Technical manual BA 1109

Filling level

Hydrocont K

Hydrostatic filling level sensor

for continuous measurement
of filling levels in liquids

High accuracy and long term stable filling level measurement

Ceramic highly overload resp. pressure blow resistive membrane

Various usability, especially for hygienic applications

Large selection of styles and materials

ATEX II 1/2 G Ex ia IIC T4 resp. ATEX II 2 G Ex ib IIC T4
Certificated for the use in explosive hazardous areas

Integrated evaluation electronic in 2-wire-technology with signal 4...20mA

Integrated over voltage protection

Adjustable measuring signal – adjustable signal damping

ACS-CONTROL-SYSTEM
know how mit system

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Application

The device **Hydrocont K** with integrated analogue evaluation electronic is a compact transmitter for continuous measuring of fill levels and temperatures in liquids at hydrostatic pressures from -1 up to 20 bar within pressure less container, also in explosive hazardous areas, at process temperatures from – 20°C to +140°C.

The use of a capacitive measuring sensor with ceramic membrane, allows the use in nearly all fields of industry, especially in hygienic applications.
Application fields are e.g. water, waste water, solvents, oil, sludge, fat, cleaning liquids, etc.

By using suitable materials like PEEK, FEP or also FFKM, the device can also be used at applications with especially aggressive liquids.

Function

The device **Hydrocont K** is sunken down into the liquid by the carrying cable or mounted by the respective process connection into the wall of the container or pipe

Measuring principle

The device **Hydrocont B** 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.

$$h = \frac{p}{\rho * g}$$ with

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 eighty times the nominal pressure, vacuum resistance, very 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.

Characteristics of the process diaphragm seal – high temperature variant – type H

The hydrostatic pressure of the liquid is applied to the metallic membrane of the process diaphragm seal and is transmitted by a pressure transmitting liquid to the ceramic measuring membrane that is placed behind.
This leads among others to a extension of the permissible medium temperature up to +140°C.

Signal processing

The filling level proportional hydrostatic pressure signal of the ceramic membrane is measured by the integrated analogue electronic and converted in a output current signal of 4…20mA.
The measuring signal range can be adjusted corresponding to the requirements of the application in a wide range for measuring range zero and end value.

Furthermore an influence of the measuring signal by an adjustable damping for neutralization of short pressure blows or also for calming down cyclic fluctuating pressure signals is possible.

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

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Permissible pressure to the measuring membrane

measurement range	vacuum	overload / burst pressure
0…50 mbar	0,7 bar_{abs}	+4 bar_{rel}
0…100 mbar	0,7 bar_{abs}	+4 bar_{rel}
0…200 mbar	0,5 bar_{abs}	+6 bar_{rel}
0…400 mbar	0 bar_{abs}	+6 bar_{rel}
0…1000 mbar	0 bar_{abs}	+10 bar_{rel}
0…2000 mbar	0 bar_{abs}	+18 bar_{rel}
0…4000 mbar	0 bar_{abs}	+25 bar_{rel}
0…10000 mbar	0 bar_{abs}	+40 bar_{rel}
0…20000 mbar	0 bar_{abs}	+40 bar_{rel}
0…25000 mbar	0 bar_{abs}	+40 bar_{rel}
-1000...+1000 mbar	0 bar_{abs}	+18 bar_{rel}
-1000...+6000 mbar	0 bar_{abs}	+40 bar_{rel}
0...1000 mbar absolute pressure	0 bar_{abs}	10 bar_{abs}
0...4000 mbar absolute pressure	0 bar_{abs}	25 bar_{abs}

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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 suitability to the respective application requirements (contacting substances, process temperature). An unsuitable material can lead to damage, abnormal behavior or destruction of the device and to the resulting dangers.

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

Safety notes for electrical operating supplies for explosive hazardous areas

If a device is installed and operated in explosive hazardous areas, the general Ex construction standards (EN60079-14, VDE0165), this safety notes and the enclosed EC conformity certificate 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
II 2 G Ex ib IIC T4

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 device with over voltage protection Hydrocont Ex1K_ _ _2... is earthen for safe technical function. Provide sufficient potential compensation along the complete cable way.
Connect the PA-clamp in the connection housing 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 (e.g. connection housing, cable), 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

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Installation

The installation of the device at locations where high pressure blows can occur should be avoided.

The installation of the device should be made if possible at temperature calmed places to get a reliable measuring result. Large temperature steps, e.g. at filling of a hot medium into a cold system, can produce a short-time higher measuring signal deviation at the variants with ceramic measuring membrane.
At a large amplification of the measuring signal this deviation will be also amplified accordingly.
The deviation will be completely neutralized after the adaptation of the measuring membrane of the filling level transmitter to the temperature.
At a step from +20°C ...+80°C this neutralization can wile up to 3 minutes.
The use of a process diaphragm seal can cause an essential improvement.

The installation position has influence on the measuring result of the kind of a zero value shift because of the deadweight of the measuring membrane and a possible pressure transmitting liquid. This deviation can be eliminated by an offset adjustment. Zero and end value must be shifted by the same amount.

Drive the system pressure free prior installation resp. deinstallation of the sensor.

The tightening of the process connection with screw-in thread may only be done at the hexagon by a suitable spanner.
The maximum permitted torque strength is 50 Nm.
The screw in of the process connection by using the housing tube is not permitted.

Avoid the pollution of the pressure compensation vent. The hindrance of the pressure compensation can lead to faulty measuring results.

For simplifying the system sided cable run the connection head can be arbitrary rotated after installation of the device.
After the opening of the housing at first the electronic module must be removed.
By this the two screws that fixes the electronic module must be released.
At pulling out the electronic module take care that the sensor cables that are connected at the bottom side of the electronic module will not be damaged or detached.
Loosen now the three screws below and rotate the connection head into the desired orientation.
After that fix the three screws again.
The electronic module must be inserted now and fixed with the two screws.

The correct function of the device within the specific technical data can only be guaranteed, if the permitted temperature in the area of the connection housing (see technical data) will not be exceeded.
This can be achieved by the using a process diaphragm seal (high temperature variant – type H), by isolation of the liquid carrying part of the plant or by other constructive measures to reduce the transferring of an extreme temperature to the connection housing.

A process diaphragm seal (high temperature variant – type H) together with the measuring transmitter forms a closed, calibrated system, that is filled by openings in the process diaphragm seal and in the measuring system of the measuring transmitter. These openings are sealed and may not be opened.

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.

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

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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.

Use only twisted 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 connection housing by using the terminal PE. At the variant with plug M12x1 the earthing of the cable shield must be done at the evaluation side of the installation.

The metallic parts of the device (probe housing, screwing thread of the connection housing) are electrically connected with the terminal PE in the connection housing. The socket of the plug M12x1 is not connected to the other metallic parts of the device.

The cable gland is suitable für cable diameter from 7 to 13 mm.
After the installation of the cable the cable gland must be firmly screwed to ensure the tightness of the connection housing. The same is valid for the housing cap.

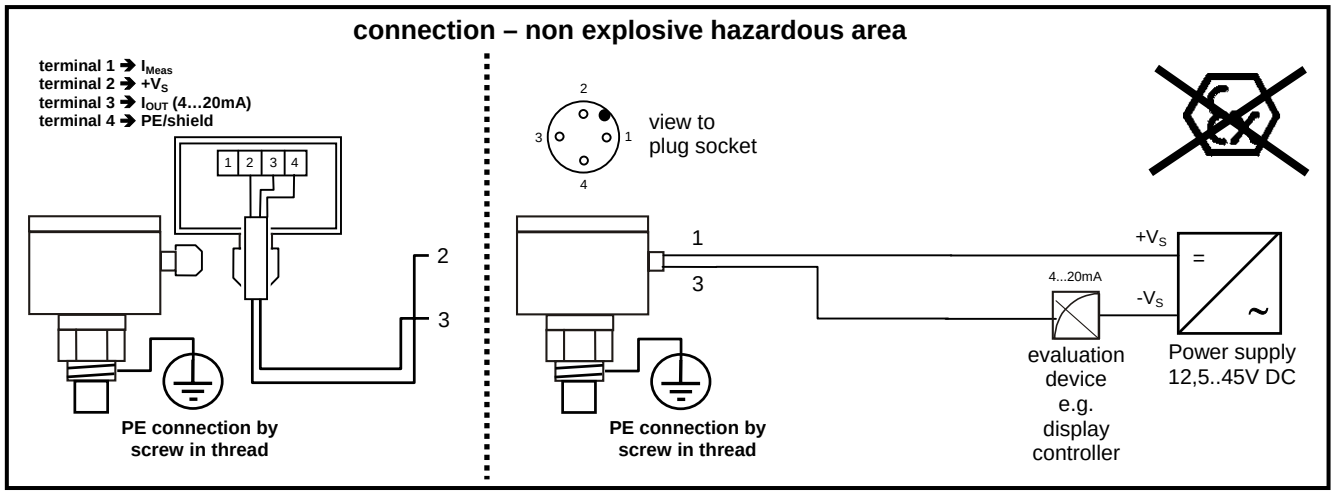
The voltage applied to the plug contacts may not exceed 45 V, to avoid damage of the electronic.
All connections are polarity protected.

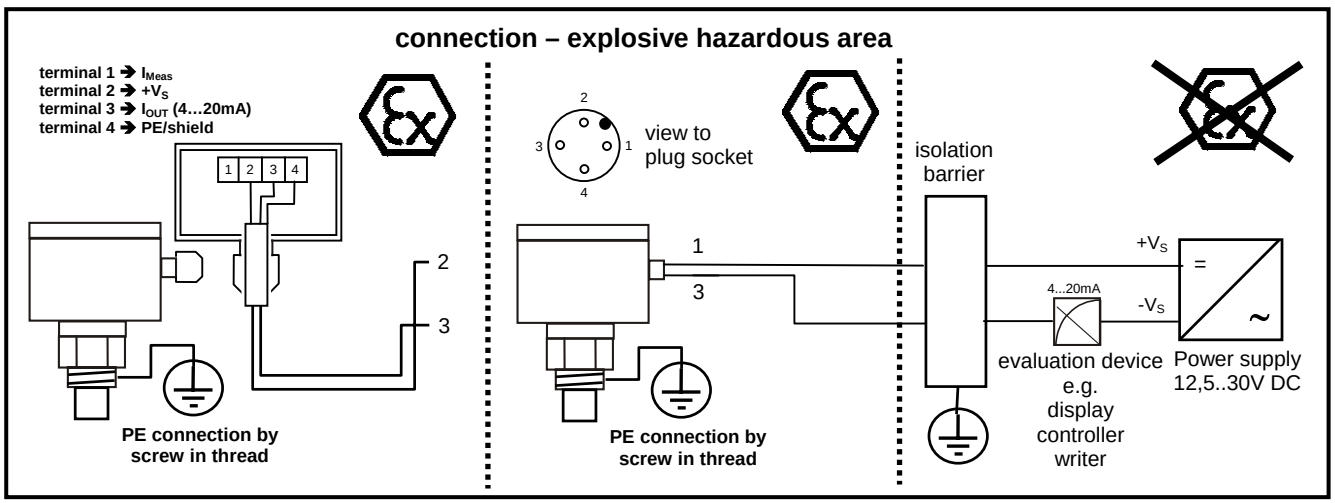
A load, e.g. the measuring shunt of an evaluation device, in series with a device with 4...20 mA current signal in 2-wire-technology reduces the supply voltage available at the device. This results in a maximum value for this resistor, where a correct function is still possible.

The maximum load at signal current 20mA can be calculated by the equation:

$$R_L \text{ max} = (V_S - 12{,}5V) / 20mA \quad \text{with } V_S = \text{applying supply voltage.}$$

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





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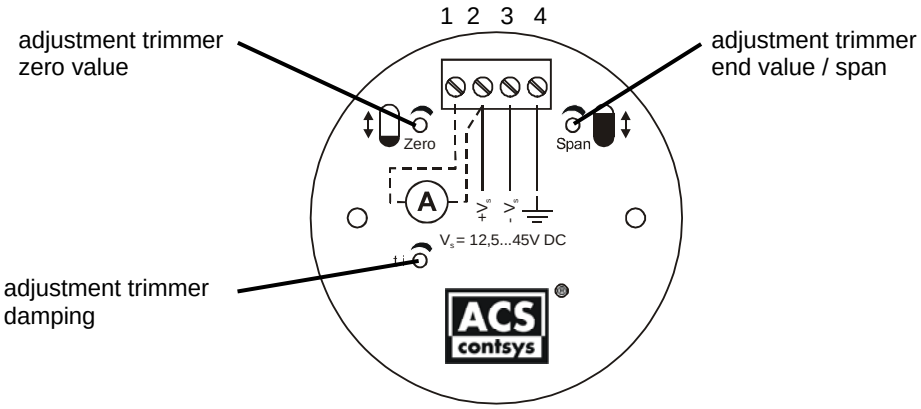
Operation elements - adjustment



Adjustment trimmer zero value resp. end value

For adjustment of the measuring range at zero and end value.

For simplifying the procedure a current measuring device can be connected to the terminals 1 and 2 without the need to disconnect the measuring circuit.

A turn to the right increases the output current. At a turn to the left the output current will be decreased.

Procedure at adjustment:

- Set liquid to the minimum filling level and adjust a signal current of 4mA with the zero value trimmer (zero).
- Set liquid to the maximum filling level and adjust a signal current of 20mA with the end value trimmer (span).
- At large measuring range variations it could be necessary to repeat the zero and end value adjustment one or two times, because the variation of the potentiometer adjustment at zero and end value produces additionally an influence the respectively other value.

The adjustment range is limited to

- Maximum zero value increasement to 25 % of the nominal measuring range
- Minimum measuring range 25 % of the nominal measuring range

Adjustment trimmer damping

For adjustment of the damping of the measuring signal.

For neutralization of short pressure blows or also for calming down cyclic fluctuating pressure signals, produced by mixing machines or also at fill-in.

A turn to the right increases the damping time constant.
At a turn to the left the damping time constant will be decreased.

Without damping the device responses to pressure changes within milliseconds.
At the maximum damping the complete transmission of a pressure change to the output signal can be delayed by approx. 25 seconds in an exponential function.

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Technical data

Auxiliary supply

Supply voltage:	reverse polarity protected 12,5 to 45 V DC	for Ex-variant 12,5 V to 30 V DC
Ripple voltage:	≤ 2 V_{PP}	condition: within the permitted supply voltage range

Signal output 4...20mA

Signal type:	linear characteristic from ≤ 4 mA resp. ≥ 20 mA, minimum 2,75 mA ± 0,75 mA / maximum 27 mA		
Permitted load:	R_L max = (V_S – 12,5V) / 20mA		
Characteristic deviation [3) 5) 12)]:	≤ 0,1% resp. 0,2% FS [2)]		
Nonlinearity [6) 12)]:	≤ ±0,1% / 0,2% FS [2)]		
Hysteresis [6) 12)]:	negligible		
Long term deviation [6) 12)]:	≤ ±0,1% FS [2)] / year	not cumulative	
Temperature deviation [6) 12)]:	T_k [4)] Zero	≤ ±0,10% FS [2)] / 10 K, max. ±0,75% FS [2)]	(-20...+80°C)
	T_k [4)] Span	≤ ±0,10% FS [2)] / 10 K, max. ±0,5% FS [2)] max. ±0,8% FS [2)] (≤ 0..0,4 bar)	(-20...+80°C) (-20...+80°C)
		besides -20...+80°C with factor 2 for T_k	

High temperature variant – type H
A change in temperature produces a change of the volume of the pressure transmitting liquid and thus results in an additional zero value shift, whose amount depends on the style of the process diaphragm seal. The influence of the temperature can be minimized by a process diaphragm seal with a wider membrane diameter.

Influence of supply voltage:	≤ ±0,01% FS [2)] / 10V	
Minimum delay time:	≤ 2 ms	at maximum damping ≥ 20 seconds damping characteristic exponential

Mounting position

Maximum deviation [10)]: ≤ 0,18 mbar

High temperature variant – type H
At versions with process diaphragm seal the deadweight of the membrane and of the pressure transmitting liquid produces an additional zero value shift, whose amount depends on the style of the process diaphragm seal.

Over voltage protection

not available for Ex-variant Ex0K

Category:	coarse protection / fine protection
Signal voltage:	max. 30V peak value, to PE connection
Nominal bypass surge current:	10 000 A – wave 8/20µs
Trigger voltage:	90V coarse protection 33V fine protection

2) Referring to nominal measuring span resp. full scale (FS)
3) Nonlinearity + Hysteresis + Reproducibility
4) T_k = Temperature coefficient
5) At limit value adjustment
6) Specification valid, if adjusted measuring range = nominal measuring range, i.e. for TD [7)] = 1
At TD [7)] ≥ 1 (adjusted measuring range ≤ nominal measuring range):
Specification at adjusted measuring range = specification at nominal measuring range x TD [7)]
7) Turn-Down TD = nominal measuring range (FS [2)]) / adjusted measuring range)
10) Device rotated by 180°, process connection upside.
12) Higher values for special measuring range

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Technical data

Materials

Membrane: (medium contact)	Ceramic AL_2O_3	standard	96%
		highly clean	99,9%
	Steel 1.4404 (AISI 316L)	high temperature variant – type H	
Probe: (medium contact)	Steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti) / navy bronze CU SN 12 / hastelloy C / PEEK		
Carrying cable: (medium contact)	PE – polyethylene FEP – fluorinatedetylenepropylene		
Tube prolongation: (medium contact)	Steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)		
Process connection: (medium contact)	Steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti) / navy bronze CU SN 12 / hastelloy C / PEEK		
	Steel 1.4435 (AISI 316L)	high temperature variant – type H	
Connection housing:	POM – polyoxymethylene (Delrin®) / PP – polypropylene / CrNi-steel		
Cable gland:	Housing PA – polyamide resp. CrNi-steel, gaskets CR / NBR		
Device plug M12x1:	Socket CrNi-steel, insert PUR, contacts gold-plated		
Pressure compens. element:	Housing PA – polyamide, membrane ePTFE		
Gaskets:	medium contact ➔	FPM – fluorelastomere (Viton®) EPDM – etylene-propylene-dienmonomere CR – chloroprene-rubber (Neopren®) FFKM – perfluorelastomere (Kalrez®)	
	others ➔	FPM – fluorelastomere (Viton®) silicone	

Environmental conditions

Environmental temperature: – 20°C...+85°C, limitation at Ex variants

Limitation by variant	Environmental temperature range
Carrying cable	-20...+70°C
Limitation by material	**Environmental temperature range**
Connection housing PP	-10...+85°C

Process temperatures: – 20°C...+125°C, limitation at Ex variants

Limitation / Extension by variant	Process temperature range
High temperature variant – Typ H	-10...+140°C
Carrying cable	-20...+70°C
Limitation by material	**Process temperature range**
Gasket CR	-20...+120°C
Gasket FFKM	-15...+125°C

Process pressure ranges:	depends on variant, maximum – 1 bar ...20 bar	
Pressure transmitting liquid:	Vegetable oil	only at high temperature variant – type H
Vacuum- / overload resistance:	depends on meas. range, see table perm. pressure to the membrane	
Weight:	depends on variant	
Protection classification:	IP68	DIN EN 60529
Climatic classification:	4K4H	DIN EN 60721-3-4
Vibration classification:	4 g / 5 – 100 Hz	
EM – compatibility:	emission	DIN EN 61326-1 operation device class B
	immunity	DIN EN 61326-1 industrial range
Reference conditions:	DIN EN 60770-1 T = 25 °C, relative humidity 45...75 %, environmental air pressure 860...1060 kPa	

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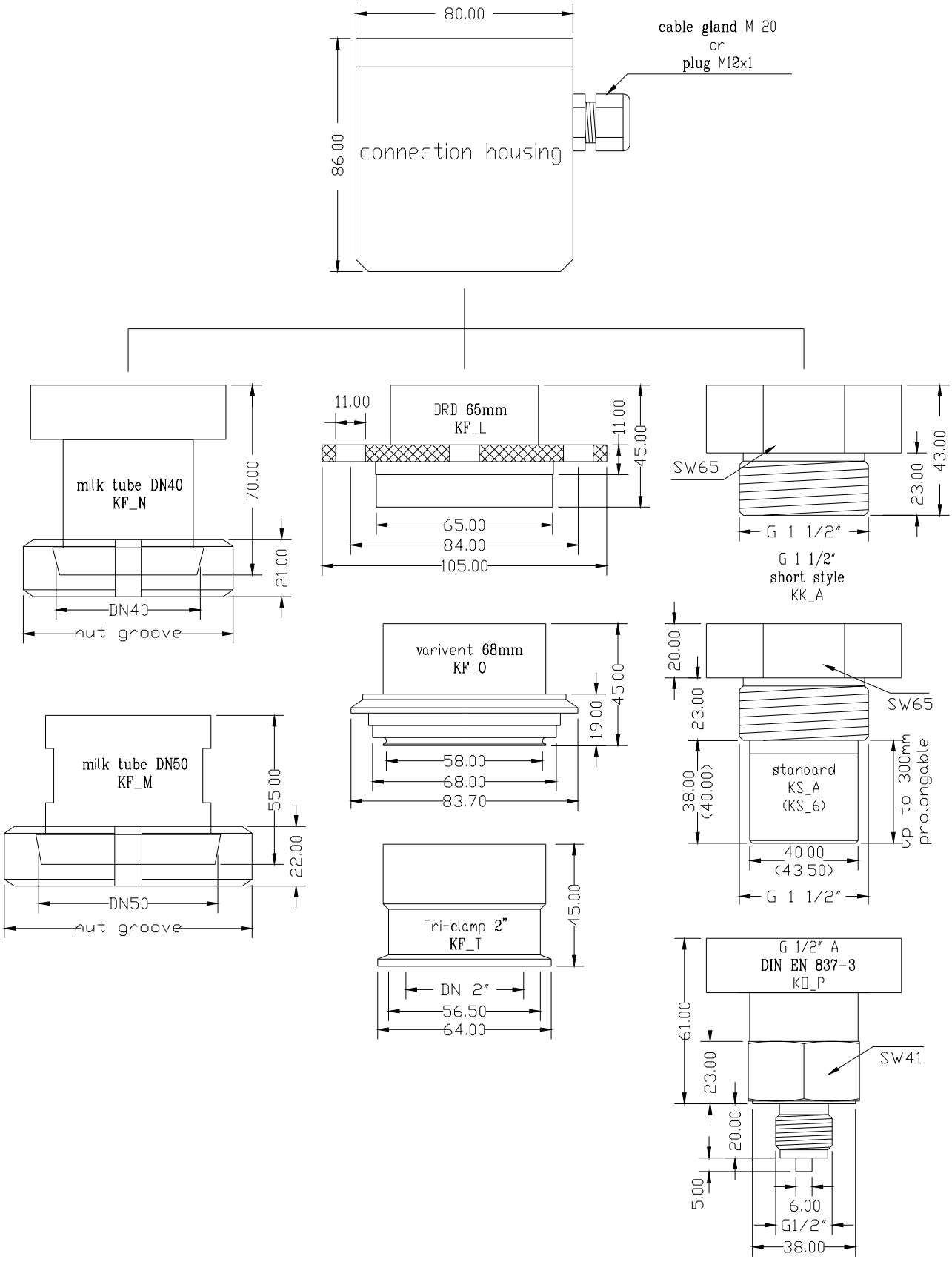
Dimension drawing



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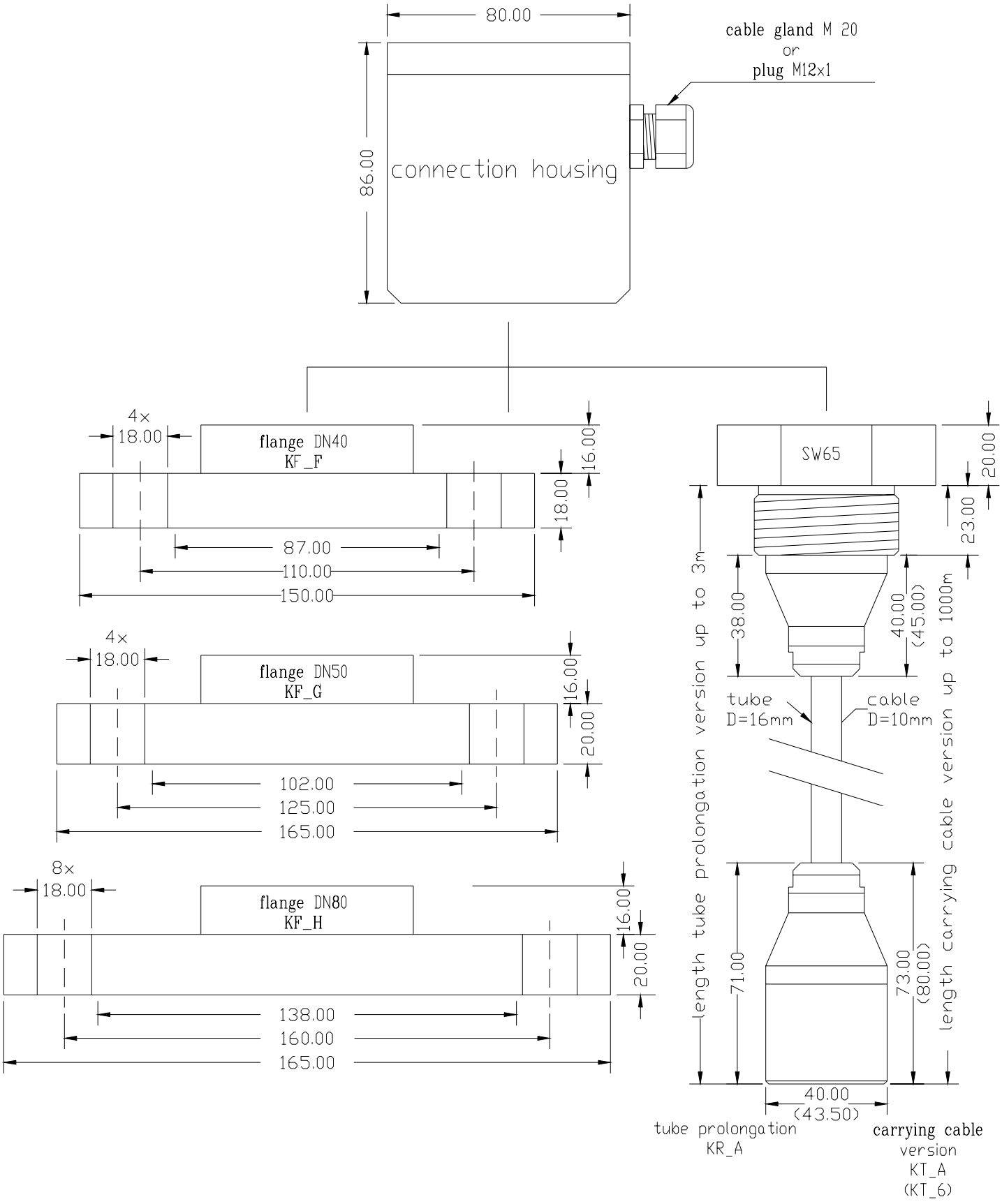
Dimension drawing



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Order code

Type:

K	Standard
Ex0K	ATEX II 1/2 G Ex ia IIC T4
Ex1K	ATEX II 2 G Ex ib IIC T4

Variant:

S	Standard	process connection type A – G 1½“
K	Short style	process connection type A – G 1½“
T	Carrying cable	probe prolongation type A – carrying cable PE / type E – carrying cable FEP
R	Tube prolongation	probe prolongation type C – tube ∅40mm / type D – tube ∅16mm
F	Front flush membrane	process connection type N, M, O, L, F, G, H, T
O	Screw-in thread	process connection type P – G ½“ manometer
H	High temperature	+140°C diaphragm seal with metallic membrane, welded
Y	others on request	

Accuracy measuring system *) – material measuring membrane (medium contact):

0	0,2%		ceramic AL_2O_3	96%
H	0,2%		ceramic AL_2O_3	99,9% (highly clean)
K	0,1%	Linearization protocol	ceramic AL_2O_3	96%
L	0,1%	Linearization protocol	ceramic AL_2O_3	99,9% (highly clean)

Process connection:

A	G 1½“ A		DIN EN ISO228-1		
N	Milk tube	DN 40, PN 40	DIN 11851		
M	Milk tube	DN 50, PN 40	DIN 11851		
O	Varivent	68 mm	DN40-80/DN1½“..6“, PN25	DN100/DN4“, PN20	DN125/DN6“, PN10
L	DRD	65 mm	DN 50, PN 40		
F	Flange	DN 40, PN 10-40	DIN EN 1092-1	sealing surface DIN 2527-D	
G	Flange	DN 50, PN 10-40	DIN EN 1092-1	sealing surface DIN 2527-D	
H	Flange	DN 80, PN 10-40	DIN EN 1092-1	sealing surface DIN 2527-D	
T	Tri-clamp	DN 2“, PN 16	ISO 2852		
P	G ½“ A		DIN EN ISO228-1	DIN EN 837-3	manometer (formerly DIN 16288)
-	without process connection				
B	Nut groove adapter				
Y	others on request				

Electronic – output – over voltage protection:

1	2-wire-technology 4...20 mA	without over voltage protection	
2	2-wire-technology 4...20 mA	with over voltage protection	not for type Ex0K

Measuring range:

P	0…50 mbar	5	0...10000 mbar
9	0…100 mbar	6	0...20000 mbar
0	0...200 mbar	A	0...25000 mbar
1	0...400 mbar	7	-1000...+1000 mbar
2	0...1000 mbar	8	-1000...+6000 mbar
3	0...2000 mbar	E	0...1000 mbar absolute pressure
4	0...4000 mbar	H	0...4000 mbar absolute pressure
		Y	special measuring range — separate spec. necessary

Material connection housing:

A	PP – polypropylene
C	CrNi-steel
D	POM – polyoxymethylene (Delrin®)

Electrical connection:

1	Terminal box
2	Plug M12x1

Material sensor housing:

1	Steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti)
3	Navy bronze CU SN 12
4	Hastelloy C

Gaskets (medium contact):

1	FPM	fluorelastomere (Viton®)	
2	CR	chloroprene-rubber (Neopren®)	
3	EPDM	etylene-propylene-dienmonomere	for food applications
4	FFKM	perfluorelastomere (Kalrez®)	
5	welded		at high temperature version type H
6	FFKM	perfluorelastomere high density	for gas applications

Probe prolongation:

0	No prolongation	
E	Carrying cable FEP	length max. 1 000 000 mm
A	Carrying cable PE	length max. 1 000 000 mm
C	Tube ∅ 40mm	length max. 300 mm
D	Tube ∅ 16mm	length max. 3000 mm
X	others on request	

Probe length incl. process connection: measure in mm

Hydrocont _ _ _ _ _ _ _ _ _ _ _ _ _____ **mm**

*) Higher values for special measuring range

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Order code

Variant with material PEEK for aggressive liquids

Type:

K	Standard
Ex0K	ATEX II 1/2 G Ex ia IIC T4
Ex1K	ATEX II 2 G Ex ib IIC T4

Variant:

S	Standard	process connection type 6 – G 1½“
K	Short style	process connection type 6 – G 1½“
T	Carrying cable	probe prolongation type A – carrying cable PE / type E – carrying cable FEP
Y	others on request	

Accuracy measuring system *) – material measuring membrane (medium contact):

0	0,2%		ceramic AL_2O_3	96%
H	0,2%		ceramic AL_2O_3	99,9% (highly clean)
K	0,1%	Linearization protocol	ceramic AL_2O_3	96%
L	0,1%	Linearization protocol	ceramic AL_2O_3	99,9% (highly clean)

Process connection:

6	G 1½“ A	DIN EN ISO228-1
-	without process connection	

Electronic – output – over voltage protection:

1	2-wire-technology 4...20 mA	without over voltage protection	
2	2-wire-technology 4...20 mA	with over voltage protection	not for type Ex0K

Measuring range:

P	0…50 mbar	5	0...10000 mbar
9	0…100 mbar	6	0...20000 mbar
0	0...200 mbar	A	0...25000 mbar
1	0...400 mbar	7	-1000...+1000 mbar
2	0...1000 mbar	8	-1000...+6000 mbar
3	0...2000 mbar	E	0...1000 mbar absolute pressure
4	0...4000 mbar	H	0...4000 mbar absolute pressure
		Y	special measuring range – separate spec. necessary

Material connection housing:

A	PP – polypropylene
C	CrNi-steel
D	POM – polyoxymethylene (Delrin®)

Electrical connection:

1	Terminal box
2	Plug M12x1

Material sensor housing:

6	PEEK

Gaskets (medium contact):

1	FPM	fluorelastomere (Viton®)	
2	CR	chloroprene-rubber (Neopren®)	
3	EPDM	etylene-propylene-dienmonomere	for food applications
4	FFKM	perfluorelastomere (Kalrez®)	
6	FFKM	perfluorelastomere high density	for gas applications

Probe prolongation:

0	No prolongation	
E	Carrying cable FEP	length max. 1 000 000 mm
A	Carrying cable PE	length max. 1 000 000 mm
X	others on request	

Probe length incl. process connection: measure in mm

Hydrocont _ _ _ _ _ _ _ _ 6 _ _ _____ mm

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

*) Higher values for special measuring range

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