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Technical Information
Ceracore UTC30
Process pressure measurement

Pressure transducer with capacitive, ceramic pressure sensor

Application
Pressure transducer for use in the pressure measurement of liquid and gaseous media.

Your benefits
Dry capacitive ceramic sensor with ultrapure (99.9 %) Al_2O_3 ceramic

- High overload resistance
- Very good long-term stability
- High corrosion resistance
- Digital/analog signal output (SPI, UART, U)
- Small physical size
- Measuring ranges from 0 to 0.1 bar (0 to 1.5 psi) to 0 to 100 bar (0 to 1500 psi)
- Optional temperature output, switch output

Endress+Hauser
People for Process Automation

Table of contents

About this document

Document function

This document contains all the technical data for the device and provides an overview of the device versions and accessories that can be ordered.

Symbols used

Safety symbols

Symbol	Meaning
⚠ WARNING	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
NOTICE	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personal injury.

Symbols for certain types of information

Symbol	Meaning
	**Tip** Indicates additional information.
	Reference to documentation
	Reference to page

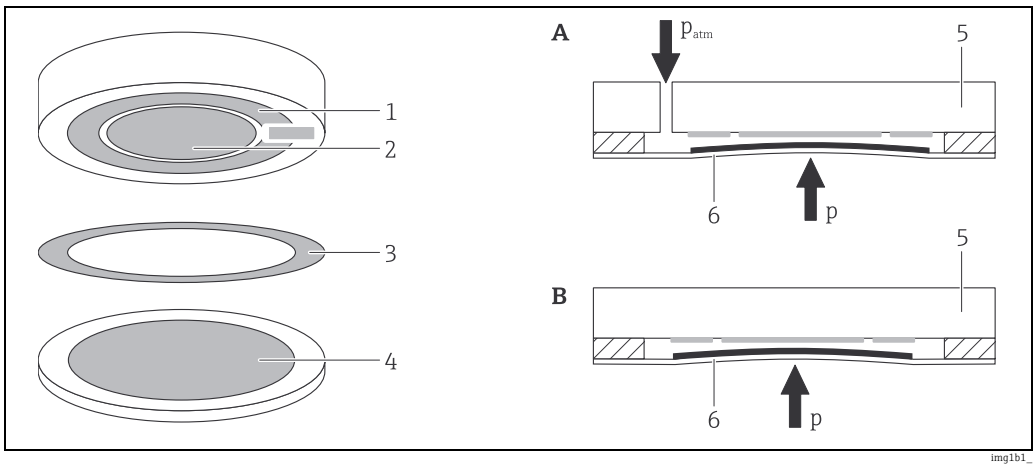
Symbols in graphics

Symbol	Meaning
1, 2, 3, ...	Item numbers
A, B, C, ...	Views

Function and system design

Measuring principle

A capacitive ceramic sensor element is at the core of the UTC30. The basic material is (Al_2O_3), an ultra-pure (99,9%) aluminum oxide ceramic that is highly resistant to many aggressive gases and liquids. Two cylindrical ceramic components (process isolating diaphragm and meter body) are hermetically sealed together. In the case of absolute pressure sensors, the reference vacuum of 3,0 x 10^{-6} mbar that is generated in the production process between the process isolating diaphragm and the meter body becomes permanent, thereby enabling precise pressure measurement relative to the vacuum. In the case of gauge pressure sensors, the back of the process isolating diaphragm is aerated, i.e. this sensor measures the gauge pressure relative to the atmospheric pressure.
In electrical terms, the sensor element represents a plate capacitor whose change in capacitance is a measure for the change in pressure. The capacitive measurement method satisfies the highest requirements with regard to resolution and reproducibility. Together with the hysteresis-free behavior of the Al_2O_3 material, it forms the basis for the excellent technical specifications of the pressure transducer. Furthermore, the sensor element is a dry measuring cell, i.e. there is no separating diaphragm or oil filling which could influence the measurement. Another clear advantage of the capacitive ceramic sensor is its high overload resistance.



img1b1_

A *Gauge pressure cell*
B *Absolute pressure cell*
1 *Cr electrode*
2 *Cp electrode*
3 *Brazing ring preform*
4 *Counterelectrode*
5 *Meter body*
6 *Process isolating diaphragm*
p_{atm} *Atmospheric pressure*

CARMEN

The CARMEN ASIC is used in sensor applications to measure physical variables (e.g. pressure) with external capacitive or resistive sensors in industrial environments.

Each type of sensor has its individual properties. CARMEN must compensate for these physical properties individually. To do so, CARMEN performs the following steps:
- Measurement of the external sensor (capacitance difference, voltage difference, temperature)
- Compensation of the sensor offset
- Gain adjustment
- Linearization of the sensor characteristics
- Compensation of temperature effects
- Output of the corrected and compensated measured values
- Additional functions (damping, filtering, etc.)

For the standard settings of the sensor, → 22.
The functionality and communication are explained in the S&C CARMEN Manual.

Input

Measured process variable

- Gauge pressure or absolute pressure
- Temperature

Measuring range

Sensor	Maximum sensor measuring range		Lowest calibratable span [1]	MWP	OPL	Vacuum resistance
	lower (LRL)	upper (URL)				
[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar_{abs} (psi_{abs})]
Sensors for gauge pressure measurement						
0.1 (1.5)	-0.1 (-1.5)	+0.1 (+1.5)	0.04 (0.6)	2.7 (40.5)	4 (60)	0.7 (10.5)
0.2 (3)	-0.2 (-3)	+0.2 (+3)	0.08 (1.2)	3.3 (49.5)	5 (75)	0
0.4 (6)	-0.4 (-6)	+0.4 (+6)	0.16 (2.4)	4 (60)	6 (90)	0
1 (15)	-1 (-15)	+1 (+15)	0.4 (6)	6.7 (100.5)	10 (150)	0
2 (30)	-1 (-15)	+2 (+30)	0.8 (12)	12 (180)	18 (270)	0
4 (60)	-1 (-15)	+4 (+60)	1.6 (24)	16.7 (250.5)	25 (375)	0
10 (150)	-1 (-15)	+10 (+150)	4 (60)	26.7 (400.5)	40 (600)	0
20 (300)	-1 (-15)	+20 (+300)	8 (120)	26.7 (400.5)	40 (600)	0
40 (600)	-1 (-15)	+40 (+600)	16 (240)	40 (600)	60 (900)	0
100 (1500) [1]	-1 (-15)	+100 (+1500)	40 (600)	100 (1500)	150 (2250)	0
Sensors for absolute pressure measurement						
0.1 (1.5)	0	+0.1 (+1.5)	0.04 (0.6)	2.7 (40.5)	4 (60)	0
0.2 (3)	0	+0.2 (+3)	0.08 (1.2)	3.3 (49.5)	5 (75)	0
0.4 (6)	0	+0.4 (+6)	0.16 (2.4)	4 (60)	6 (90)	0
1 (15)	0	+1 (+15)	0.4 (6)	6.7 (100.5)	10 (150)	0
2 (30)	0	+2 (+30)	0.8 (12)	12 (180)	18 (270)	0
4 (60)	0	+4 (+60)	1.6 (24)	16.7 (250.5)	25 (375)	0
10 (150)	0	+10 (+150)	4 (60)	26.7 (400.5)	40 (600)	0
20 (300)	0	+20 (+300)	8 (120)	26.7 (400.5)	40 (600)	0
40 (600)	0	+40 (+600)	16 (240)	40 (600)	60 (900)	0
100 (1500) [1]	0	+100 (+1500)	40 (600)	100 (1500)	150 (2250)	0

1) on request

⚠ WARNING

The maximum pressure for the measuring device depends on the lowest-rated element with regard to pressure.

- ▸ The measuring device must be operated only within the specified limits!

Power supply

Supply voltage

Type	Value
Digital output	2.9 ... 5.5 V DC
Analog output	4.9 ... 5.1 V DC [1]

1) other values on request

Current consumption

Connection of the sensor	Current consumption
Female header strip	< 1.6 mA
Male pin header strip	< 2.0 mA

Sensor connection

NOTICE

Incorrect polarity can damage the ASIC!

- Ensure polarity is correct.

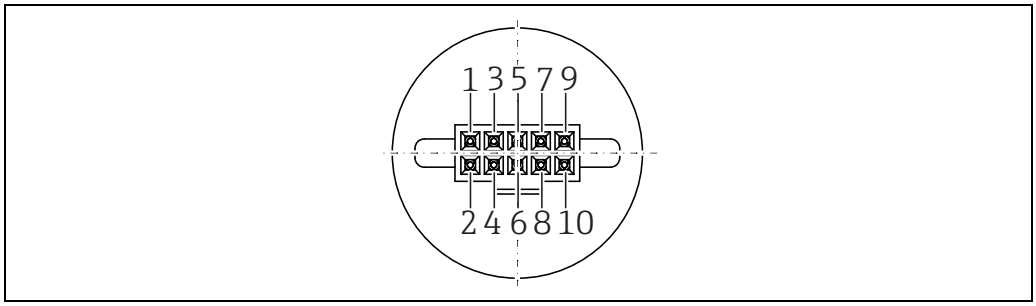
NOTICE

Incorrect analog measured value due to cable break from GND!

- Prevent cable break from GND.

Female header strip 2x5 pins (1.27 mm (0.05 in) spacing)

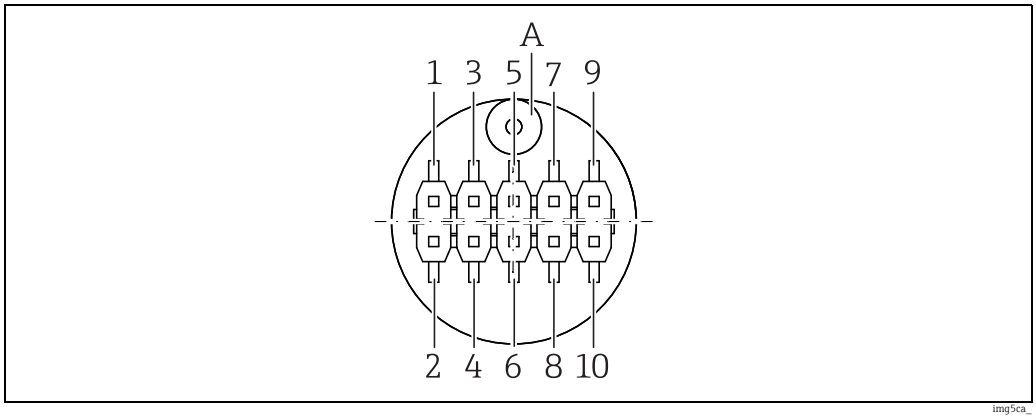
- Socket type: SAMTEC SFML-105-02-L-D
- Insertion force (axial only): max. 40 N



imgdf1_

PIN	Designation	Explanation	Application		
			Digital		Analog
			UART	SPI	
1	GND	Negative supply voltage	X	X	X
2	RESET_N	Reset (low active)	optional	optional	optional
3	VDD	Positive supply voltage	X	X	X
4	DAC	Analog output	optional	optional	optional
5	SW_OUT	Switch output (open drain)	optional	optional	optional
6	SPI_SEL	Communication mode selection (UART "GND" or SPI "VDD")	force to "GND"	force to "VDD"	force to "GND"
7	SCK	SPI clock, must be connected to GND if SPI is used	–	X	–
8	CS_N	Chip select (low active)	optional	optional	–
9	TxD/SO_RDY	Digital communication output	X	X	–
10	RxD/SI	Digital communication input, must be connected to GND if not used	X	X	force to "GND"

Male pin header strip 2x5 pins (2,54 mm (0,1 in) spacing)



A Reference air tube for orientation of the pin assignement

PIN	Designation	Explanation	Application		
			Digital		Analog
			UART	SPI	
1	SPI_SEL	Communication mode selection (UART "GND" or SPI "VDD")	force to "GND"	force to "VDD"	force to "GND"
2	SCK	SPI clock, must be connected to GND if SPI is not used	–	X	–
3	VDD	Positive supply voltage	X	X	X
4	TxD/SO_RDY	Digital communication output	X	X	X
5	GND	Negative supply voltage	X	X	X
6	RxD/SI	Digital communication input, must be connected to GND if not used	X	X	force to "GND"
7	DAC	Analog output	optional	optional	X
8	SW_OUT	Switch output (open drain)	optional	optional	optional
9	CS_N	Chip select (low active)	optional	optional	–
10	RESET_N	Reset (low active)	optional	optional	optional

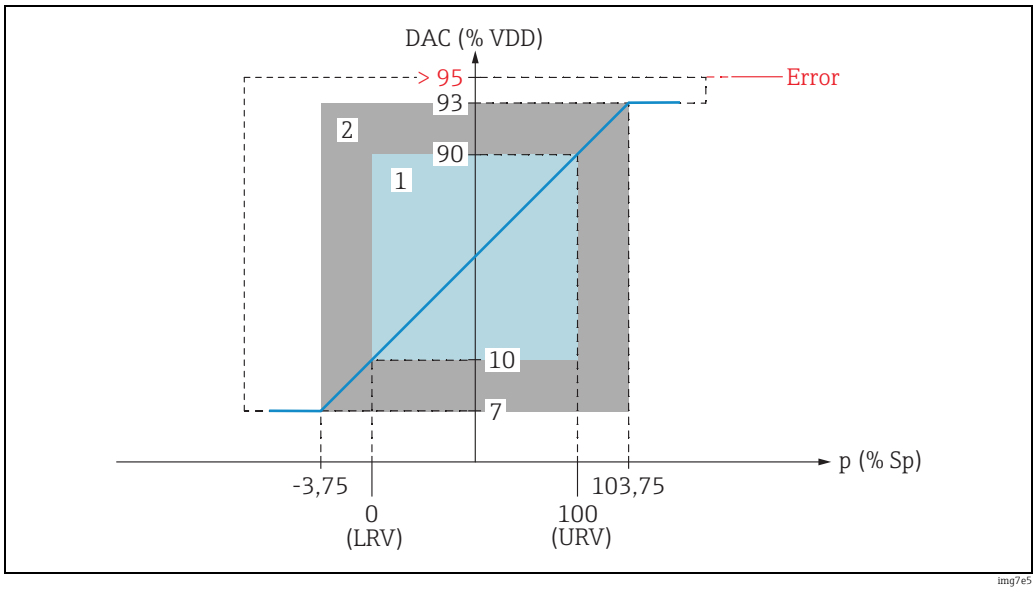
Output

Output signal

Type	Output
Voltage output (pressure)	10 to 90 % VDD (ratiometric, VDD = 5.0 V DC)
	10 to 90 % VDDA (absolut, VDDA = 2.65 V DC)
Digital output (pressure & temperature)	SPI
	UART
Switch output (pressure) [1]	Switch (via CARMEN)

1) On request

Signal range and signal on alarm of voltage output



1 Calibrated measuring range
2 Extended measuring range
DAC Digital-to-analog converter

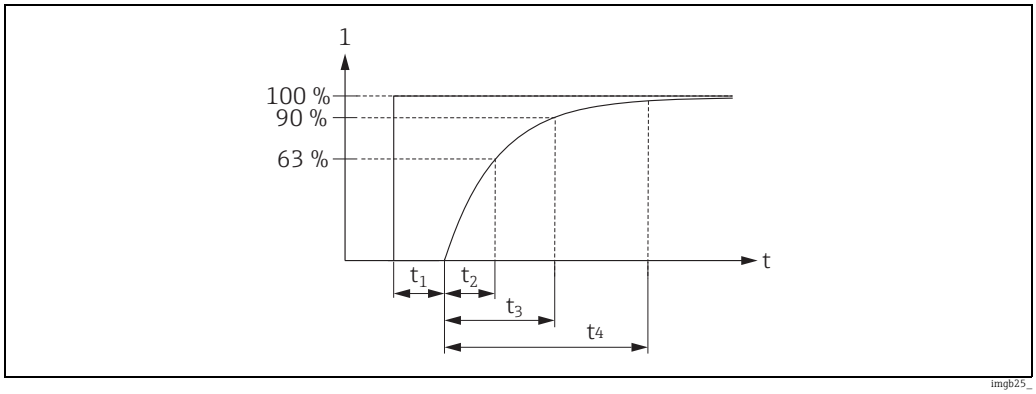
The signal range and the signal on alarm are based on NAMUR NE 43. The error value of the signal on alarm can be configured and is displayed in the illustration for the example > 95 % VDD (CARMEN standard sensor setting).

Behavior in the event of an error

See the S&C CARMEN Manual

Dead time, time constant

Presentation of the dead time and the time constant:



1 % of the measured value

Dynamic behavior

Output	Sampling rate [ms]	Dead time (t_1) [ms]	Time constant T63 (t_2) [ms]	Time constant T90 (t_3) [ms]	Time constant T99 (t_4) [ms]
Digital	20	40	74	88	99
	5	10	18,5	22	25
	1,25 [1)]	3,75	6	7	8
Analog	20	29	63	75	88
	5	8	15,5	19	22
	1,25	2	4,5	6	8,5

1) The maximum sampling rate that can be configured for measured value recording is 1.25 ms, but the maximum speed of the digital output is limited to 2.5 ms.

Damping

Customizable setting: 0 to 40 s

Switch-on time and Warm-up period

The switch-on time is the time that elapses from when the supply voltage is switched on to when the first digital value or initial analog value is available.

The warm-up period is the time that elapses from when the supply voltage is switched on to the first digital measured value or analog value within the specified reference accuracy (e.g. 0.1 % span).

Output	Sampling rate [ms]	Switch-on time [ms]	Warm-up period [ms]
Digital	20	38.75	98.75
	5	23.75	38.75
	1.25	20	23.75
Analog	20	10	50
	5	10	35
	1.25	10	30

Performance characteristics

Reference operating conditions

- As per DIN EN IEC 62828
- Ambient temperature T_A = constant, in range: +23 to +27 °C (+73 to +81 °F)
- Relative humidity φ = constant, in range: 5 to 80 % RH.
- Ambient pressure p_A = constant, in range: 860 to 1 060 mbar (12.47 to 15.37 psi)
- Position of measuring cell = constant, in range: process isolating diaphragm pointing downwards (see also the "Influence of installation position" section → 12)
- Process isolating diaphragm material: Al_2O_3 (aluminum oxide ceramic FDA, ultrapure 99.9 %)
- Analog output supply voltage: 4.9 to 5.1 V DC
- Digital output supply voltage: 2.9 to 5.5 V DC

Reference accuracy

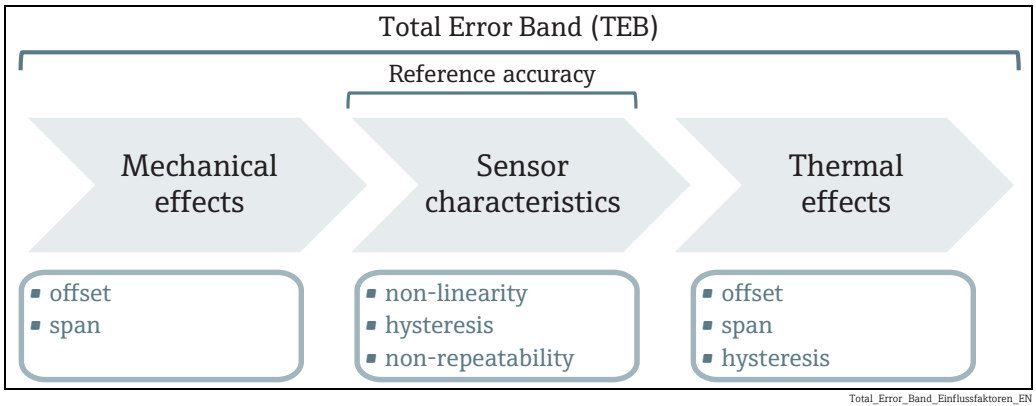
The reference accuracy includes the non-linearity [DIN EN 61298-2 3.9], the non-repeatability [DIN EN 61298-2 3.10] and the pressure hysteresis [DIN EN 61298-2 3.11] in accordance with the limit point method as per [DIN EN 61298-2].

Sensor	Reference accuracy in % of calibrated span
Platinum	±0,1 x TD for TD [1] 1:1 to TD 5:1

1) TD = Turn Down, → 23.

Total Error Band (TEB)

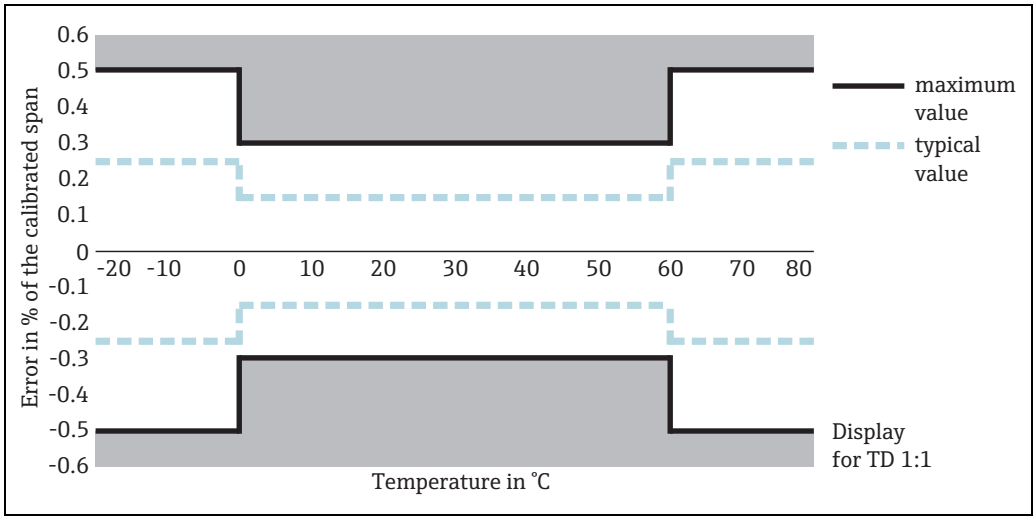
The Total Error Band includes the following influencing factors:



Total_Error_Band_Einflussfaktoren_EN

Total Error Band

- Sensor measuring range: 0.1 to 0.4 bar
- Process temperature: -20 to 80 °C

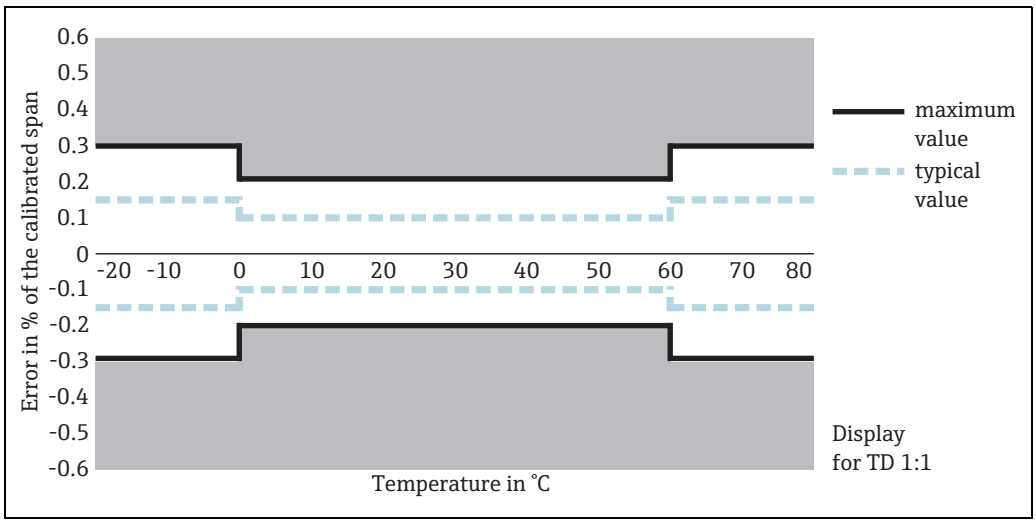


Total_Error_Band_below_1_bar_EN

Temperature range						Error in % of the calibrated span	
						Typ. value	Max. value
0	to	+60 °C	(+32	to	+140 °F)	± 0.15 x TD	± 0.30 x TD
−20 +60	to	0 °C +80 °C	(−4 (+140	to	+32 °F) +176 °F)	± 0.25 x TD	± 0.50 x TD

Total Error Band

- Sensor measuring range: 1 to 40 bar
- Process temperature: -20 to 80 °C



Total_Error_Band_1_to_40_bar_EN

Temperature range						Error in % of the calibrated span	
						Typ. value	Max. value
0	to	+60 °C	(+32	to	+140 °F)	± 0.10 x TD	± 0.20 x TD
−20 +60	to	0 °C +80 °C	(−4 (+140	to	+32 °F) +176 °F)	± 0.15 x TD	± 0.30 x TD

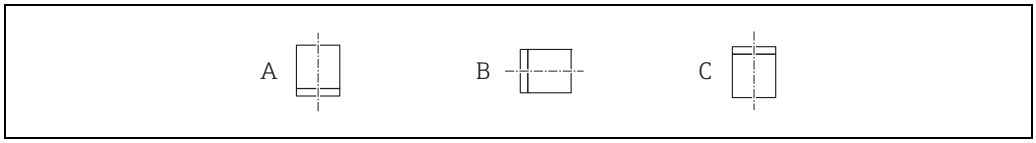
Long-term stability

≤ 0,1 %/year related to the upper range limit (URL).

Installation

Influence of the installation position

Any installation position is possible but it may cause a zero point shift.



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	Process isolating diaphragm pointing downwards (A)	Process isolating diaphragm axis is horizontal (B)	Process isolating diaphragm pointing upwards (C)
<1 bar (15 psi)	Reference position, no effect	Up to +0.1 mbar (0.0015 psi)	Up to +0.2 mbar (0.0030 psi)
≥1 bar (15 psi)	Reference position, no effect	<0.1 mbar (0.0015 psi)	Up to +0.1 mbar (0.0015 psi)

Installation conditions

- During installation, electrical connection and operation, no moisture may penetrate the device.
- The back of the sensor element must not be encapsulated. For a version suitable for encapsulation, the electronics housing (→ 15) must be used.

Process

Process temperature range

−20 to +80 °C (−4 to 176 °F)
Extended temperature range −40 to +125 °C (−40 to +257 °F) (on request)

Process temperature range, seals

Seal	Notes	Process temperature range
FKM	–	−20 to +80 °C (−4 to +176 °F)
FKM	FDA21 CFR177.2600 USP Class VI 3A; BAM	0 to +80 °C (+32 to +176 °F)
EPDM	FDA21 CFR177.2600 USP Class VI (up to +70 °C (+158 °F)) 3A DVGW (W270, W534), WRAS, ACS NSF61	−20 to +80 °C (−4 to +176 °F)
NBR	–	−20 to +80 °C (−4 to +176 °F)

Environment

Ambient temperature range

−20 to +80 °C (−4 to 176 °F)
Extended temperature range −40 to +125 °C (−40 to +257 °F) (on request)

Storage temperature range

−40 to +125 °C (−40 to +257 °F)

Degree of protection

System	Degree of protection
Open	IP00

Climate class

System	Climate class	Note
Open	Class 3K3	Air temperature: 5 to 40 °C (41 to 104 °F), relative humidity: 5 to 85 % satisfied according to 60721-3-3 (condensation not permitted)

Electromagnetic compatibility (EMC)

No specifications (open system)

Overvoltage protection

6 V DC (maximum voltage for CARMEN ASIC)

Vibration resistance

Test standard	Vibration resistance
GL VI-7-2 Part 7: Guidelines for the Performance of Type Approvals Chapter 2: Test Requirements for Electrical/Electronic Equipment and Systems	Guaranteed for 5 to 25 Hz: ±1.6 mm (0.06 in); 25 to 100 Hz: 4 g in all 3 axes

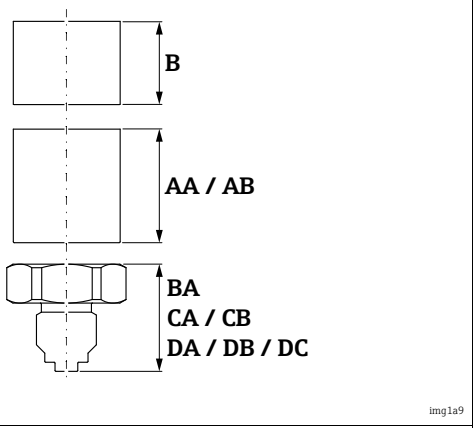
Mechanical construction

Device height

The total height is calculated from

- the height of the housing and
- the height of the individual process connection.

The individual heights of the components can be found in the following sections. To calculate the total height, simply add up the individual heights of the components. You can use the following table for this:

Section	Page	Height	Example
Electronics housing	→ 15	B	
Process connections	→ 15	AA / AB BA CA / CB DA / DB / DC	
Device height			

Materials

Materials in contact with process

Component part	Material
Process connections	316L
Process isolating diaphragm	Al_2O_3 aluminum-oxide ceramic FDA, ultra-pure 99.9 % [1]
Seal	▪ FKM ▪ FKM (inkl. FDA approval) ▪ EPDM ▪ NBR

1) The US Food & Drug Administration (FDA) has no objections to the use of ceramics made of aluminum oxide as a surface material in contact with foodstuffs. This declaration is based on the FDA certificates of our ceramic suppliers.

TSE free (Transmissible Spongiform Encephalopathy)

The following applies to all device components in contact with the process:

- They do not contain any materials derived from animals.
- No additives or operating materials derived from animals are used in production or processing.

Process connections

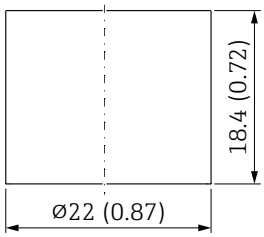
Endress+Hauser supplies a threaded connection made of stainless steel in accordance with AISI 316L (DIN/ EN material number 1.4404 or 1.4435). With regard to their stability-temperature property, the materials 1.4404 and 1.4435 are grouped together under 13E0 in EN 1092-1: 2001 Tab. 18. The chemical composition of the two materials can be identical.

Materials not in contact with process

Component part	Material
Electronics housing	316L

Electronics housing

B



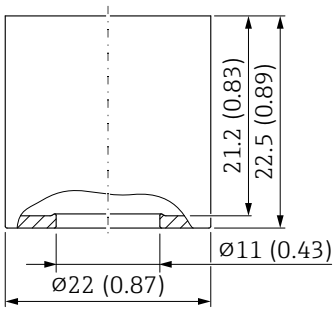
Unit of measurement mm (in)

Position	Designation	Material
B	Electronics housing (optional [1])	316L

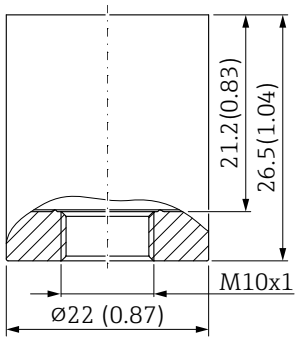
1) The electronics housing is mounted if the male pin header strip 2x5 pins is selected.

Process connections

AA



AB/AC

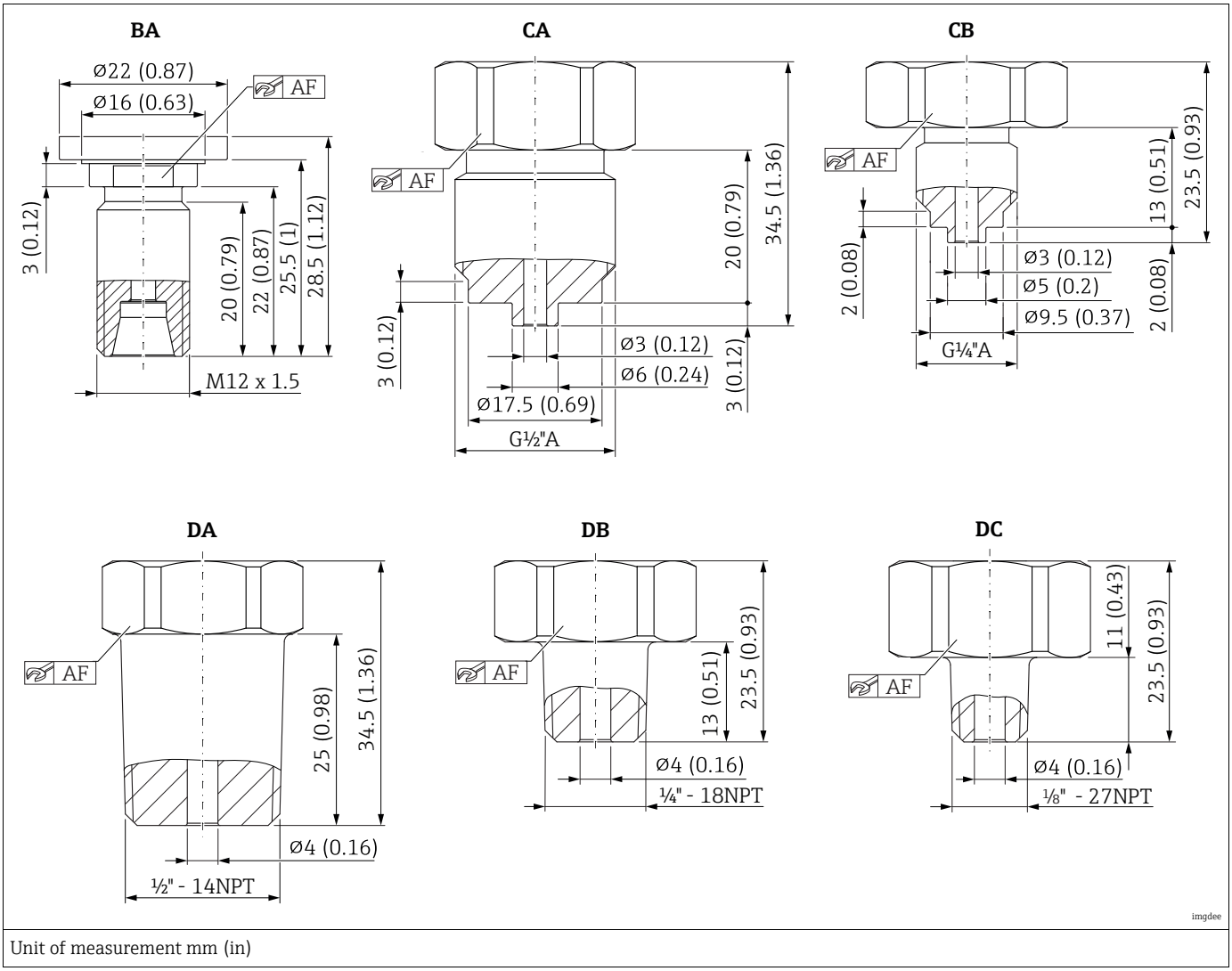


Unit of measurement mm (in)

Position	Designation	Material
AA [1]	Capsule ø22 x 22.5 mm, flush-mounted	316L
AB [2]	Capsule ø22 x 26.5 mm, M10 x 1	316L
AC	Capsule ø22 x 26.5 mm, M10 x 1	Titan (3.7035)

1) The "AA" capsule is used if the process connection KB on the following page is used.

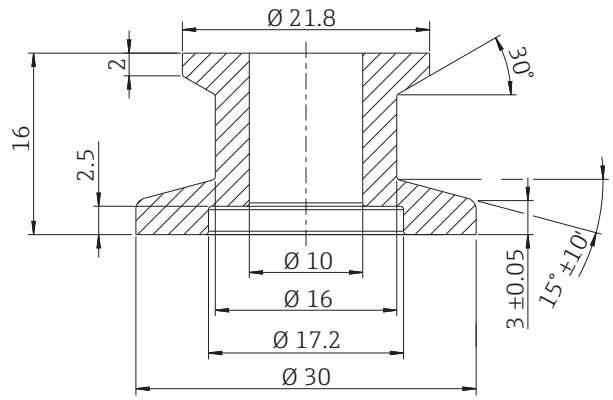
2) The "AB" capsule is used if one of the process connections BA to DC on the following page is used.



Unit of measurement mm (in)

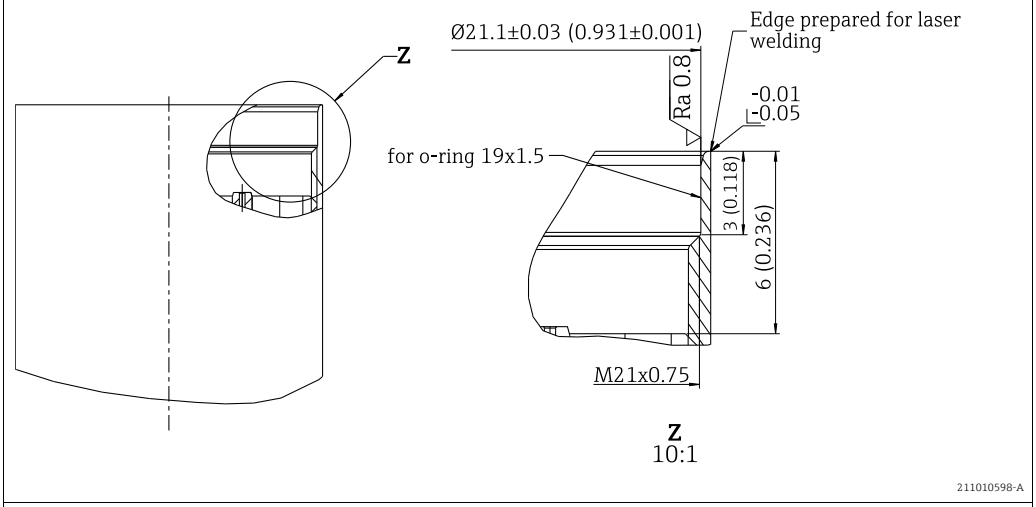
Position	Designation	AF	Material
BA	24° cutting ring fitting M12x1.5; 6L	14	316L
CA	Thread ISO 228 G1/2", EN837	24	316L
CB	Thread ISO 228 G1/4", EN837	24	316L
DA	ASME 1/2" MNPT, bore 4mm	24	316L
DB	ASME 1/4" MNPT, bore 4mm	24	316L
DC	ASME 1/8" MNPT, bore 4mm	24	316L
KB	Small flange DN16 (DIN 28403)	–	316L

KB



Unit of measurement mm (in)

Interfaces



Unit of measurement mm (in)