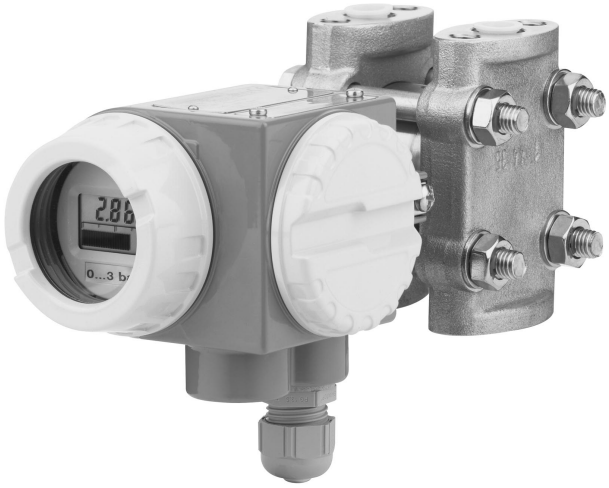
Technical
Information
TI 330P/00/en

Differential Pressure Transmitter *deltabar S PMD 25 K for use in Nuclear Power Plants*

Deltabar S with silicon sensor overload resistant with function monitoring



Application

The Deltabar S transmitter is used for the following differential pressure measurement tasks:

- Flowrate (volumetric or mass flow) in connection with primary devices in gases, vapours and liquids
- Level, volume or mass flow measurement in liquids
- Differential pressure monitoring of filters and pumps

Features and Benefits

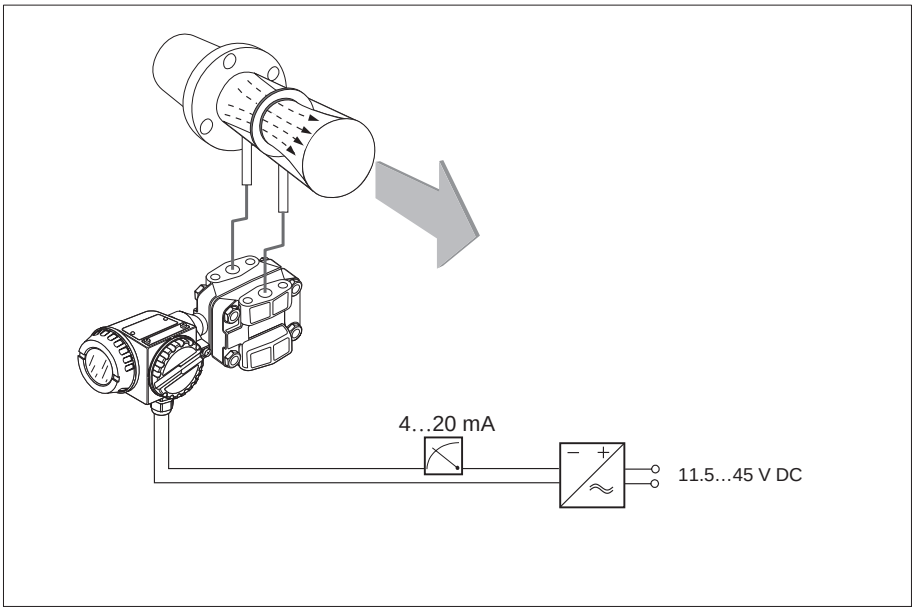
- High accuracy
  - Linearity better than 0.1% of set span
  - Long-term drift better than 0.1% per year
- Universal modularity for differential pressure and process pressure (Deltabar S – Cerabar S), e.g.
  - Replaceable display
  - Sensor modules
  - Universal electronics for process pressure and differential pressure
- Zero and span freely adjustable with or without referential pressure
- Self-monitoring from sensor to electronics
- Wide variety of software functions such as characteristic curves, diagnostic codes, totalizer etc.
- Type-tested for nuclear power plants as per KTA 3505 and IEEE standard 323/344

Endress+Hauser

The Power of Know How

Measuring System

System Components
The complete measuring system consists of:
- Deltabar S differential pressure transmitter with
  – 4…20 mA signal output
  – power supply: 11.5…45 V DC

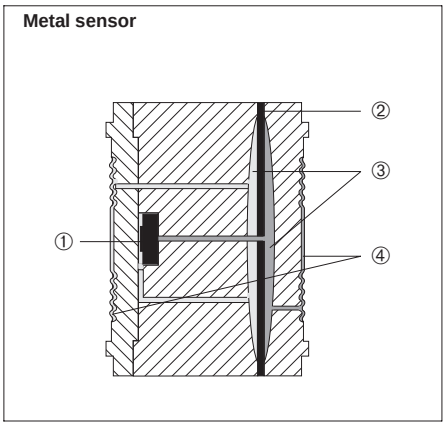


Current output
4…20 mA

Operating Principle

Metal Sensor
The separating diaphragm is deflected on both sides by the acting pressure with a fill fluid transmitting the pressure to a resistance bridge (semiconductor technology). The bridge output voltage, which is proportional to differential pressure, is then measured.

Advantages:
- Standard system pressures until 250 bar/3625 psi
- Excellent long-term stability
- Guaranteed resistance to single-sided overload
- Alloy C diaphragm as standard



Metal sensor
① Measuring element
② Overload diaphragm
③ Fill fluid
④ Separating diaphragm as nap diaphragm extended

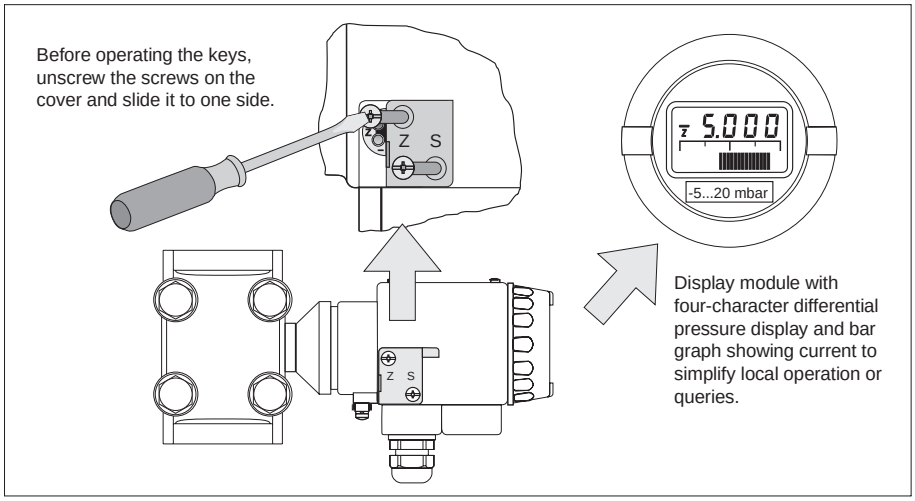
Operation

Operation Using Keys on the Instrument

The Deltabar S is calibrated via four keys on the instrument, directly at the place of installation. The differential pressure for 4 mA and 20 mA output can either be adopted directly from the system pressure or else calibrated without reference pressure.

- Lower range-value: +Z and –Z
- Upper range-value: +S and –S

A zero point shift due to the orientation of the instrument (bias pressure) can also be corrected using these keys as well as for locking and unlocking the measuring point.



Operating with keys

Screw the cover down securely with both screws after operation.

Installation

Mounting Instructions

- The instrument can be easily commissioned without interrupting the process by using a three or five way manifold.
- For measurement in media with a solids content (e.g. contaminated liquids) separators and drain valves should be used in order to trap and remove any build-up that may occur.
- By simply loosening the locking screw, the housing of the Deltabar S can be rotated up to 330°.

Shifting of the Zero Point due to Position

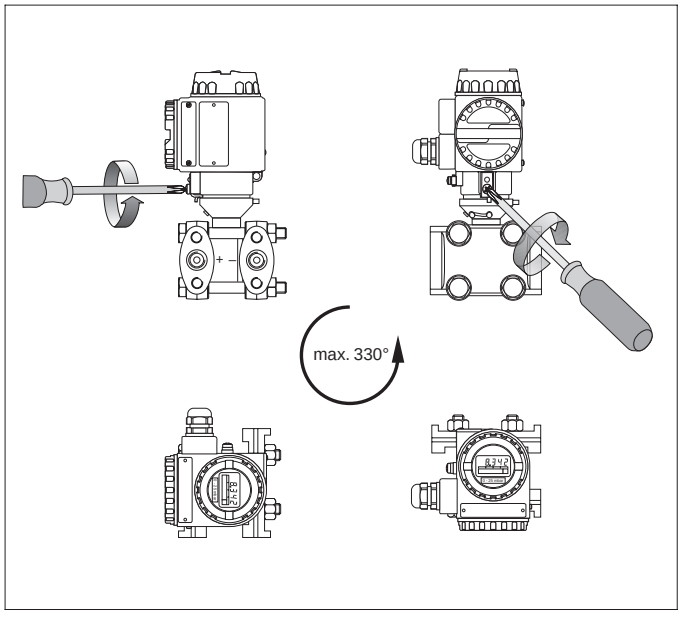
The Deltabar S is calibrated based on the limit point method according to DIN 16086.
Due to the hydrostatic column of fluid in the sensor, the zero point of the instrument depends on it being positioned between the vertical and horizontal planes and may vary up to 2 mbar (0.029 psi). Diaphragm seals also shift the zero point depending on the orientation of the instrument. This shift due to position can also be fully corrected by zero point calibration.

Instructions for Mounting with Pressure Piping

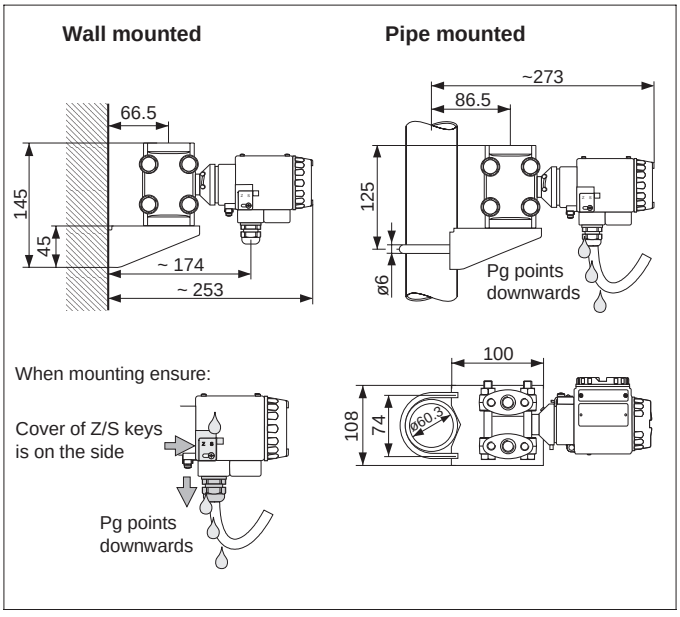
- General recommendation for laying pressure pipes are found in DIN 19210 "Process lines for flow measurement systems" or else in the appropriate national or international standards.
- Pressure piping must be laid at a slight incline.
- There must be suitable frost protection when installing pressure piping in the open (e.g. parallel heating pipes).

Conversion factors
1 mm = 0.039 in
1 in = 25.4 mm

Dimensions are in mm.



Positioning the housing
After mounting the Deltabar S, position the housing so that:
- the terminal connection compartment is easily accessible,
- the display can be seen most easily (display can be rotated in steps of 90°,
- the cable entry and the cover of the Z/S keys are protected from water (best position: cable entry points downwards).



Wall and pipe mounting with bracket
Mount the housing so that:
- The cable gland always points downwards thus any moisture on the connecting cable can run off and not enter the housing.
- The cover for the Z/S keys is on the side of the housing thus condensation and moisture can run off and not enter the housing.

Installation for Flow Measurement

Flow Measurement
For flow measurement, a differential pressure is created by primary elements in the piping.
The Deltabar S differential pressure transmitter measures volumetric or mass flow derived from the differential pressure.

This measuring principle can be used anywhere:
- in gases, vapours and liquids
- for any nominal diameters
- for circular and square pipe cross-sectional areas
- for flowrates with a dynamic range of 12:1 (if density is stable); typically: 6:1 to 3:1.

Primary Elements
The following primary elements are standardised according to DIN ISO 5167 and DIN 1952:
- Orifice plates
- Nozzles
- Venturi nozzles
- Venturi pipes and others

For standard nominal widths these sensor elements are used in applications on a case to case basis. Because dimensions are standard, no calibration of the entire flow measurement section is required. Calibrated measurement sections are used for nominal diameters outside the standard range.

Pitot Tube Sensors
Very small pressure losses can be measured using pitot tube sensors. Because of standards used for orifice plates, again no calibration is required.

Measuring Systems with Flow Computers
When high accuracy is required with varying temperatures and static pressures the use of a flow computer is recommended. This processes the input variables of differential pressure, process pressure and temperature and supplies the following output variables:
- Volumetric flowrate
- Mass flowrate
- Heat quantity
- Calorific value

Installation for Level Measurement

Level, Volumetric and Mass Measurement
Hydrostatics is the most widely used principle for continuous level measurement of liquids.
A hydrostatic pressure is created due to the weight of a column of liquid. At constant density ρ the hydrostatic pressure is determined only by the height h of the column of liquid.

$$\Delta p = \rho \times g \times h$$

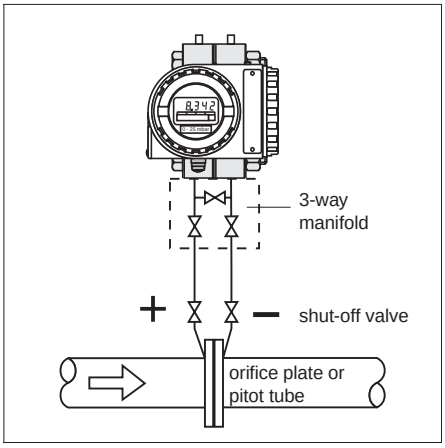
Where:
ρ: density of the medium
g: gravity constant (9.81 m/s^2)
h: level

If the liquid is under pressure, then this pressure acts on both sides of the Deltabar S and is thus cancelled out, refer to measuring systems on page 6.

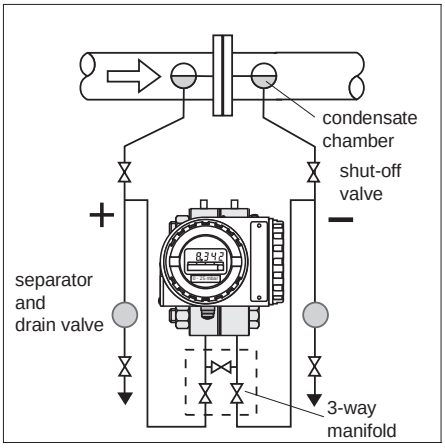
The measurement principle can be used especially for measuring
- liquids with foam,
- in vessels with agitators or filters
- and also in any shape of vessel.

Examples for Measuring Systems

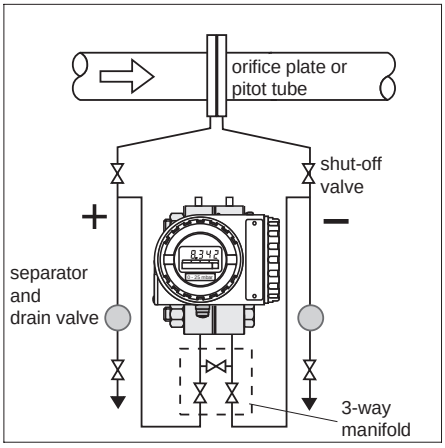
Flow Measurement



Gas:
- Mount the Deltabar S above the measuring point so that any condensate in the process line runs out.

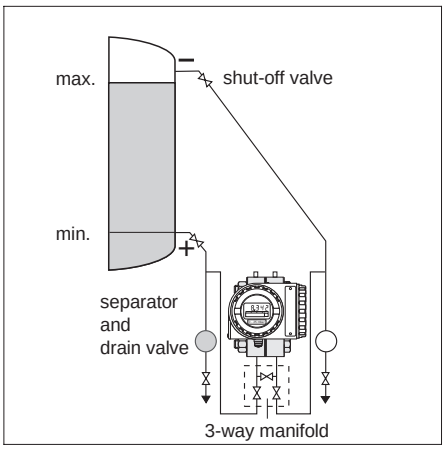


Vapours:
- Mount the Deltabar S below the measuring point.
- Mount and fill the condensate chambers at the same height as the bleeder connection.



Liquids:
- Mount the Deltabar S below the measuring point so that the pressure piping is always filled with liquid.

Level Measurement



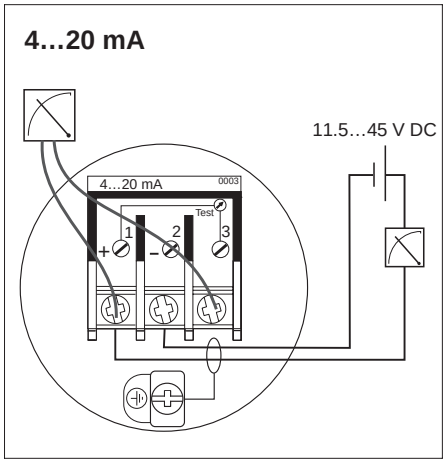
Closed vessels:
- Mount the Deltabar S below the lower connection so that the pressure piping is always filled with liquid.
- The negative side must be connected above the maximum level.

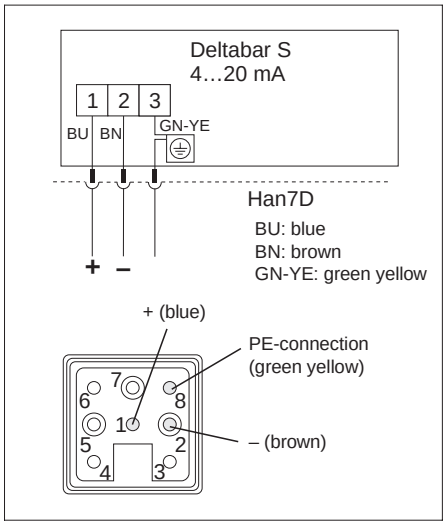
Electrical Connection

Wiring 4…20 mA

The two-wire cable is connected to screw terminals (wire diameter 0.5…2.5 mm^2/AWG 20…13) in the connecting compartment.

- We recommend using a twisted, screened two-wire cable for the connection line.
- Supply voltage: 11.5…45 V DC
- Internal protection circuits against reverse polarity, HF interference and overvoltage peaks.
- Test signal:
  The output current can be measured between terminal 1 and 3 without interrupting the process measurement.





Harting plug schematic diagram, view from the plug side

Technical Data

General Information

Manufacturer	Endress+Hauser
Designation	Deltabar S PMD 25 K

Application

Deltabar S	The instrument is used for the measurement of flow in gases, vapours and liquids; for the measurement of level in liquids as well as for the measurement of differential pressure in gases, vapours and liquids

Operation and System Design

Measuring Principle	piezoresistive with metallic sensor
With 4…20 mA current output	Deltabar S and power supply Operation using four keys on the instrument and a plug-in display module

Input

Measured variables	Differential pressure for deriving flowrate (volumetric or mass flow), level, mass or volume

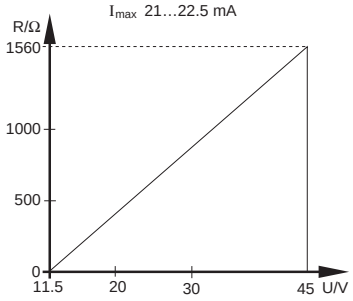
Measuring range

Nominal value Silicon sensor (URL)	Measurement limits		Recommended span		System pressure	Overload		Sensor
PMD 25 K [mbar]	Lower (LRL) [mbar]	Upper (URL) [mbar]	Minimum [mbar]	Maximum [mbar]	PN [bar]	One-sided	Two sided	Filling fluid
100	–100	100	5	100	250	PN	1.5 x PN	silicone oil
500	–500	500	25	500	250	PN	1.5 x PN	silicone oil
3000	–3000	3000	150	3000	250	PN	1.5 x PN	silicone oil
16000	–16000	16000	800	16000	250	PN	1.5 x PN	silicone oil

Min. system pressure	p_{abs} larger than 1 mbar for all sensors and measuring ranges

Output

4…20 mA

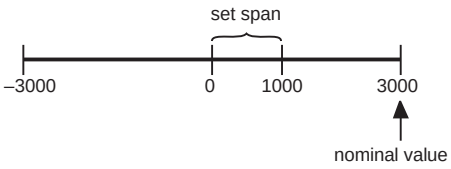
Output signal	4 to 20 mA, under-run 3.8 mA (4 mA adjustable), over-run 21…22.5 mA
Load diagram	
Signal on alarm	Standard: 22 mA Options: max.: setting in the range 21…22.5 mA continue: last measured value held min.: 3.6 mA
Resolution	1 µA
Damping (Integration time)	adjustable, 0…16 s via rotary switch
Adjusting range	freely adjustable within the limits of the lower range-value and the upper range-value
Reference conditions	DIN IEC 60770 T_U=25°C Accuracy data adopted after entering "Low sensor calibration" and "High sensor calibration" for lower range-value and upper range-value (measuring range based on zero point)
Linearity including hyteresis and repeatability based on the limit point method to IEC 60770	toTD 10:1: ±0,1% of the set span for TD 10:1 to 20:1: 0.1% span x [Nominal value/(set span x 10)]
Long-term drift	0.1% of nominal value/year, 0.25% of nominal value/ 5 years
Effects of system pressure on the zero point (on the span) Values in percent of nominal value	**Metal sensor** Nom. Value: 100 mbar, 500 mbar, 3 bar, 16 bar Deviation: 0.2 (0.2)%/100 bar
Temperature hysteresis	< 0.1% of the sensor nominal value

Root values
For root characteristic curves:
The accuracy specifications of the Deltabar S are reduced by factor of ½ when calculating flowrates.

Accuracy

Explanation of terms

Turn-down (TD)
= Nominal value / set span

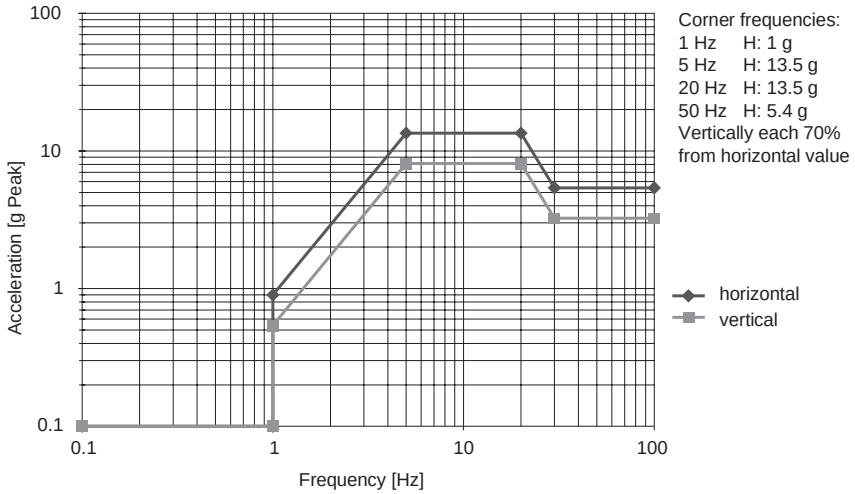


Example: Nominal value = 3000 mbar
set span = 1000 mbar
TD = 3:1

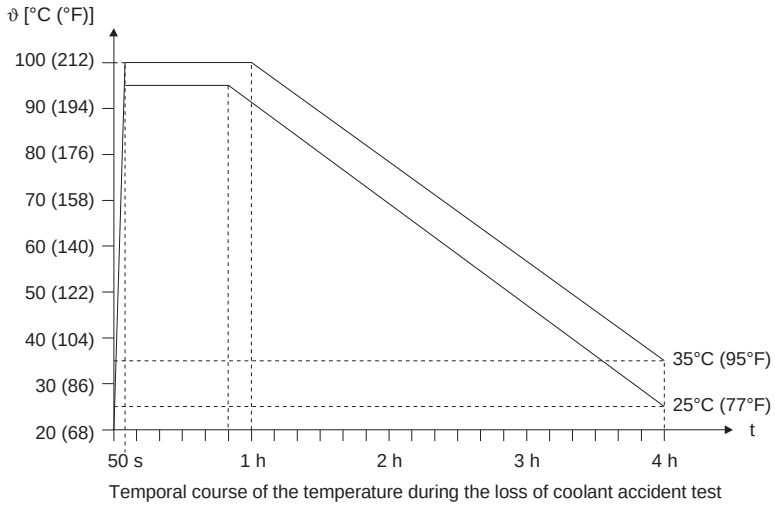
Accuracy (continuation)

$T_{63\%}$ (τ)	390 ms
Thermal effects	(0.2% x TD + 0.2%) of set span
Response under irradiation	no influence on the output signal at effect of a cumulative total dose of 10 Gy
Vacuum resistance	to 1 $mbar_{abs}$
Vibration load	type-tested as per KTA 3505 and IEEE standard 323/344
Seismic construction	no deviation of the output signal at maximum twice-repeated effect of a mechanical load as per diagram

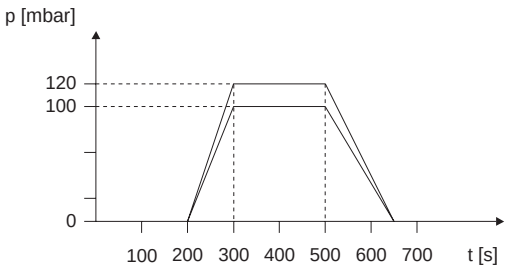
Required response spectrum of safe shutdown earthquake (SSE)



Loca (Loss of Coolant Accident)	Non-recurring permitted accident load, see temperature and pressure diagram. Deviation of < 0.1% after influence has subsided (see diagram).



Temporal course of the temperature during the loss of coolant accident test



Temporal course of the ambient pressure during the loss of coolant accident test

Application conditions

Installation conditions

Position for calibration	vertical on an oval flange
Orientation	as required, orientation-dependent zero shift con be fully corrected, with no effect on span

Process conditions

Product temperature range in process	on the measuring diaphragm: –40…+120°C (–40...+248°F)
Process pressure	Corresponds to permissible overload, see Page 8

Ambient conditions

Ambient temperature	–20…+85°C (–4...+185°F)
Storage temperature	–40…+85°C (–40...+185°F)
In gress Protection	IP 65
Electromagnetic compatibility	Interference emission to EN 61 326 electrical equipment B, Interference immunity to EN 61 326 Annex A (industrial) and NAMUR directive EMC (NE 21), Interference immunity to EN 61000-4-3: 30 V/m

Mechanical Construction

Design

Housing	HousingT4 (display on side) or T5 (display on top). Housing can be rotated up to 330°. Optional electrical connection via cable gland or M 20x1.5, G ½, ½ NPT thread or cable connection Harting Han7D plug Terminal connection for wire cross section: 0.5…2.5 mm^2 (AWG 20...13)

Materials

Housing	Cast aluminium housing with protective polyester based powder coating RAL 5012 (blue), cover RAL 7035 (grey), seawater spray test DIN 50021 (504 h) passed
Nameplate	AISI 304 (1.4301)
Process connections	AISI 316L (1.4435)
Process diaphragm	Alloy C276 (2.4819)
Seals sensor	FKM (Viton)
O-ring for cover seal	NBR

Display and Operating Interface

Display and operating module

Display (optional)	Plug-in display module with four-character pressure display and analogue display (bar graph) of current with 28 segments
Operation	Four keys Z–, Z+, S–, S+

Power supply

Power voltage	11.5…45 V DC
Residual ripple	No effect for 4...20mA signal up to 5% residual ripple within permissible range

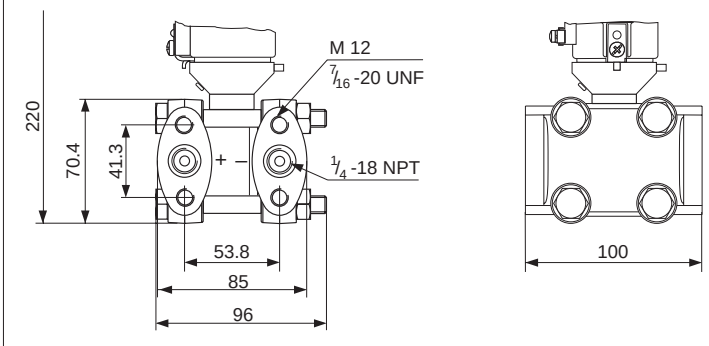
Certificates and Approvals

CE Mark	By attaching the CE Mark, Endress+Hauser confirms that the instrument fulfils all the requirements of the relevant EC directives.

Dimensions
Flange

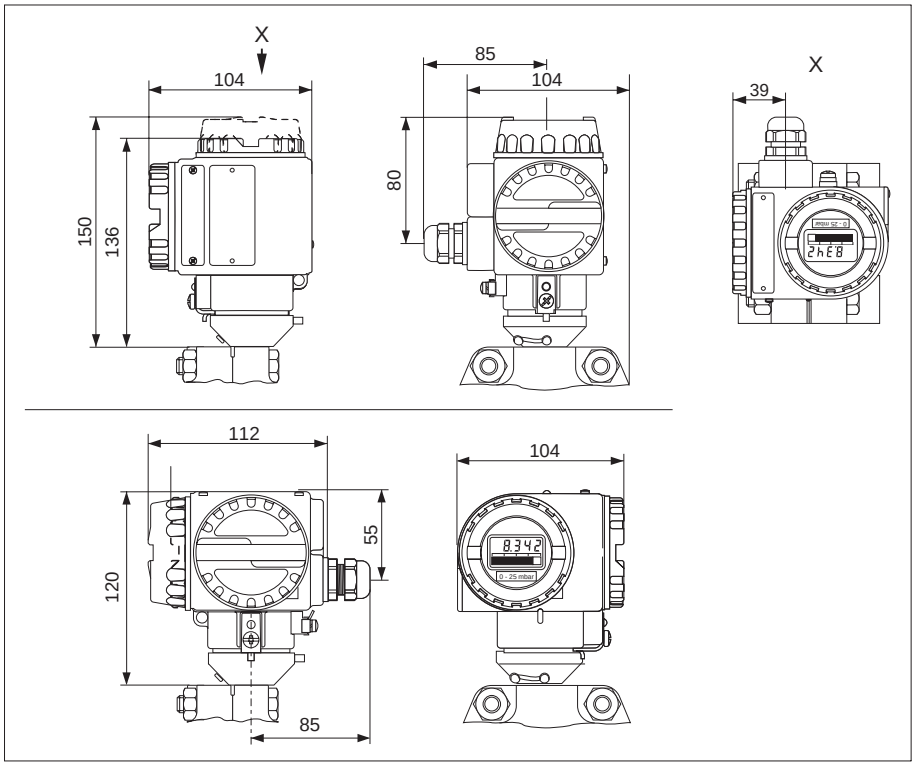
Conversion factors
1 mm = 0.039 in
1 in = 25.4 mm

Dimensions are in mm.



Deltabar S PMD 25 K optional with:
- Oval flange with M 12 to DIN 19213 and ¼-18 NPT connection
- Oval Flange with $^{7}/_{16}$ - 20 UNF mounting pin and ¼-18 NPT connection

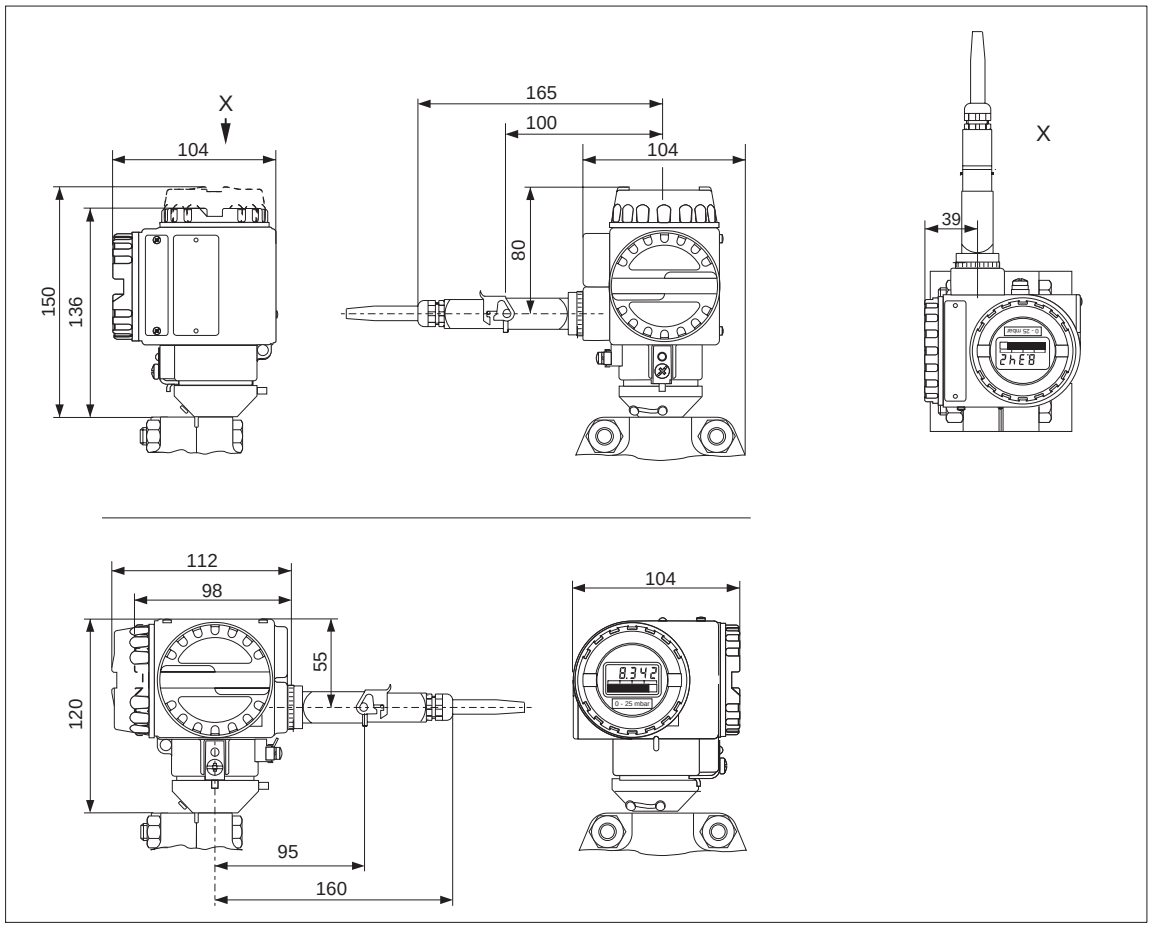
Dimensions
Housing



Conversion factors
1 mm = 0.039 in
1 in = 25.4 mm

Dimensions are in mm.

Deltabar S
housing versions
above: housing T5
(display on top)
below: housing T4
(display on side)



Deltabar S with Harting
Han7D plug
housing versions
above: housing T5
(display on top)
below: housing T4
(display on side)

Product Structure

Deltabar S PMD 25 K

Cable entry, approval KTA 3505 / IEEE 323/344

K Cable gland M 20x1.5
5 Cable entry G ½
S Cable entry ½ NPT
7 Cable connection Harting Han7D plug, straight

Electronics, Display, Housing

B 4…20 mA, with display, Housing Type T5
H 4…20 mA, without display, Housing Type T5
U 4…20 mA, with display, Housing Type T4
M 4…20 mA, without display, Housing Type T4

Metal sensor (wetted diaphragm Alloy C276)

	Nominal range	Static Pressure
CD	100 mbar	max. 250 bar
CF	500 mbar	max. 250 bar
CH	3 bar	max. 250 bar
CL	16 bar	max. 250 bar

Calibration and Technical Units

1 Nominal value calibration in mbar/bar
2 Nominal value calibration in kPa/MPa
6 Nominal value calibration in psi
9 Adjusted from…to…, technical units, linear or square root
E Calibrated from … to … technical units, with calibration report

Additional options

AA 3.1B Inspection certificate acc. to EN 10204 for all wetted parts AISI 316L (1.4435)
AH same as "AA" version with 2 vent valves and 1 mounting bracket

Sensor seal

1 FKM (Viton), wetted and pressurised

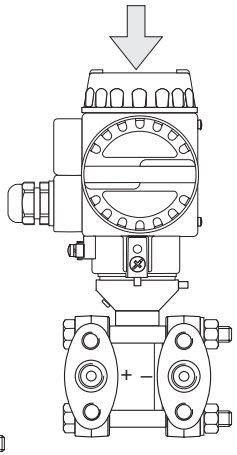
Process connection ¼ - 18 NPT
Mounting, Material

C Oval flange with M 12 DIN 19213, AISI 316L (1.4435)
D Oval flange with 7/16 - 20 UNF, AISI 316L (1.4435)

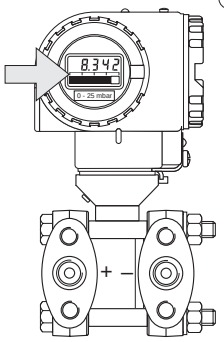
PMD 25 K – [ ][ ][ ][ ][ ][ ][ ] Product designation

Calibration position
as shown vertical on the oval flange

Housing Type T5
display on top



Housing Type T4
display on side



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05.02/PT1

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