuring membrane causes on the measuring membrane the so-called hydrostatic pressure, that is defined besides the height of the liquid column also by the density of the liquid and the gravitational constant.

$$h = \frac{P}{\rho * g}$$

h height (filling level)

p pressure

ρ density of the liquid

g gravitational constant

Characteristics of the ceramic measuring membrane

The hydrostatic pressure of the liquid is applied to the ceramic membrane and causes there a variation of the capacity at the back side of the membrane.

A pressure transmitting liquid is not used.

The ceramic membrane offers excellent characteristics like highest pressure and pressure blow strength up to fifty times the nominal pressure, high resistance against chemicals, corrosion and abrasion as well as very good insensitiveness against temperature shocks, highest accuracy and reproducibility, good long term stability and a very low temperature influence.

Signal processing

The filling level proportional hydrostatic pressure signal of the ceramic membrane is measured by the integrated analogue electronic and converted in an output current signal of 4...20mA resp. an output voltage signal 0...10V. The measurement signal range is adjusted by factory in many standard measurement ranges. A factory provided adjustment by customer specification is also possible.

Optionally a temperature dependent resistor Pt100 in 3-wire-technology can be integrated in the sensor. By this temperature measurement resistor a temperature measurement of the filling medium with removing the lead resistance can be realized in parallel to the filling level measurement.

When using a wall installation housing a Pt100 – transmitter can be integrated that is adjusted by customer specification.

Integrated over voltage protection components prevents the filling level sensor from destruction by atmospheric influences like e.g. lightning stroke.

3. Safety notes

Each person that is engaged with inauguration and operation of this device, must have read and understood this technical manual and especially the safety notes.



Installation, electrical connection, inauguration and operation of the device must be made by a qualified employee according to the informations in this technical manual and the relevant standards and rules.

The device may only be used within the permitted operation limits that are listed in this technical manual.

Every use besides these limits as agreed can lead to serious dangers.

The materials of the device must be chosen resp. checked for compatibility with the respective application requirements (contacting materials, process temperature). An unsuitable material can lead to damage, abnormal behavior or destruction of the device and to the resulting dangers.

The sensors may not be used as sole device for prevention of dangerous conditions in machines and plants. This measuring device meets article 3 (3) of the EC directive 97/23/EC (pressure equipment device directive) and is designed and produced in good engineer practice.

The device meets the legal requirements of all relevant EC directives. **CE 0158**

Using the device in a manner that does not fall within the scope of its intended use, disregarding this instruction, using under-qualified personnel, or making unauthorized alterations releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null and void.

Special safety notes

Electrical operating supplies for explosive hazardous areas

If a device is installed and operated in explosive hazardous areas, the general Ex construction standards (EN/IEC 60079-14, VDE 0165), these safety notes and the enclosed EC conformity certificate incl. supplements must be observed.

The installation of explosive hazardous systems must be carried out principally by specialist staff.

The device meets the classification:

II 1/2 G Ex ia IIC T4 Ga/Gb	T _a = - 20...+80°C
II 2 G Ex ib IIC T4 Ga	T _a = - 20...+80°C

The devices are conceived for measurement of filling levels in explosive hazardous areas. The measured medium may also be combustible liquids, gases, fogs or steams.

The permitted operating temperatures and pressures are type and variant dependent and can be found in this technical manual.

For applications, which require devices of category 1/2, the process pressure and temperature range of the media has to be between 0,8 bar and 1,1 bar and between -20 °C and 60 °C.

The field enclosure of variant Hydrocont Ex_MW... resp. the terminal enclosure at the variant Hydrocont Ex_MOG... must be installed outside Ex-zone 0.

The device Hydrocont Ex_M is earthen for safe technical function. Provide sufficient potential compensation along the complete cable way.

Connect the PA-clamp in the field enclosure or the in the terminal enclosure with the potential compensation of the explosive hazardous area. Install the intrinsically safe circuit earth free.

At variants of the devices with chargeable plastic parts, a warning marking points out to the safety measures, that must be applied because of the electrostatic charging in operation and especially in the case of maintenance activities.

- avoid friction
- no dry cleaning
- no assembling in pneumatic conveying stream

4. Installation

Avoid faulting the pressure compensation capillary at the connection side of the carrying cable resp. the pressure compensation element of the field enclosure or terminal enclosure.

The hindrance of the air pressure compensation can lead to faulty measurement results.

The environmental air pressure is supplied to the measurement membrane of the probe by a pressure compensation capillary that is integrated in the carrying cable. This capillary may not be folded or sealed.

To avoid faulting, a micro air filter is placed at the end of the capillary.

In the case of an application conditioned cutting of the carrying cable there must be especially paid attention that this micro air filter will be replaced to the end of the capillary after the cutting.

At the variant with terminal enclosure – Hydrocont M0G – a user sided cutting of the carrying cable is not scheduled.

After the installation of the cable resp. cables the cable glands of the field enclosure or terminal enclosure must be fixed screwed on to achieve the tightness of the housing. This is also valid for the respective cover of the enclosure.

Strange substances that come into the enclosure can lead to faulty measurement results or to the destruction of the device and to the resulting dangers.

For simplifying the system sided cable run the terminal head of the variant with terminal enclosure – Hydrocont M0G – can be arbitrary rotated after installation of the device.

After the opening of the enclosure at first pull out the clamp plate after removing the two screws that fixes the clamp plate.

At pulling out the clamp plate take care that the sensor cables that are connected at the bottom side of the clamp plate will not be damaged or detached.

Loosen now the three screws below. Rotate the terminal head into the desired orientation. After that fix the three screws, put in the clamp plate and fix it again with the two screws.

5. Electrical connection

The electrical connection of the device must be carried out according to the respective country specific standards.

Incorrect installation or adjustment could cause applicationally conditioned risks.

For inauguration it is suggested, to deactivate all connected control devices, to avoid unwanted control reactions.

Potential equalization - earthing

The device must be grounded.

The metallic parts of the device are electrically connected with the terminal PE in the terminal enclosure resp. with the shield connection of the open cable connection.

Connection cable

Use only shielded signal and measurement wires and install these wires separated from power leading wires. Connect the cable shield only at one side to earth, ideally at the installation place of the device.

The earthing of the cable shield of an connected cable can be done at the installation place of the field enclosure or terminal enclosure by using the terminal PE.

Supply voltage

The voltage applied to the terminal contacts may not exceed the maximum permitted supply voltage to avoid damage of the electronic.

The maximum permitted supply voltage range at the respective version is:

2-wire / signal 4...20mA	11...45V _{DC}
2-wire / signal 4...20mA ATEX	12,5...25,2V _{DC}
3-wire / signal 0...10V	14...30V _{DC}

All connections are reverse polarity protected.

Load resistor

Signal 4...20 mA

A load resistor, e.g. the measuring shunt of an evaluation device, requires a minimum supply voltage.

Dependent on the connected supply voltage, it results in a maximum value for this resistor, where a correct function is still possible.

This resistor can be calculated by the following term:

$$R_{Lmax} = (U_S - U_{Smin}) / 20mA$$

R_{Lmax} = maximum load resistor

U_S = connected supply voltage

U_{Smin} = minimum supply voltage

Signal 0...10 V

A load resistor, e.g. the measuring shunt of an evaluation device, requires at a definitive output voltage an output current. Due to the limitation of that output current, it results in a minimum value for this resistor, where a correct function is still possible.

This resistor can be calculated by the following term:

$$R_{Lmin} = U_{Out} / 2mA$$

R_{Lmin} = minimum load resistor

U_{Out} = output voltage

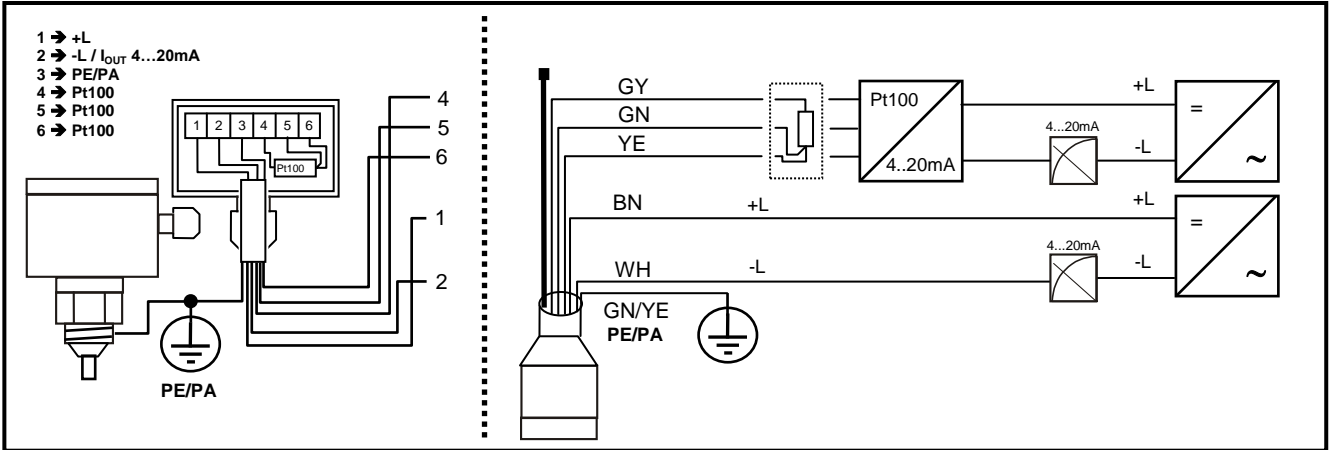
Resistance temperature sensor Pt100

The integrated temperature measurement resistor Pt100 is galvanically not safe separated against the fill level evaluation circuit and against the metallic parts of the device.

Informations for the connection of the resistance temperature sensor Pt100 to the used Pt100-transmitter can be found in the technical manual of the transmitter.

Connection scheme

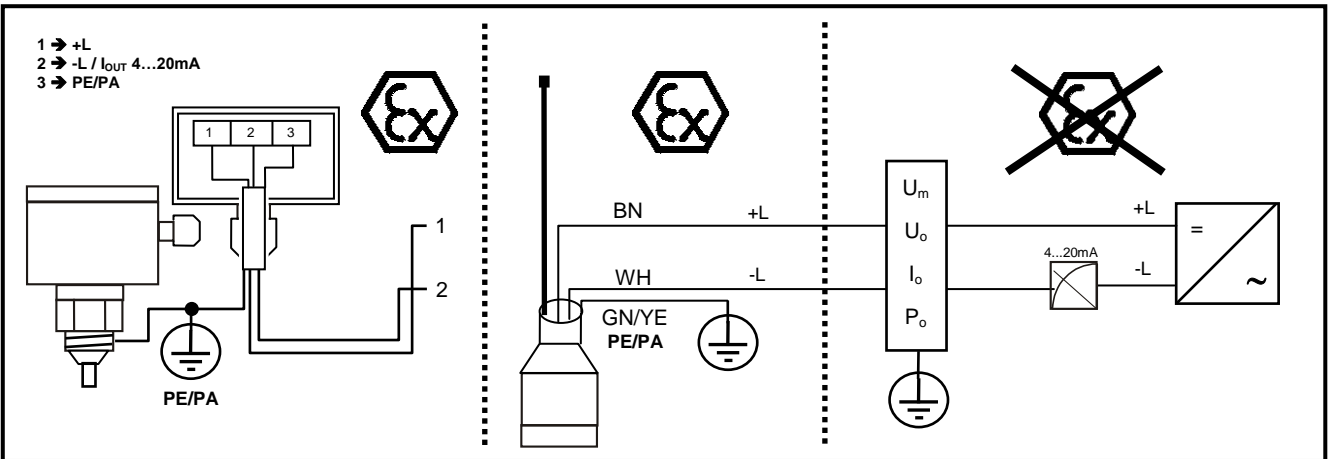
Signal 4...20 mA



Conductor color cable:

WH = white, BN = brown, GN = green, YE = yellow, GY = grey, GN/YE = green/yellow

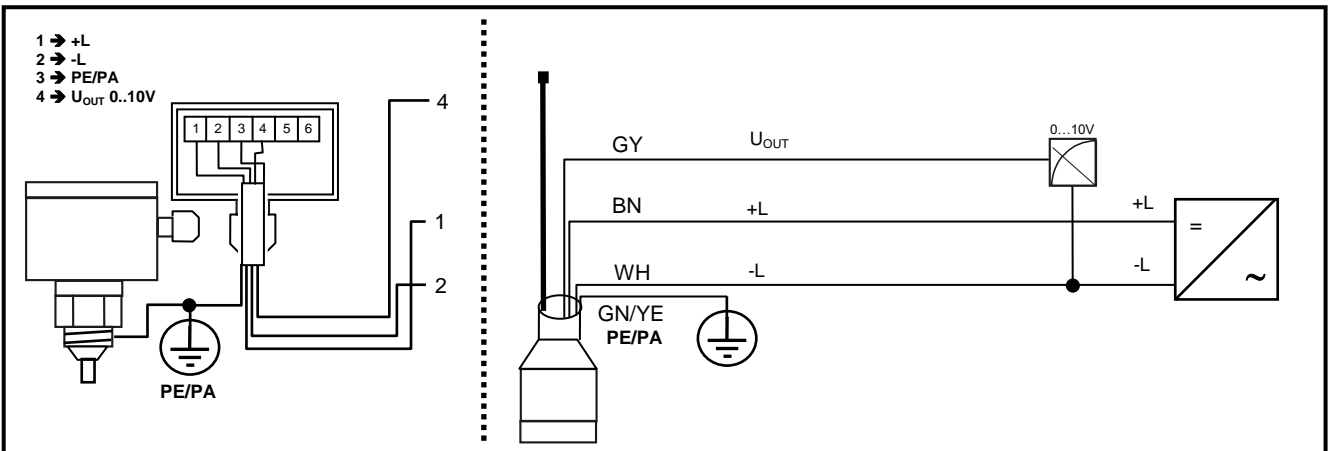
Signal 4...20 mA ATEX



Conductor color cable:

WH = white, BN = brown, GN/YE = green/yellow

Signal 0...10 V



Conductor color cable:

WH = white, BN = brown, GY = grey, GN/YE = green/yellow

6. Operation

An operation provided by user is not designated.

7. Maintenance

The device is free of maintenance.

Special substances can lead to solid coatings on the membrane.

Such depositions can lead to faulty measurement results of the device.

In the case of coat forming liquids the membrane must be regularly cleaned e.g. with clear water.

Don't use sharp tools or aggressive chemicals for cleaning.

8. Repair

A repair may only be carried out by the manufacturer.

If the device must be sent back for repair, the following informations must be enclosed:

- An exact description of the application.
- The chemical and physical characteristics of the product.
- A short description of the occurred error.

Before returning the device for repair, the following measures must be proceeded:

- All stick product residues must be removed. This is especially important, if the product is unhealthy, e.g. caustic, toxic, carcinogenic, radioactive etc.
- A returning must be refrained, if it is not possible by 100% to remove the unhealthy product completely, because e.g. it is penetrate into cracks or is diffused through plastic.

9. Technical data

Auxiliary power supply

Supply voltage U_S	2-wire 4...20 mA 11..45 V _{DC} , reverse polarity protected 11..30 V _{DC} , at earthed –L-connection and overvoltage protection 2-wire 4...20 mA ATEX 12,5..25,2 V _{DC} , reverse polarity protected 3-wire 0... 10 V 14..30 V _{DC} , reverse polarity protected
Residual ripple U_{PP}	$\leq 2 V_{PP} / U_{Smin} \leq U_S \leq U_{Smax}$
Supply current I_{In}	2-wire 4...20 mA ≤ 30 mA 3-wire 0... 10 V ≤ 6 mA

Output Signal 4...20mA

Operating range I_{Out}	≤ 2 mA ... ≥ 22 mA, max. 28 mA
Permitted load R_L	$\leq (U_S - U_{Smin}) / 20mA$
Step response time T_{90}	≤ 5 ms
Start-up time t_{on}	≤ 1 s

Output Signal 0...10V

Operating range U_{Out}	0 V ... ≥ 11 V, max. $U_S - 1,5$ V
Permitted load R_L	$\geq U_{Out} / 2mA$
Step response time T_{90}	≤ 5 ms
Start-up time t_{on}	≤ 1 s

Measuring accuracy

Reference conditions	EN/IEC 60770-1 resp. EN/IEC 61003-1
	T = 25 °C, relative humidity 45...75 %, environmental air pressure 860..1060 kPa
Calibration position	Vertical, process connection bottom side
Warm-up time	≤ 240 s
Characteristic deviation ^{3) 5) 12)}	$\leq \pm 0,1\% / \pm 0,25\% FS$ ²⁾
Nonlinearity ¹²⁾	$\leq \pm 0,1\% / \pm 0,25\% FS$ ²⁾
Hysteresis ¹²⁾	negligible
Influence of supply voltage	$\leq \pm 0,02\% FS$ ²⁾ / 10V
Long term drift ¹²⁾	$\leq \pm 0,15\% FS$ ²⁾ / year - not cumulative
Temperature deviation ¹²⁾	T_k ⁴⁾ Zero
	$\leq \pm 0,15\% FS$ ²⁾ / 10 K, max. $\pm 0,75\%$ (-20°C...+80°C)
	T_k ⁴⁾ Span
	$\leq \pm 0,15\% FS$ ²⁾ / 10 K, max. $\pm 0,5\%$ (-20°C...+80°C / > 0,4 bar), max. $\pm 0,8\%$ (-20°C...+80°C / $\leq 0,4$ bar)

- 2) Referring to nominal measuring span resp. full scale (FS)
3) Nonlinearity + Hysteresis + Reproducibility / at limit point set
4) T_k = Temperature coefficient
5) At limit point adjustment
12) Higher values for special measuring range

Output Pt100

Type	Pt100 class B / 3-wire
Measurement deviation ⁸⁾ :	$\leq \pm(0,25 \text{ K} + 0,3 \text{ K} + 0,005 * [t])$ (e.g. $\leq 0,9 \text{ K}$ at $+70^\circ\text{C}$) [t] = process temperature in $^\circ\text{C}$, without sign, unit K
Long term drift ⁸⁾ :	$\leq \pm 0,15\% \text{ FS}^{2)}$ / year - not cumulative
Step response time T_{90} ⁹⁾ :	$\leq 240\text{s}$
Transmitter	See technical data of the transmitter

- 2) Referring to nominal measuring span resp. full scale (FS)
 8) At reference conditions
 9) According to EN/IEC 60751 / water / 0,4 m/s / temperature step 23 to 33°C

Mounting position

Maximum deviation ¹⁰⁾	$\leq 0,18 \text{ mbar}$
----------------------------------	--------------------------

- 10) Device rotated by 180° , process connection upside

Over voltage protection

Category:	coarse protection / fine protection
Signal voltage:	max. 30V peak value, to PE connection
Nominal bypass surge current:	2500 A – wave 8/20 μs
Trigger voltage:	90V coarse protection / 33V fine protection

Process conditions

Process temperature	$-20^\circ\text{C} \dots +70^\circ\text{C}$		
Process pressure [R] Gauge pressure [A] Absolute pressure	<i>Pressure range</i>	<i>Over/Burst pressure</i>	<i>Vacuum</i>
	0...0,5 mWs	5 bar [R]	0 bar [A]
	0...0,1 bar [R] / 1 mWs	5 bar [R]	0 bar [A]
	0...0,2 bar [R] / 2 mWs	5 bar [R]	0 bar [A]
	0...0,4 bar [R] / 4 mWs	6 bar [R]	0 bar [A]
	0...0,6 bar [R] / 6 mWs	10 bar [R]	0 bar [A]
	0...1 bar [R] / 10 mWs	10 bar [R]	0 bar [A]
	0...2 bar [R] / 20 mWs	15 bar [R]	0 bar [A]
	0...4 bar [R] / 40 mWs	25 bar [R]	0 bar [A]
	0...5 bar [R] / 50 mWs	40 bar [R]	0 bar [A]
	0...6 bar [R] / 60 mWs	40 bar [R]	0 bar [A]
	0...10 bar [R] / 100 mWs	40 bar [R]	0 bar [A]
0...20 bar [R]	40 bar [R]	0 bar [A]	

Environmental conditions

Environmental temperature	-20°C...+70°C
Protection	<i>Probe</i> IP68 (EN/IEC 60529) <i>Screw plug</i> IP67 (EN/IEC 60529) <i>Terminal enclosure</i> IP67 (EN/IEC 60529) <i>Field enclosure</i> IP65 (EN/IEC 60529)
Climatic classification	4K4H [-20...+55°C / 4...100%] (EN/IEC 60721-3-4)
Shock classification	15 g [11ms] (EN/IEC 60068-2-27)
Vibration classification	4 g [10 - 2000 Hz] (EN/IEC 60068-2-6)
EM compatibility	Operation device class B / Industrial range (EN/IEC 61326)
Weight	<i>Type without field enclosure / terminal enclosure</i> 0,3 kg + (L1 x 0,035 kg/m)

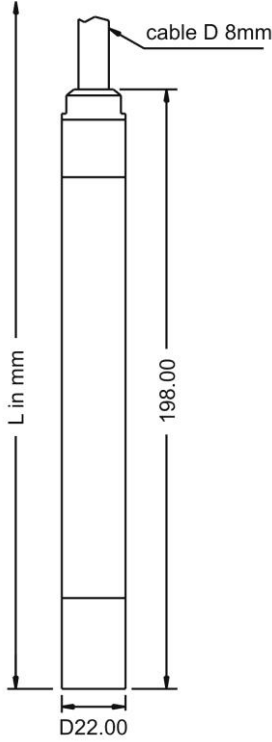
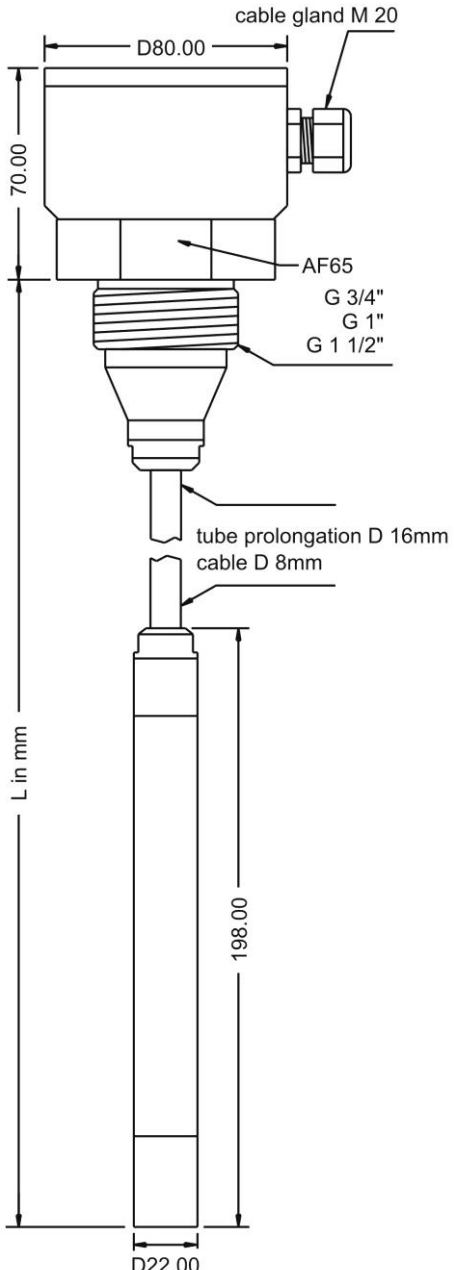
Materials - process wetted

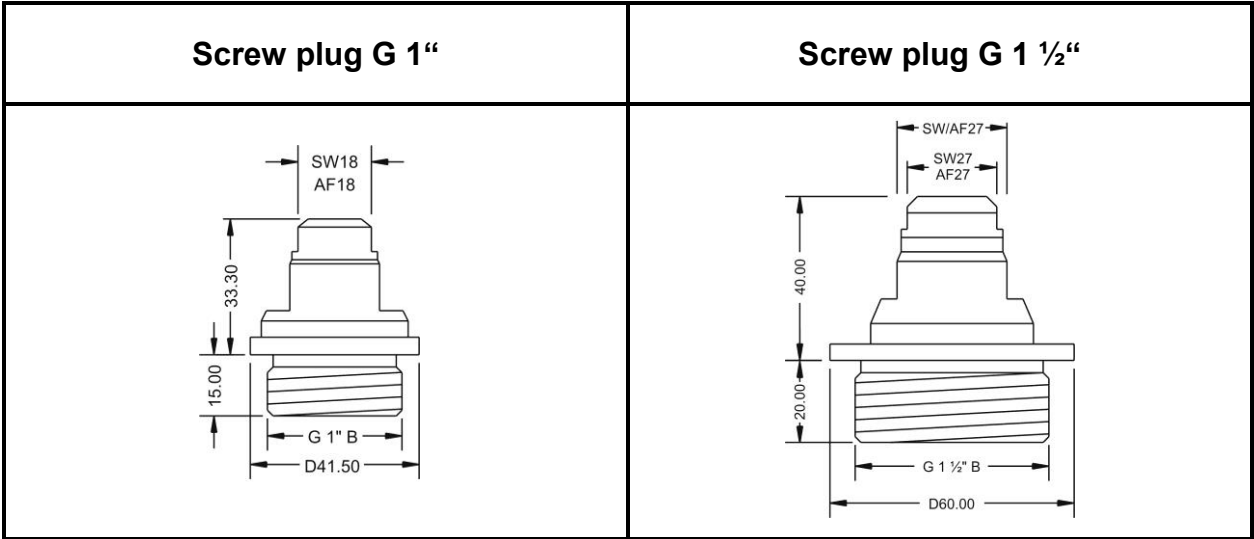
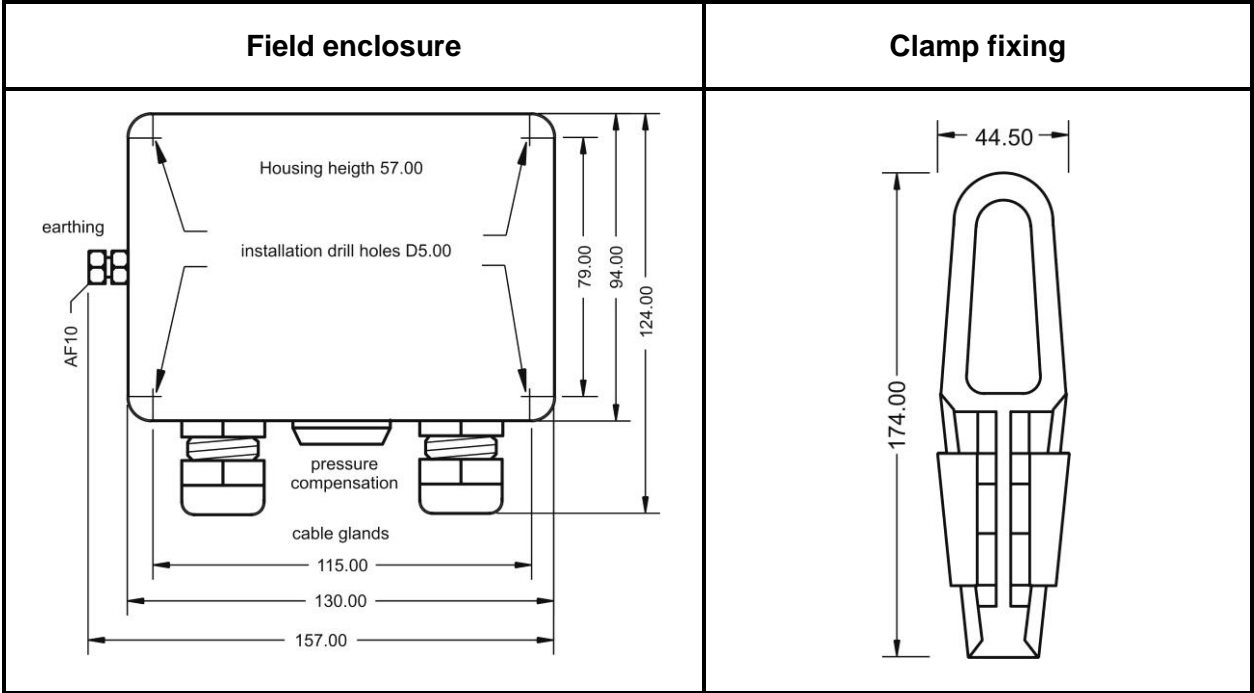
Membrane	Ceramic aluminum oxide ≤ 1 bar 99,7% ≥ 2 bar 96%
Process connection / probe / tube prolongation	Steel 1.4404 (316L) / 1.4571 (316Ti)
Carrying cable	PE – polyethylene PUR – polyurethane
Gaskets	FPM – fluorelastomere (Viton®) CR – chloroprene-rubber (Neopren®) EPDM – ethylene-propylene-dienmonomere

Materials - not process wetted

Terminal enclosure	POM – polyoxymethylene (Delrin®)
Field enclosure	PS – polystyrene / PC – polycarbonate
Screw plug	CrNi-steel
Clamp fixing	CrNi-steel / steel hot galvanized Weather proof plastic
Electrical connection part	Cable gland PA / CrNi-steel Gasket CR / NBR
Pressure compensation element	PTFE / PES
Gaskets	FPM – fluorelastomere (Viton®) silicone

10. Dimension drawings

Sensor – without terminal enclosure	Sensor with terminal enclosure
	



11. Order code

Type:

M standard
 Ex0M ATEX II 1/2 G Ex ia IIC T4 Ga/Gb
 Ex1M ATEX II 2 G Ex ib IIC T4 Gb

Variant field enclosure:

W field enclosure
 0 without field enclosure

Put-in device / process connection:

0	without put-in device		
S	cable clamp fixing		steel, hot galvanized
U	cable clamp fixing		CrNi-steel
W	screw plug	G 1"	ISO228-1 steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)
T	screw plug	G 1½"	ISO228-1 steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)
G	terminal enclosure	G 1½"	ISO288-1 steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)
8	terminal enclosure	G ¾"	ISO288-1 steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)
9	terminal enclosure	G 1"	ISO288-1 steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)

Variant sensor:

S standard Ø 22mm
 T food and drink water suitability of all process wetted materials
 R tube prolongation Ø 22mm

Transmitter electronic:

0 4...20 mA 2-wire
 B 0...10 V 3-wire (not for Ex)

Measurement range:

8	0...100 mbar	A	0...1 m water column (mwc)
0	0...200 mbar	B	0...2 m water column (mwc)
1	0...400 mbar	C	0...4 m water column (mwc)
6	0...600 mbar	M	0...5 m water column (mwc)
2	0...1000 mbar	D	0...6 m water column (mwc)
3	0...2000 mbar	E	0...10 m water column (mwc)
4	0...4000 mbar	F	0...20 m water column (mwc)
9	0...5000 mbar	L	0...25 m water column (mwc)
7	0...6000 mbar	G	0...40 m water column (mwc)
5	0...10000 mbar	J	0...50 m water column (mwc)
Z	0...20000 mbar	K	0...60 m water column (mwc)
		H	0...100 m water column (mwc)
		Y	special measuring range separate spec. necessary

Accuracy measuring system¹⁾ – material measuring membrane (process wetted):

0	0,25%	ceramic AL ₂ O ₃	99,7 / 96%
K	0,1%	Linearization protocol ceramic AL ₂ O ₃	99,7 / 96%

Over voltage protection:

P integrated over voltage protection not for type Ex0M
 0 without over voltage protection

Temperature sensor:

0 without temperature sensor
 1 integrated temperature sensor Pt100 not for type Ex0M / Ex1M
 2 integrated temperature sensor Pt100 not for type Ex0M / Ex1M
 with an installed Pt100 transmitter in the field enclosure
 specify transmitter type and temperature measurement range separately

Material probe (process wetted):

1 steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)

Material gaskets (process wetted):

1 FPM fluorelastomere (Viton®)
 2 CR chloroprene-rubber (Neopren®)
 3 EPDM ethylene-propylene-dienmonomere for food applications

Materials probe prolongation (process wetted):

A PE polyethylene
 B PUR polyurethane
 D tube Ø 16mm steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)

Sensor length incl. process connection:

measure in mm

Hydrocont _____ 1 _____ mm

Installation material and connection cable are not enclosed in the delivery contents.

¹⁾ Higher values for special measuring range