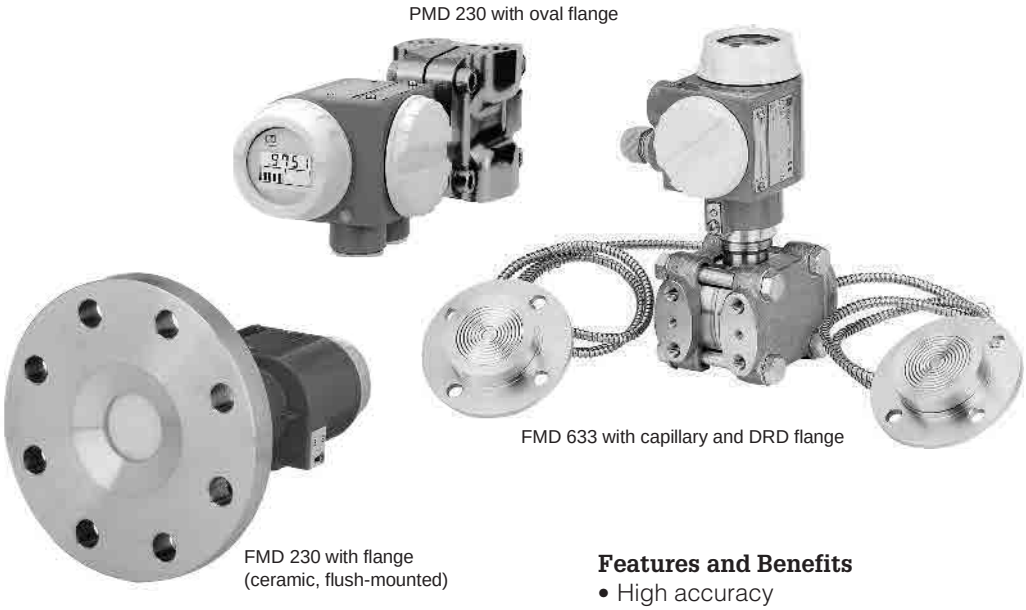
Technical
Information
TI 256P/00/en

Differential Pressure Transmitter
deltabar S PMD 230 / 235
deltabar S FMD 230 / 630 / 633

Deltabar S with ceramic and silicon sensors overload resistant with function monitoring Communication using PROFIBUS-PA, HART, Foundation Fieldbus



PMD 230 with oval flange

FMD 633 with capillary and DRD flange

FMD 230 with flange
(ceramic, flush-mounted)

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
  - With "platinum" version, linearity better than 0.05 % of set span
  - Long-term drift better than 0.1 % per year or 0.25 % per 5 years
- Process temperatures up to 120 °C as standard
- 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
- Simple and easy operation via 4…20 mA, HART protocol or connection to PROFIBUS-PA or Foundation Fieldbus
- 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.

Endress+Hauser

The Power of Know How

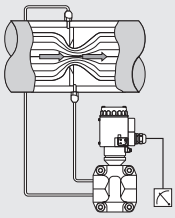
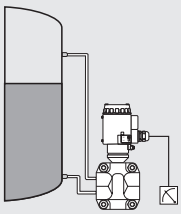
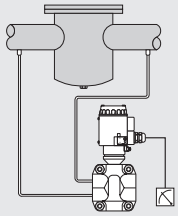
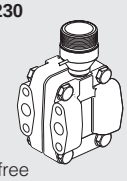
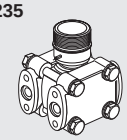
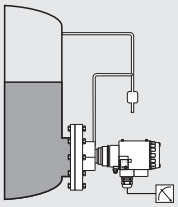
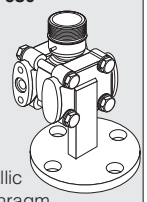
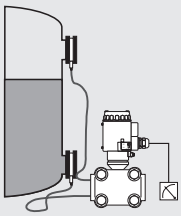
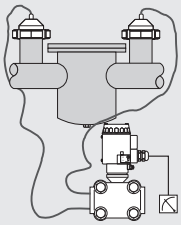
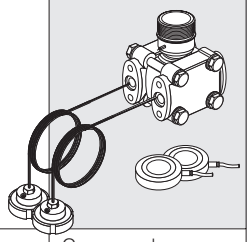
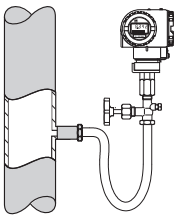
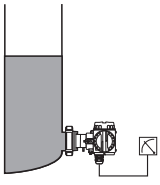
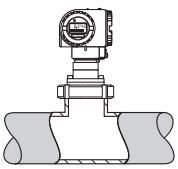
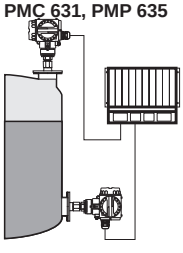
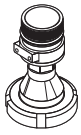
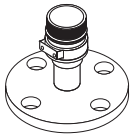
Selecting the Instrument

The Deltabar S is designed with replaceable modules and is based on the same construction principle as its "twin brother", the Cerabar S.
This has the following advantages:

- One electronics unit for all process pressure and differential pressure transmitters.
- Sensor modules and electronics can be replaced on site (autom. up-load).

The table below gives a complete summary of the Cerabar S/ Deltabar S product family. Further information on instruments:

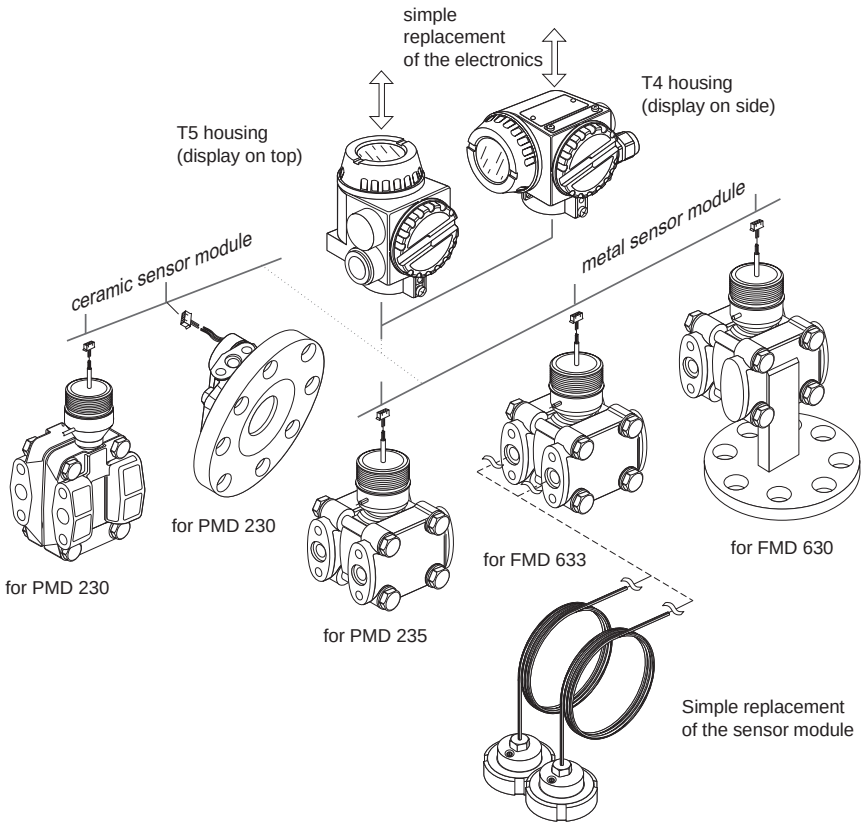
- in the grey fields is found in this Technical Information
- in the white fields is found in Technical Information TI 216P and TI 217P.

	Applications				Sensors	
	Gauge and absolute pressure	**Flow (see also TI 297P "Deltatop" and TI 329P "Deltaset")**	**Level**	**Differential pressure**	**Ceramic sensor** Differential pressure – 25 mbar: PN 10 – to 3 bar: PN 100	**Metallic sensor** Differential pressure – from 10 mbar: PN 160/PN 420 – to 40 bar: PN 420
Deltabar S **Oval flange**		**PMD 230, PMD 235** 	**PMD 230, PMD 235** 	**PMD 230, PMD 235** 	**PMD 230**  metal-free connection also available	**PMD 235**  Hastelloy diaphragm at no additional cost
Flange			**FMD 230, FMD 630** 		**FMD 230**  flush-mounted ceramic sensor, also metal-free connection available	**FMD 630**  metallic diaphragm with optional extension
Diaphragm seal with capillary extension			**FMD 633** 	**FMD 633** 		**FMD 633** including hygienic applications 
					Gauge pressure – 5 mbar to 40 bar Absolute pressure – from 20 mbar to 40 bar	Gauge and absolute pressure – from 125 mbar to 400 bar
Cerabar S **threaded and flush-mounted process connections TI 216P**	**PMC 731, PMP 731** 		**PMC 731, PMP 731** 		PMC 731  including flush-mounted process connections	**PMP 731**  optional flush-mounted diaphragm or with internal diaphragm with adapter, also welded
Diaphragm seal TI 217P	**PMC 631, PMP 635** 		**PMC 631, PMP 635** 		**PMC 631** 	**PMP 635** 

Mechanical Construction

Modularity
Both intelligent pressure transmitters from Endress+Hauser
- Deltabar S: differential pressure, level and flow measurement
- Cerabar S (TI 216P, TI 217P): gauge/absolute pressure measurement

offer optimum modularity for future product development.



Interchangeable Sensor Modules
The sensor modules are fully calibrated for pressure and temperature. These data are permanently stored in the sensor module. After replacing the module, the electronics automatically calls up the data from the calibrated sensor module when it is switched on again. The transmitter is then ready to measure without having to be recalibrated.

Features include:
- Interchangeable sensor module and process connections
- Universal electronics for process pressure and differential pressure
- Simple and uniform operation

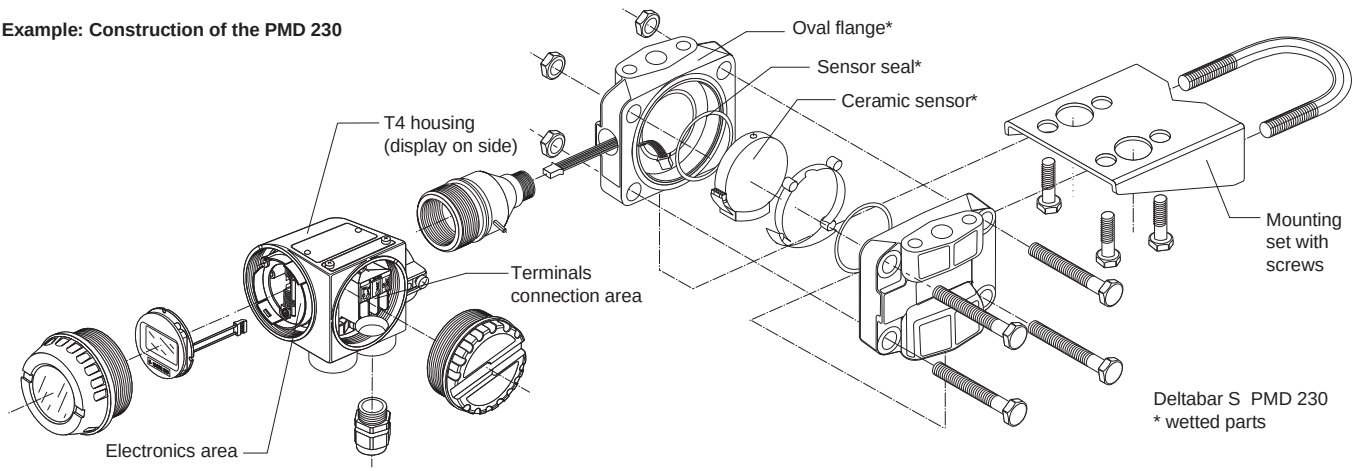
Display Module
A display module with the following features can be used for showing measured values and for simplifying local operation:
- Large four-character pressure display with bargraph showing current.
- Separate electronics and connection compartments. The display is plugged into the electronics compartment so that the terminals are always accessible from the connection compartment.
- Certified for explosion hazardous areas.

Housings
The following housings are available for the Deltabar S differential pressure transmitter:
- T5 for horizontal mounting and
- T4 for vertical mounting

Both housings comply with the following requirements:
- IP 65
- Separate electronics and terminal connection compartments
- Easily accessible operating elements on the outside of the instrument
- Optional Pg 13.5 cable with water-tight thread, M 20x1.5, ½ NPT or G ½
- PROFIBUS-PA M12, FF 7/8" or Harting HAN7D connector
- Housing can be rotated by 330°

Replaceable Process Connections
- The sensor seal and process connection of the Deltabar S can easily be replaced in just a few simple steps.
- Chemical resistance can be guaranteed by selecting suitable materials for the process connection.

Example: Construction of the PMD 230



Measuring System

System Components

The complete measuring system consists of:

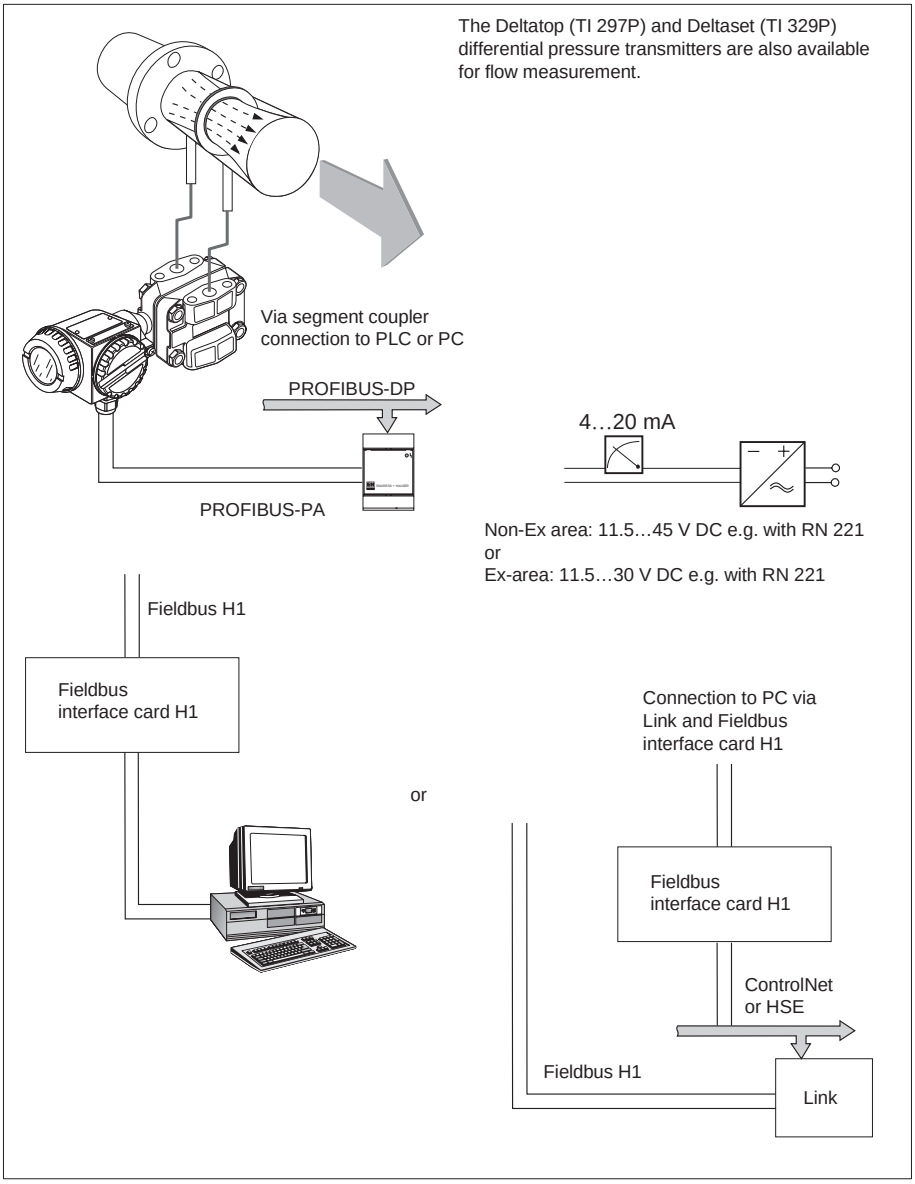
- Deltabar S differential pressure transmitter with
  - 4…20 mA signal output and **HART** communication protocol and
  - power supply e.g. with the RN 221 transmitter power supply unit from Endress+Hauser
    Non-EEx: 11.5…45V DC or
    EEx: 11.5…30 V DC

or

- Deltabar S differential pressure transmitter with
  - **PROFIBUS-PA** digital communications signal and
  - connection via segment coupler to a PLC or PC using e.g. the Endress+Hauser Commuwin II operating program

or

- Deltabar S differential pressure transmitter with
  - **Foundation Fielbus** digital communications signal and
  - Fieldbus interface card H1 or Link and Fieldbus interface card H1 for connecting to a PC with the operating program



Complete measuring system Deltabar S

- left above: PROFIBUS-PA see also Operation Page 7
- right above: Current output 4…20 mA with HART communications signal
- below: Foundation Fieldbus see also Operation Page 8

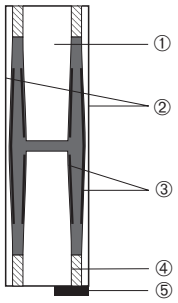
Operating Principle

Ceramic Sensor

The system pressure acts on the diaphragm of the sensor causing a displacement. This change in distance between the very finely drawn gold electrodes causes a change in capacitance on both sides.

Advantages:
- Self-monitoring for diaphragm breakage or loss of filling fluid (continuous comparison of the measured temperature with that calculated from capacitance values)
- Extremely high chemical resistance
- For use with vacuums down to 1 $mbar_{abs}$ (0.0145 psi_{abs})
- Metal-free versions available

Ceramic sensor
Deltabar S PMD 230, FMD 230



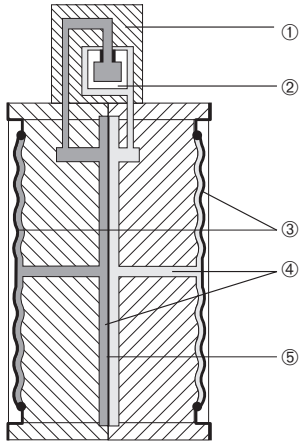
Ceramic sensor
① Basic body
② Diaphragm
③ Electrodes
④ Fritted glass
⑤ Temperature sensor

Metal Sensor

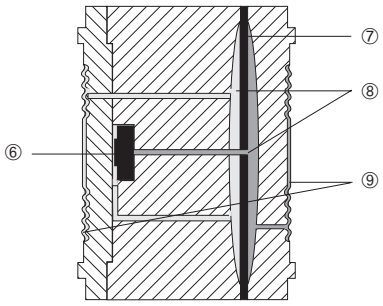
The separating diaphragm is deflected on both sides by the acting pressure with a filling fluid transmitting the pressure to a resistance bridge (semiconductor technology). The bridge output voltage, which is proportional to differential pressure, is then measured.

Advantages:
- Standard system pressures: 160 bar (2320 psi) and 420 bar (6090 psi)
- Excellent long-term stability
- Guaranteed resistance to single-sided overload
- Hastelloy C diaphragm as standard at no extra cost
- Welded stainless steel versions also available

Metal sensor 10 mbar and 40 mbar
Deltabar S PMD 235, FMD 630, FMD 633



Metal sensor from 100 mbar
Deltabar S PMD 235, FMD 630, FMD 633



Metal sensor
10 mbar, 40 mbar
① Measuring element
② Silicon diaphragm
③ Separating diaphragm as nap diaphragm extended
④ Filling fluid
⑤ Integrated overload protection

Metal sensor
from 100 mbar
⑥ Measuring element
⑦ Overload diaphragm
⑧ Filling fluid
⑨ Separating diaphragm as nap diaphragm extended

Operation

The Deltabar S can be operated in the following ways:
- Using the four keys on the instrument directly for calibrating zero point and span at the touch of a button.

or
- Operating remotely using intelligent HART data protocol
  - e.g. via Commubox FXA 191 and a PC with the Endress+Hauser Commuwin II operating program or
  - using handheld terminals

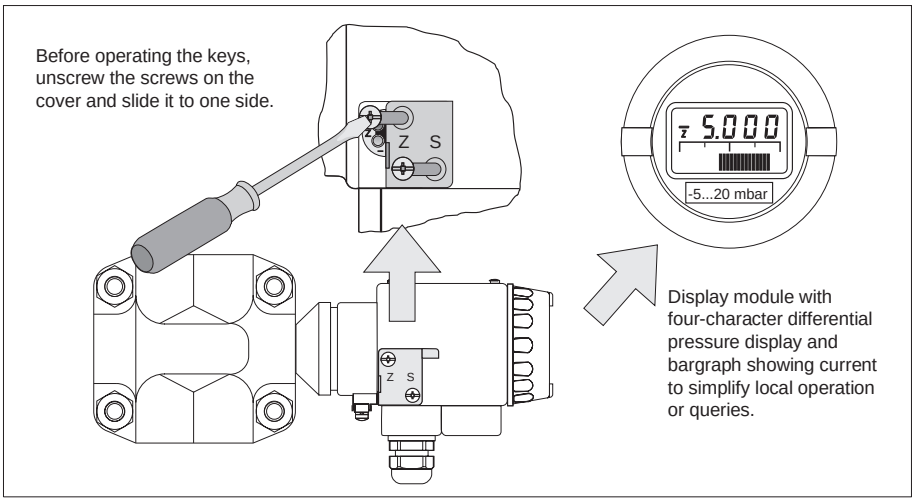
or
- Using segment couplers to connect the intrinsically-safe PROFIBUS-PA and PROFIBUS-DP fieldbus and operating the instrument via PC and Commuwin II operating program

or
- Using interface card H1 or via Link and interface card H1 for connecting the intrinsically safe Foundation Fieldbus and for operating via PC and operating program.

Operation Using Keys on the Instrument

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.
- ZERO: +Z and –Z
- SPAN: +S and –S

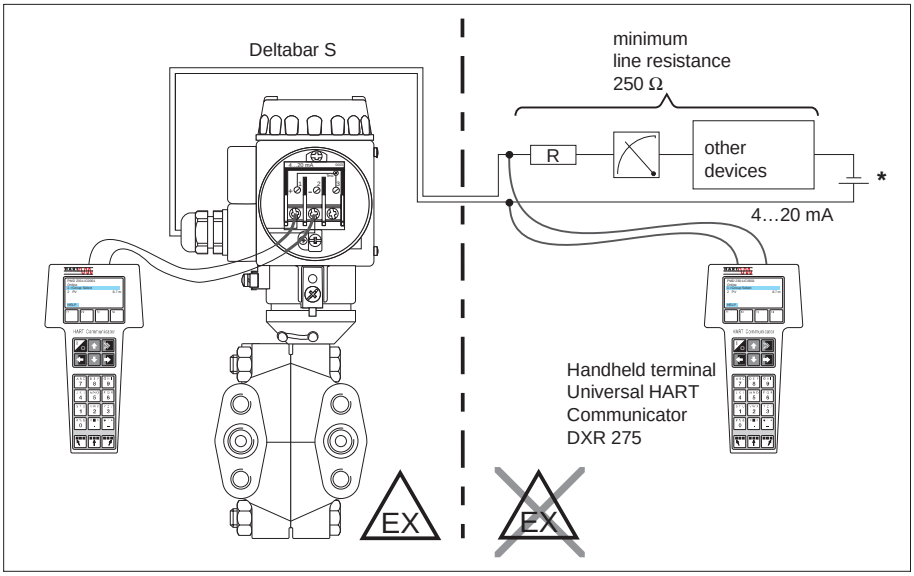
A zero point shift due to the orientation of the instrument (bias pressure) can also be corrected using these keys as well as for locking and unlocking the measuring point.



When operating with keys, screw the cover down securely with both screws after operation.

Handheld Terminal

The Hart Communication DXR 275 can be connected at any point along the 4…20 mA line to check, configure and read additional information (operating matrix, see Page 7).



The HART Communicator DXR 275 can be connected anywhere along the 4…20 mA line.

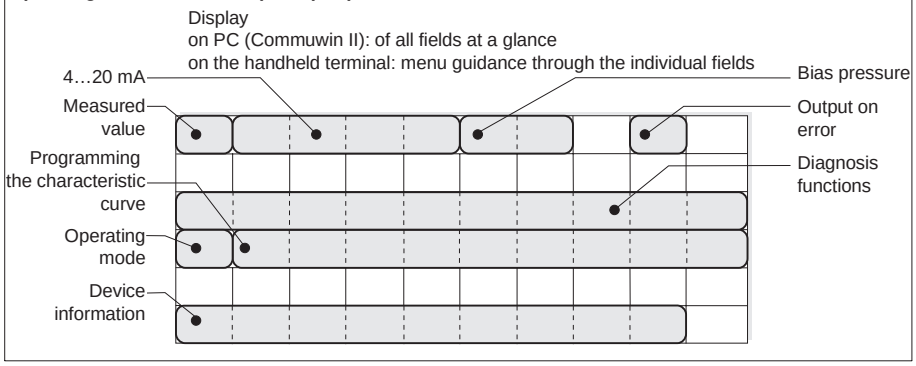
* Use an intrinsically safe power supply for Ex i.

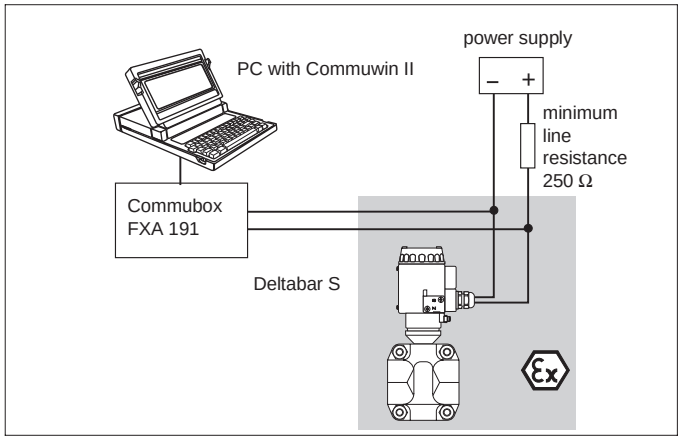
Operation Using the Matrix

All operations and functions are identical whether the Deltabar S is calibrated using a process bus and PC or a handheld terminal.

All information can easily be accessed using the operating matrix. Calibration is just as easy.

Operating matrix with fields (examples)





The Commubox can be connected anywhere along the 4…20 mA line.

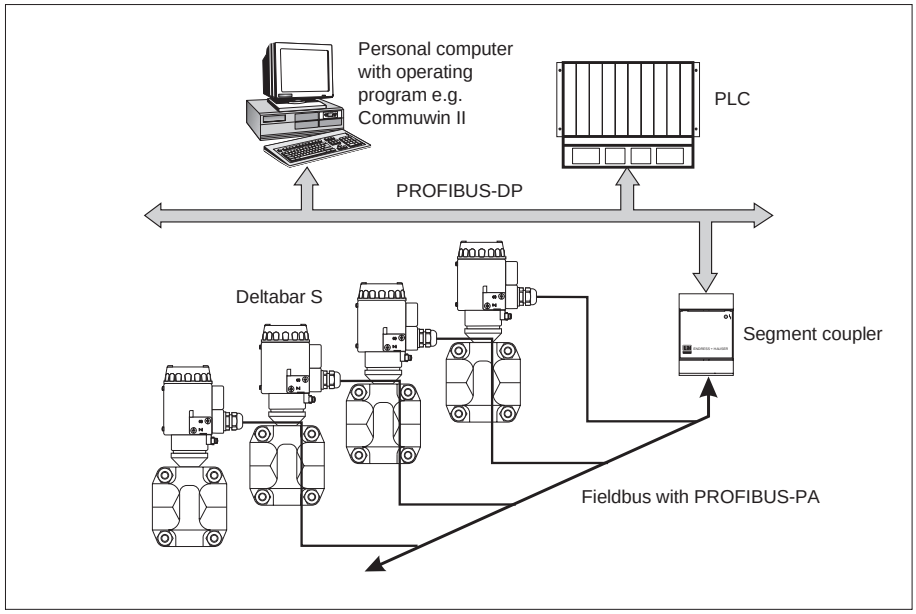
Operation Using the Commubox FXA 191

The Commubox FXA 191 connects 4…20 mA Smart transmitter that has a HART protocol to the RS 232 C serial interface of a personal computer. This enables the transmitter to be remotely operated with the Endress+Hauser Commuwin II operating program. Commuwin II shows, for example, the operating matrix above for easy programming of the transmitter.
Die Commubox FXA 191 is used for intrinsically safe signal circuits.

Connecting to PROFIBUS-PA

PROFIBUS-PA is an open fieldbus standard to enable several sensors and actuators, including those in explosion-hazardous areas, to be connected to a bus line. With PROFIBUS-PA, two-wire looped instruments can be supplied by the sensor with power and digital process information.

The number of instruments operated by one bus segment is:
- up to 10 for EEx ia applications
- up to 32 for non-Ex applications



Deltabar S with PROFIBUS-PA

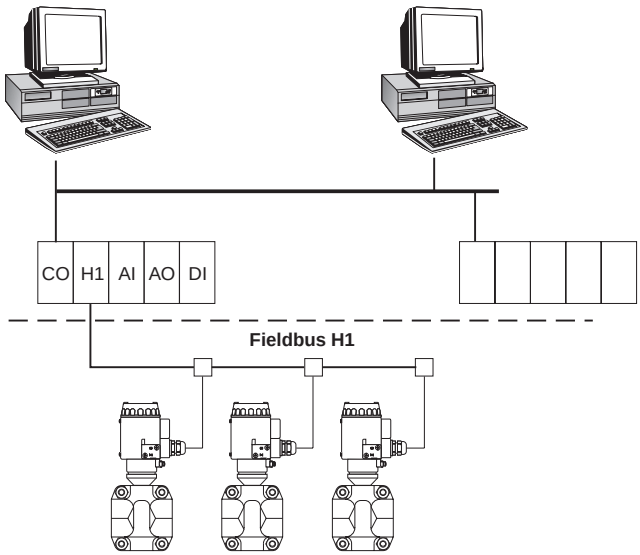
Connecting to Foundation Fieldbus

Foundation Fieldbus is an open fieldbus standard to enable several sensors and actuators, including those in explosion-hazardous areas, to be connected to a bus line. With Foundation Fieldbus, two-wire looped instruments can be supplied by the sensor with power and digital process information.

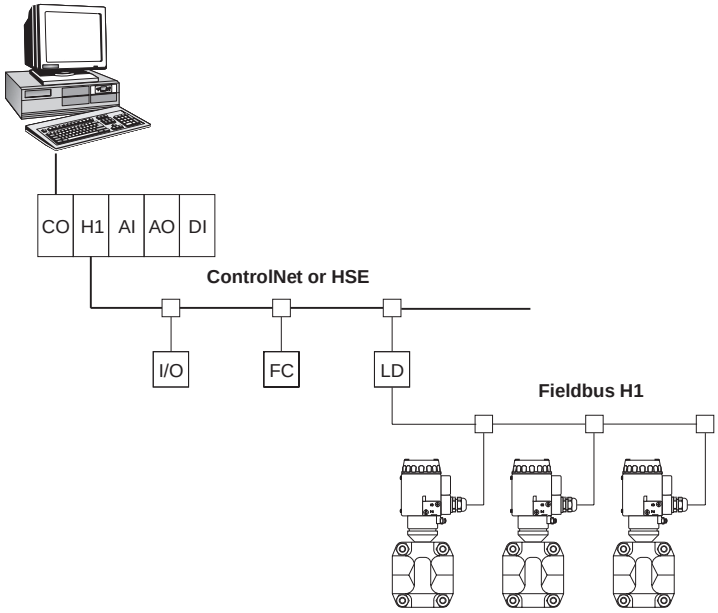
The following instruments can be operated via an interface card or via Link and an interface card:

- up to 10 instruments for Ex ia applications
- up to 32 instruments for Non-Ex applications

Direct connection via Fieldbus interface card H1



Connection via Link and Fieldbus interface card H1



Deltabar S with Foundation Fieldbus
CO: Controller
H1: H1 interface
CN: ControlNet
AI: Analogue Input
AO: Analogue Output
DI: Digital Input
I/O: Input/Output
FC: Frequency converter
LD: Link

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 through 330°.
- A mounting bracket for wall or pipe mounting is also available for the Deltabar S.

Shifting of the Zero Point due to Position

The Deltabar S is calibrated based on the limit point method according to DIN 16 086.
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 in the Ex-area directly on the instrument using the keys.

Instructions for Mounting with Impulse Piping

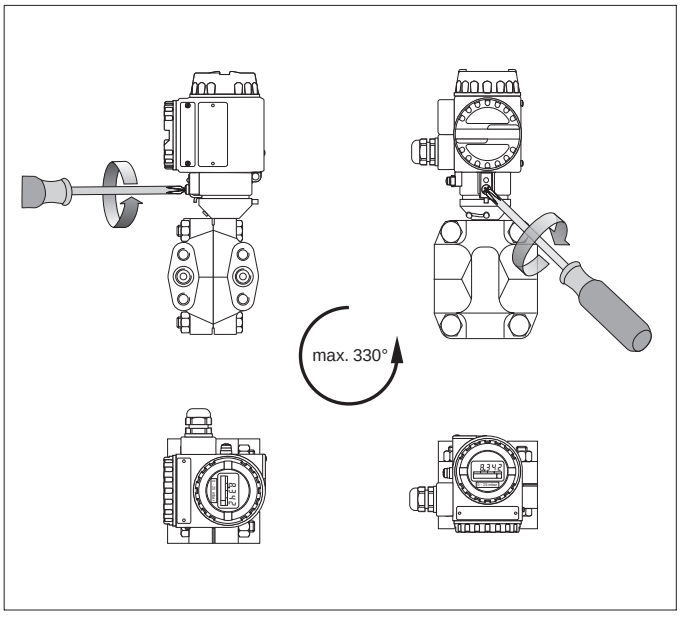
- General recommendation for laying impulse pipes are found in DIN 19210 "Process lines for flow measurement systems" or else in the appropriate national or international standards.
- Pressure piping must have a constant gradient of at least 10:1.
- There must be suitable frost protection when installing pressure piping in the open (e.g. parallel heating pipes).

Instructions for Diaphragm Seals (FMD 630, FMD 633)

- The diaphragm seal and the pressure sensor together form a closed and calibrated system which is filled with filling fluid. All filling holes are sealed and are not to be opened!
- The protective caps should only be removed just before mounting in order to protect the transmitter or diaphragm seal.
- When using a bracket for mounting the FMD 633 (with capillary tubing), it should not be put under strain and cause kinks in the capillary tubing (minimum bending radius 100 mm/ 3.94 in).

Conversion factors

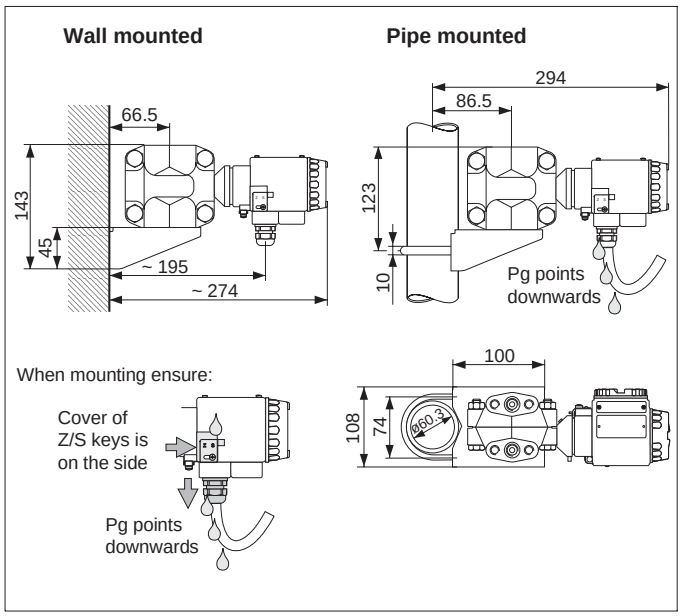
- 1 mm = 0.039 in
  1 in = 25.4 mm



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 entry 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 (see also TI 297P "Deltatop" and TI 329P "Deltaset"). The Deltabar S differential pressure transmitter measures volumetric or mass flow derived from the differential pressure. The "totalizer function" comes as standard in the Deltabar S software.

This measuring principle can be used anywhere:
- in gases, vapours and liquids
- for any nominal diameters (DN 4 … DN 12000)
- for circular and square pipe cross-sectional areas
- for flowrates with a dynamic range of 1:12 (if density is stable)

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.
The following conditions apply:
- Static pressures up to 500 bar (7250 psi)
- Product temperatures up to 1000°C (1832°F).

Pitot Tube Sensors
Very small pressure losses can be measured using pitot tube sensors (max. DN 12000).
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 (see also TI 032D/06/en for Compart DXF). 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

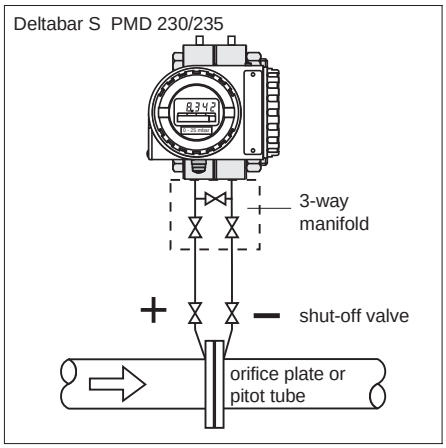
If the liquid is under pressure, then this pressure acts on both sides of the Deltabar S and is thus cancelled out.

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.

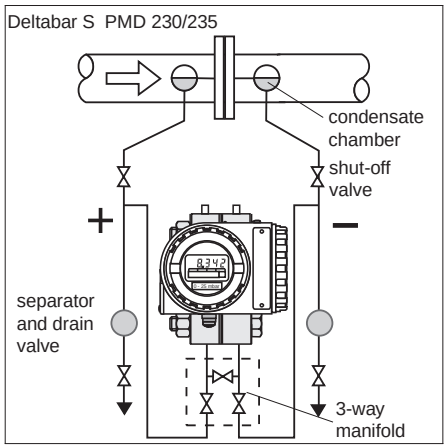
Using the freely programmable characteristic curve (linearisation), the level value can be converted into a volumetric or mass variable.

Examples of Measuring Systems

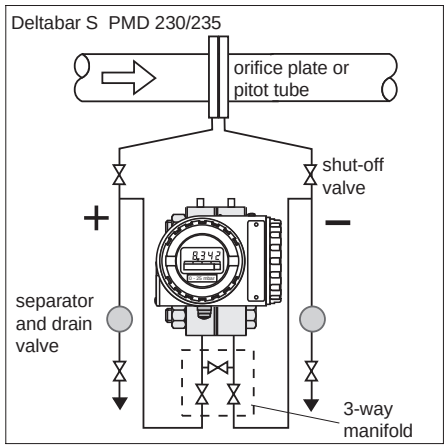
Flow Measurement



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

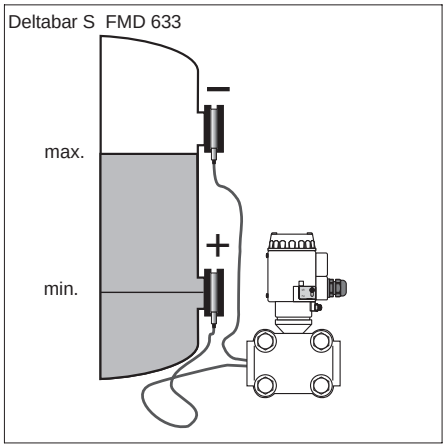


Vapours:
- Mount the Deltabar S below the measuring point.
- Mount and fill the condensate chambers at the same height as the bleeder connection.

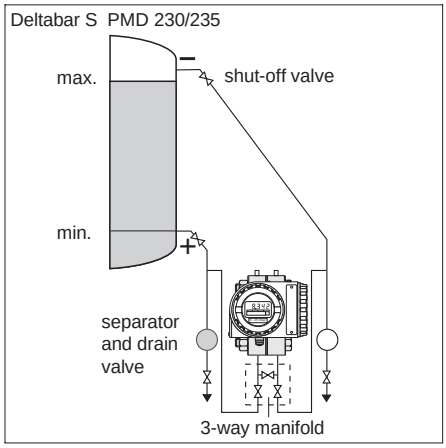


Liquids:
- Mount the Deltabar S below the measuring point so that the pressure piping is always filled with liquid.

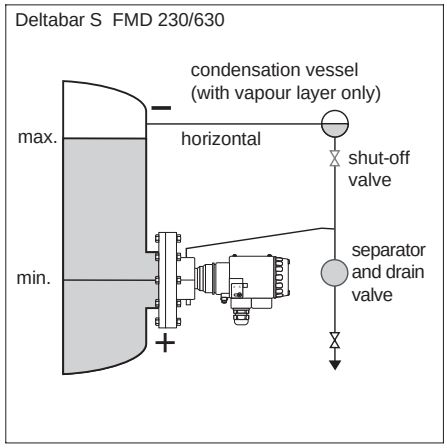
Level Measurement



Capillary diaphragm seal:
- Mount the Deltabar S below the lower connection. Exceptions: see Page 12
- Mount the diaphragm seal with capillary tube on the vessel.

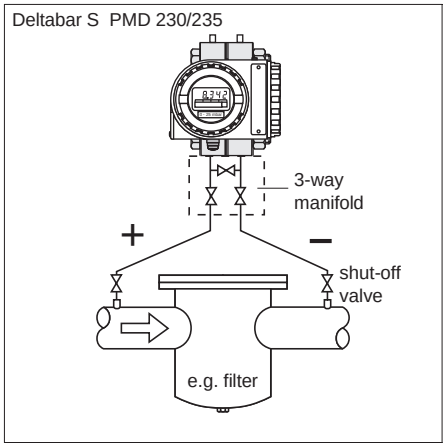


Closed vessels:
- Mount the Deltabar S below the lower connection so that the pressure piping is always filled with liquid.
- The negative side must be connected above the maximum level.

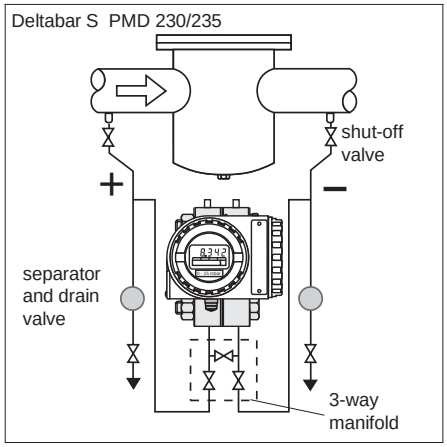


Closed vessels with flanged Deltabar S:
- Mount the Deltabar S directly onto the vessel.
- The negative side must be connected above the maximum level.
- The condensate chambers ensure a constant column of fluid with a layer of vapour.

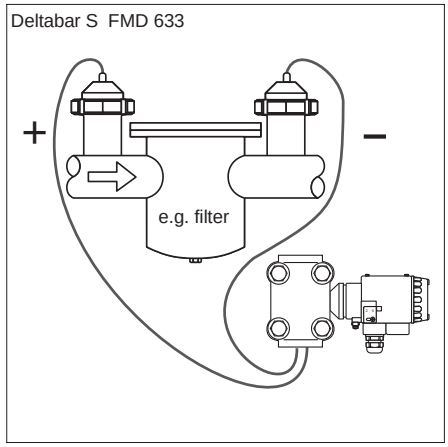
Differential Pressure Measurement



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



Liquids:
- Deltabar S below the measuring point so that the pressure piping is always filled and gas bubbles can rise and return to the process piping.



Deltabar S FMD 633:
- Mount the diaphragm seal above the piping.
- Mount the transmitter below the measuring point.

Instructions for Diaphragm Seals with FMD 630, FMD 633

Diaphragm Seal Filling Fluid
The temperature and pressure of the process are of critical importance when selecting the fluid for the diaphragm seal.
①, ②
The suitability of the fluid to meet the requirements of the medium must also be considered. For foodstuffs applications only physiologically safe fluids such as vegetable oil or silicone oil (AK 100) may be used in the diaphragm seal.
⑥

The Smallest Recommended Measuring Span and Diaphragm Seal
The effects of temperature cause the diaphragm seal to expand. This in turn gives rise to an additional temperature effect on the measurement. When selecting the diaphragm seal the following points are to be observed:
- The nominal diameter of the diaphragm seal determines the width of the diaphragm.
- Temperature effects on measurement vary inversely to the diameter of the size of the diaphragm seal.
- The largest possible width of diaphragm should be chosen so that the temperature effects remain within the nominal range of the application (recommended ≥ ø80 mm/ø3 in).

Guidelines for Mounting Capillary Tubes
If the transmitter is mounted above the lower measuring point, then there is a maximum height which should not be exceeded.
This will otherwise result in a break in the column of fluid in the capillary and damage the diaphragm seal.
③
- Minimum bending radius of capillary tubing: 100 mm (4 in).

Temperature Effects
- The temperature coefficients of the diaphragm seals as stated in the technical data apply to silicone oil (calibrating temperature +25°C/+77°F) and are determined by the process temperature.
  For other fluids used, the T_K value is to be multiplied by the T_K correction factor.
  (See also diaphragm seal tables from page 29 onwards.)
  ⑤
- The total temperature coefficient T_K is derived by adding the T_K of the Deltabar S to that of the diaphragm seal together with the T_K of the capillary tubing.
- The temperature effects of the capillary tubing are determined by the ambient temperature at the measuring point.
  T_K for every meter of silicone oil
  – one-sided 0.5 mbar/10 K
  – two-sided 0.12 mbar/10 K. ⑤
  Both capillary tubes are always the same length in order to minimise temperature effects.
  Both capillary tubes should be at the same temperature.

	①	②	③	④	⑤	⑥
Filling fluid of the diaphragm seal	**Temperature of the medium at 0.05 bar ≤ p_{abs} ≤ 1 bar (0.73 psi ≤ p_{abs} ≤ 14.5 psi)**	**Temperature of the medium at p_{abs} ≥ 1 bar (p_{abs} ≤ 14.5 psi)**	**maximum height difference * at p_{abs} ≥ 1 bar (p_{abs} ≤ 14.5 psi)**	**Density [g/cm³]**	**T_K Correction factor**	**Notes**
Silicone oil (AK 100)	–40…+180°C (–40…+356°F)	–40…+250°C (–40…+482°F)	max. 7 m (max. 23 ft)	0.96	1	Standard, foodstuffs applications
High temperature oil (paraffin)	–10…+200°C (+14…+392°F)	–10…+350°C (+14…+662°F)	max. 7 m (max. 23 ft)	0.81	0.72	
Fluorolube	–40…+80°C (–40…+176°F)	–40…+175°C (–40…+347°F)	max. 7 m (max. 23 ft)	1.87	0.91	Inert oil for very pure gas applications
Glycerine	—	+15…+200°C (+59…+392°F)	max. 4 m (max. 13.1 ft)	1.26	0.64	Foodstuffs applications
Vegetable oil (Neobee)	–10…+120°C (+14…+392°F)	–10…+200°C (+14…+392°F)	max. 7 m (max. 23 ft)	0.94	1.05	Foodstuffs applications

* Max. height difference between the transmitter and the lower measurement point connection.
For applications in vacuum the transmitter should be mounted below the lower measurement point connection.

Electrical Connection

Wiring 4…20 mA

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

- Use screened transposed two-wire cabling.
- Supply voltage (see Page 18):
  – Non-Ex: 11.5…45 V_{DC}
  – EEx: 11.5…30 V_{DC}
- Internal protection circuits against reverse polarity, HF interference and overvoltage peaks (see TI 241F "EMC Guidelines").
- Test signal:
  The output current can be measured between terminal 1 and 3 without interrupting the process measurement.

Wiring PROFIBUS-PA

The digital communication signal is transmitted to the bus using a two-wire connecting cable. The bus cable also carries the power supply.

- Supply voltage:
  – Non-Ex: 9…32 V_{DC}
  – EEx: 9…24 V_{DC}
- Bus cable:
  Use screened twisted pairs. The following specifications must be observed when using the FISCO model (explosion protection):
  – Loop resistance (DC)
  15…150 Ω/km
  – Inductance 0.4…1 mH/km
  – Capacitance 80…20 nF/km

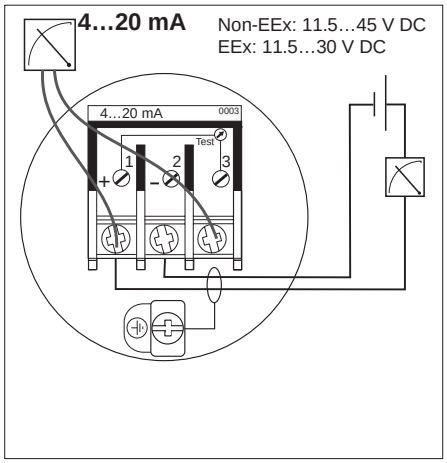
Instructions on connecting and grounding the network are given in BA 198F "Project Instructions for PROFIBUS-PA" as well as PROFIBUS-PA specifications.

Wiring Foundation Fieldbus

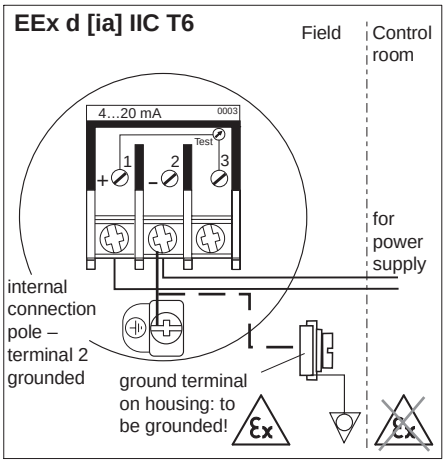
The digital communication signal is transmitted to the bus using a two-wire connecting cable. The bus cable also carries the power supply.

- Supply voltage:
  – Non-Ex: 9…32 V_{DC}
  – EEx: 9…24 V_{DC}
- Bus cable:
  Use screened twisted pairs. Further information on the type of cabling to be used can be found in the FF specification or in IEC 61158-2.

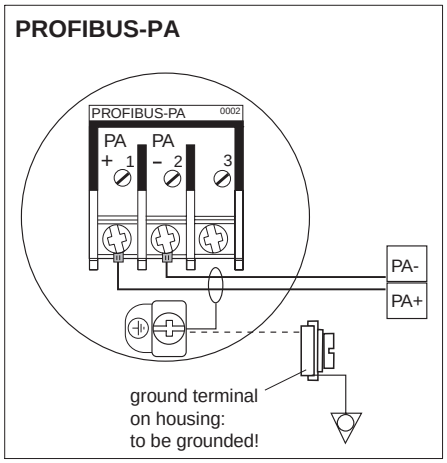
Further information on connecting and grounding the network is given at the Internet address "http://www.fieldbus.org".



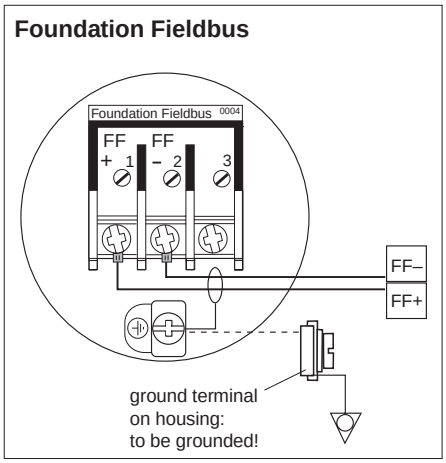
Electrical connection:
Deltabar S for all versions with 4…20 mA



Electrical connection:
Deltabar S for version with flameproof enclosure



Electrical connection:
Deltabar S for all versions with PROFIBUS-PA
(Reversed polarity has no effect on function.)



Electrical connection:
Deltabar S for all versions with Foundation Fieldbus
(Reversed polarity has no effect on function.)

Special Applications

"Platinum" Transmitters

Besides standard versions (linearity 0.1% of set span), instruments with higher accuracy are also available. These are known as "Platinum" instruments and are special versions of the PMD 235.

Three versions are available (see also Page 21):

- PMD 235 – ❑❑❑❑ A ❑❑❑❑ (bar/mbar)
- PMD 235 – ❑❑❑❑ B ❑❑❑❑ (Pa/MPa)
- PMD 235 – ❑❑❑❑ C ❑❑❑❑ (psi)
- "Platinum" instruments can be ordered as standard with HART electronics in the 40 bar measuring range and with various diaphragm and flange materials.
  PTFE and Viton seals are also available.

Oxygen and Very Pure Gas Applications

Oxygen and other gases react very explosively with oils so that plants which are totally oil and grease-free must be used. For such applications Deltabar S can be specially treated according to DIN 19247 and BAM standards. Instruments for oxygen applications can be selected in the product structure as follows:

- PMD 230 – ❑❑❑❑❑ 6 ❑❑❑
- PMD 235 – ❑❑❑❑❑ 6 ❑❑❑
- FMD 230 – ❑❑❑❑❑ 6 ❑❑❑
- FMD 630 – ❑❑❑❑❑ 6 ❑❑❑

T_{max} = 60 °C, p_{max} = 70 bar

These state the application limits for pressure and temperature.
Exceptions:
PMD 235 with tantalum diaphragm:
T_{max} = 60°C, p_{max} = 10 bar
PMD 235 with Hastelloy or Monel diaphragm:
T_{max} = 60°C, p_{max} = 40 bar

Oil- and grease-free instruments are available but without the oxygen service.

- PMD 235 – ❑❑❑❑❑ 8 ❑❑❑
- FMD 630 – ❑❑❑❑❑ 8 ❑❑❑

Total Performance

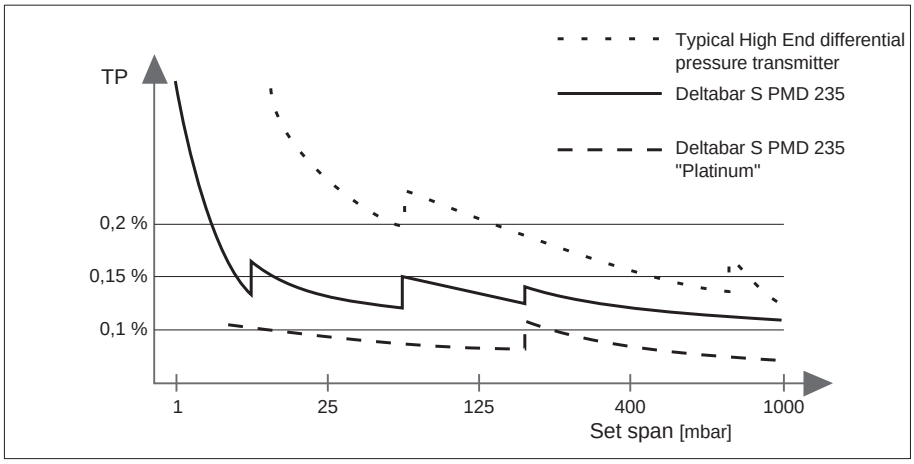
Total Performance

A detailed summary of the accuracy of measurement data under process conditions is known as the "Total Performance" (TP) and given as a % of the set span. This value is calculated as follows:

$$TP = \sqrt{(L^2 + S^2 + T^2)}$$

Where
L: linearity including hysteresis and repeatability
S: static pressure effects on the span
T: temperature effects

The following graph shows the Total Performance of PMD 235 as well as "Platinum" instruments. The example given here is for a typical 30 K temperature variation and 10 bar static pressure.



Graph showing "Total Performance" (TP) as a function of the set span.

Technical Data

General Information

Manufacturer	Endress+Hauser
Designation	Deltabar S

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	For PMD 230, FMD 230: capacitive with ceramic single-chamber sensor For PMD 235, FMD 630, FMD 633: piezoresistive with metallic sensor
With 4…20 mA current output and HART communication protocol	Deltabar S and power supply e.g. via transmitter power pack RN 221 and operation using – four keys on the instrument and a plug-in display module – Universal HART Communicator DXR 275 handheld terminal – PC with the Commuwin II operating program via Commubox FXA 191
With PROFIBUS-PA	Via segment coupler connection to the PLC or PC e.g. with the Commuwin II operating program
With Foundation Fieldbus	Via interface card H1 direct connection to PC with operating program or via Link and interface card H1 connection to PC with operating program

Input

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

Measuring range

Nom. value ceramic sensor	Measurement limits		Recommended span		Overload		Sensor
PMD 230 FMD 230 [mbar]	Lower (LRL) [mbar]	Upper (URL) [mbar]	Minimum [mbar]	Maximum [mbar]	One-sided [mbar]	Two-sided (System pres. PN) [bar]	Filling fluid [2]
25	–25	25	2	25	10	10	silicone oil
100	–100	100	5	100	16 [1]	16 [1]	silicone oil
500	–500	500	25	500	100 [1]	100 [1]	silicone oil
3000	–3000	3000	150	3000	100 [1]	140 [1]	silicone oil

1) 10 bar with PVDF process connection for PMD 230, 40 bar with process connection for FMD 230
2) Voltalef 1A for applications in very pure gases

Nom. value Silicon sensor (URL)	Measurement limits		Recommended span		System pressure [3]	Overload		Sensor
PMD 235 FMD 630 FMD 633 [mbar]	Lower (LRL) [mbar]	Upper (URL) [mbar]	Minimum [mbar]	Maximum [mbar]	PN [bar]	One-sided	Two-sided [4]	Filling fluid [2]
10 [1]	–10	10	0,5	10	160 [5]	PN	1.5 x PN	silicone oil
40 [1]	–40	40	2	40	160 [5]	PN	1.5 x PN	silicone oil
100	–100	100	5	100	160 [5]	PN	1.5 x PN	silicone oil
500	–500	500	25	500	160 420	PN	1.5 x PN	silicone oil
3000	–3000	3000	150	3000	160 420	PN	1.5 x PN	silicone oil
16000	–16000	16000	800	16000	160 420	PN	1.5 x PN	silicone oil
160	–160	160	8	160	160 [5]	PN	1.5 x PN	silicone oil
1000	–1000	1000	800	1000	160 420	PN	1.5 x PN	silicone oil
6000	–6000	6000	300	6000	160 420	PN	1.5 x PN	silicone oil
40000 [1]	–40000	40000	2000	40000	160 420	100 bar	1.5 x PN	silicone oil

1) PMD 235 only
2) Voltalef 1A for applications in very pure gases, other filling fluids on request
3) 160 bar version with stainless steel bolts, 420 bar version with chromized steel bolts
4) Type tested for burst pressure (FM) up to 1120 bar on both sides with PN 420 bar version
5) High pressure 420 bar version on request

Input (Continued)

Min. system pressure	PMD 230, PMD 235, FMD 230: p_{abs} larger than 1 mbar for all sensors and measuring ranges FMD 630, FMD 633: p_{abs} larger than 10 mbar for all sensors and measuring ranges

Output

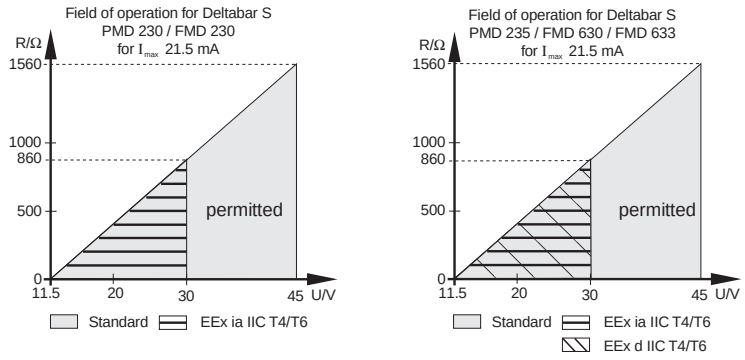
PROFIBUS-PA

Output signal	Digital communication signal, PROFIBUS-PA
PA function	Slave
Transmission rate	31.25 kBits/s
Response time	Slave: approx. 20 ms; PLC: approx. 600 ms (depending on system coupler) for approx. 30 transmitters
Signal on alarm	Signal: Status bit set, last valid measured value will be held, Display module: error code
Communication resistance	PROFIBUS-PA termination resistor

Foundation Fieldbus

Output signal	Digital communication signal, Foundation Fieldbus protocol
FF function	Publisher–Subscriber
Transmission rate	31.25 kBits/s
Signal on alarm	Signal: Status bit set, last valid measured value will be held, Display module: error code
Communication resistance	Foundation Fieldbus termination resistor

4…20 mA with HART protocol

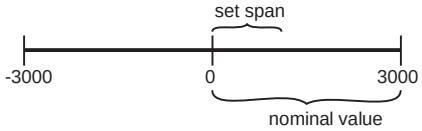
Output signal	4 to 20 mA, under-run 3.8 mA (4 mA adjustable), over-run 20.5 mA
Load	
Signal on alarm	21.5 mA selectable or last value held
Resolution	Better than 1 µA
Integration time	0…40 s adjustable via communication, 0…16 s via rotary switch
Communication resistance	min. 250 Ω
Adjusting range	Freely adjustable within the limits of the lower range value and full scale value

Accuracy

Reference conditions	DIN IEC 770 T_U=25°C (77°F) Accuracy data adopted after entering "Low sensor calibration" and "High sensor calibration" for lower range value and full scale value
Linearity including hysteresis and repeatability based on the limit point method to IEC 770	to TD 10:1: ±0.1% (* ±0.05%) of the set span for TD 10:1 to 20:1: ±0.1% (* 0.05%) x [nominal value / (set span x 10)]
Long-term drift as a function of nominal value	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** / **Ceramic sensor** Nom. value: 10 mbar — Diviation: 1.5 (0.5)%/100 bar — Nom. value: 25 mbar — Diviation: 0.5 (0.2)%/10 bar Nom. value: 40 mbar — Diviation: 0.5 (0.2)%/100 bar — Nom. value: 100 mbar — Diviation: 0.2 (0.2)%/16 bar Nom. value: 100 mbar — Diviation: 0.3 (0.2)%/100 bar — Nom. value: 500 mbar — Diviation: 0.2 (0.2)%/100 bar Nom. value: 160 mbar, 500 mbar, 1 bar, 6 bar, 3 bar, 16 bar, 40 bar — Diviation: 0.2 (0.2)%/100 bar — Nom. value: 3000 mbar — Diviation: 0.2 (0.2)%/100 bar
Temperature coefficient	0.04% (* 0.03%) of nominal value/30 K (–10 to 60°C) and 0.1% (* 0.08%) of nominal value/30 K (–40 to –10°C or 60 to 85°C)
Temperature coefficient of diaphragm seal	See table of diaphragm seals for T_K of the zero point Pages 29 and 31

Explanation of terms:

Turn down (TD)
= Nominal value / set span



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

»**Platinum**«
* Values for instruments with higher accuracy ("Platinum") are shown with an asterisk *
(PMD 235 – ****A****
PMD 235 – ****B****
PMD 235 – ****C****) see also Page 14

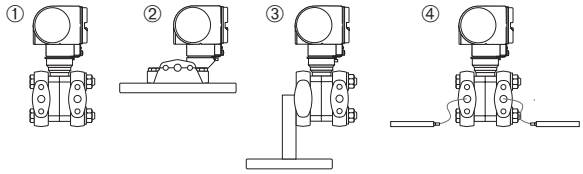
Root values
For root characteristic curves:
The accuracy specifications of the Deltabar S are reduced by a factor of ½ when calculating flowrates.

Accuracy (Continued)

Settling time	PMD 230/FMD 230: 300 ms PMD 235: 250 ms FMD 630/633: depending on diaphragm seal
Scanning time	min. 20 times per second
Rise time	1/3 of settling time
Warm-up period	2 s
Adjustable damping	0 to 16 s with switch, 0 to 40 s with handheld terminal or PC
Thermal effects	(0.2% x TD + 0.2%) of set span
Vacuum resistance	PMD 230, 235, FMD 230: up to 1 $mbar_{abs}$ FMD 630, 633: up to 10 $mbar_{abs}$

Application conditions

Installation conditions

Position for calibration	
Orientation	As required, orientation-dependent zero shift can be fully corrected, with no effect on span

Process conditions

Product temperature range in process	PMD 230/FMD 230: –40…+85°C (–40…+185°F) PMD 235: –40…+120°C (–40…+248°F) FMD 630/633: to +350°C (+662°F)
Process pressure	Corresponds to permissible overload, see Page 15

Ambient conditions

Ambient temperature	–40…+85°C (–40…+185°F)
Storage temperature	–40…+100°C (–40…+212°F)
Climatic class	G P C to DIN 40 040
Vibrational resistance	Ceramic sensor: ±0.1 % of span (DIN IEC 68 Part 2-6) Metal sensor: ±0.1 % of span (DIN IEC 68 Part 2-6)
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 NE 21, Interference immunity to EN 61 000-4-3: 30 V/m Use twisted screened two-wire cabling.

Mechanical Construction

Design

Housing	Housing T4 (display on side) or T5 (display on top), Housing can be rotated up to 330°, Separated electronics and connection compartments, Optional electrical connection via Pg 13.5 with cable gland or M 20x1.5, G ½, ½ NPT thread as well as via PROFIBUS-PA M12 , FF 7/8" or Harting HAN7D connector
Process connections	Optional flange or diaphragm seal with capillary extension available, see also Product Structures

Materials

Housing	Cast aluminium housing with protective polyester based powder coating RAL 5012 (blue), cover RAL 7035 (grey, seawater resistant, seawater spray test DIN 50021 (504 h) passed optional: 1.4435 (SS 316 L)
Nameplate	1.4301 (SS 304)
Process connections	Optional: 1.4435 (SS 316 L), Steel C 22.8, Hastelloy 2.4819 (C 276)
Process diaphragm	Ceramic sensor: Al_2O_3 Aluminium oxide ceramic Metal sensor: Optional 1.4401 (SS 316), Hastelloy C, Monel, tantalum . optional: 1.4435 (SS 316 L)
Filling fluid in diaphragm seals	Silicone oil AK 100, High-temperature oil, Fluorolube, glycerine, vegetable oil
Seals Ceramic sensor	FPM Viton, FPM Viton oil and grease-free, Kalrez, FPM Viton oil and grease-free for oxygen, EPDM, PTFE-bound Hastelloy C-4 seal for p_{abs}>900 mbar
Metal sensor	FPM Viton, NBR, FPM Viton oil and grease-free for oxygen, FPM Viton oil and grease-free, PTFE
O-ring for cover seal	NBR
Mounting accessories	Mounting set with screws 1.4301 (SS 304)

Display and Operating Interface

Display and operating module

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

Communication interfaces

Handheld terminal	HART protocol: Universal HART Communicator DXR 275 for connecting to anywhere along the 4…20 mA line minimum line resistance: 250 Ω
PC	Commubox FXA 191 for connecting to a serial interface of a PC and operating with the Commuwin II operating program for connecting anywhere along the 4…20 mA line minimum line resistance: 250 Ω
PROFIBUS-PA	Segment coupler for connecting to PLC or PC e.g. with the Commuwin II operating program
Foundation Fieldbus	Via interface card H1 direct connection to PC with operating program or via Link and interface card H1 connection to PC with operating program

Power supply

Power voltage	11.5…45 V DC
Residual ripple	No effect for 4…20 mA signal up to ±5 % residual ripple within permissible range with communication: HART protocol: U_{PP} smaller than 0.2 V (0.47 Hz to 125 Hz) and U_{eff} smaller than 2.2 mV (500 Hz to 10 kHz)

PROFIBUS-PA

Power voltage	9…32 V DC; for EEx see Certificate of Conformity
Current consumption	10 mA, ±1 mA, for EEx see Certificate of Conformity
Power up current	Corresponds to Table 4, IEC 1158-2

Foundation Fieldbus

Power voltage	9 … 32 V DC, for EEx see Certificate of Conformity
Current consumption	10 mA ±1 mA
Power up current	Corresponds to Table 4, IEC 1158-2

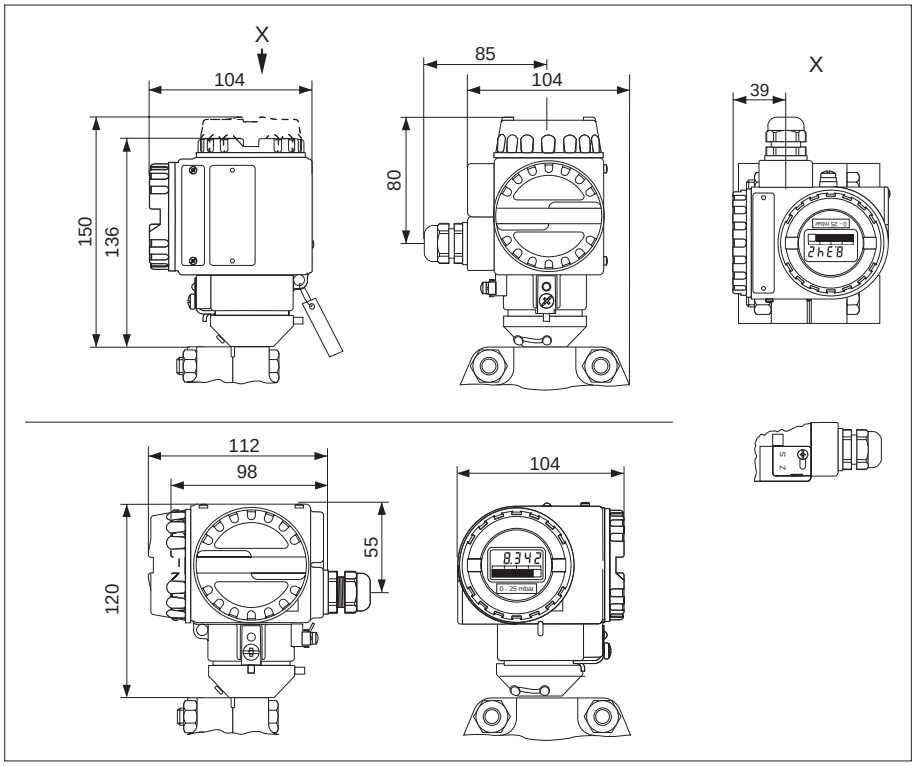
Certificates and Approvals

CE Mark	By attaching the CE Mark, Endress+Hauser confirms that the instrument fulfils all the requirements of the relevant EC directives.
Protection	See Product Structure on Page 20 onwards

Supplementary Documentation

Cerabar S / Deltabar S System Information: SI 020P/00/en
Deltabar Accessories Special Documentation: SD 069P/00/en
Deltabar S Operating Instructions: BA 174P/00/en
Deltabar S PROFIBUS-PA Operating Instructions: BA 167P/00/en
PROFIBUS-DP/PA, Guidelines for planning and commissioning: BA 198/00/en
CE Ex II 1/2 G, EEx ia IIC T4/T6 Safety Instructions: XA 002P-A/00/z1
CE Ex II 1/2 G bzw. 2 G, EEx ia IIC T4/T6 Safety Instructions (PROFIBUS-PA): XA 003P-A/00/z1
CE Ex II 2 G, EEx d IIC T5/T6 Safety Instructions: XA 005P-A/00/z1
EMC Test procedures Technical Information: TI 241F/00/en

Housing
Deltabar S

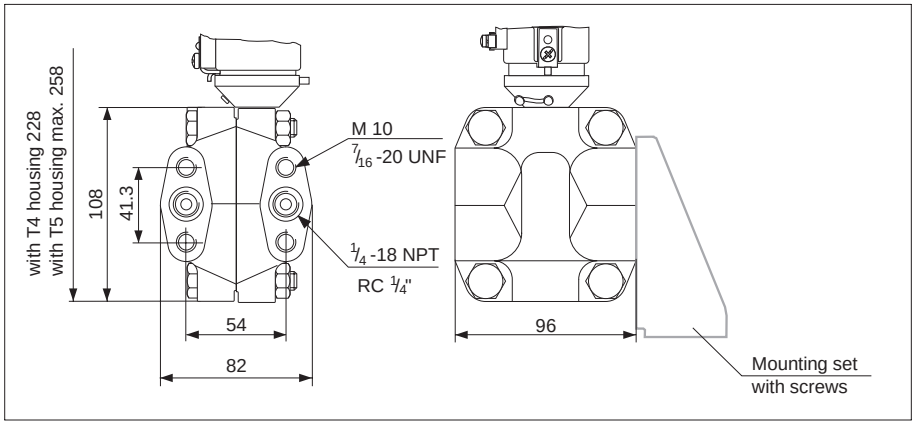


Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm

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

- Can be rotated
- Separate electronics and connection compartments
- Optional electrical connection via Pg 13.5 with cable gland or M 20x1.5, G ½, ½ NPT thread
- Material:
  Cast aluminium housing with protective polyester-based powder coating

Dimensions
Deltabar S
PMD 230



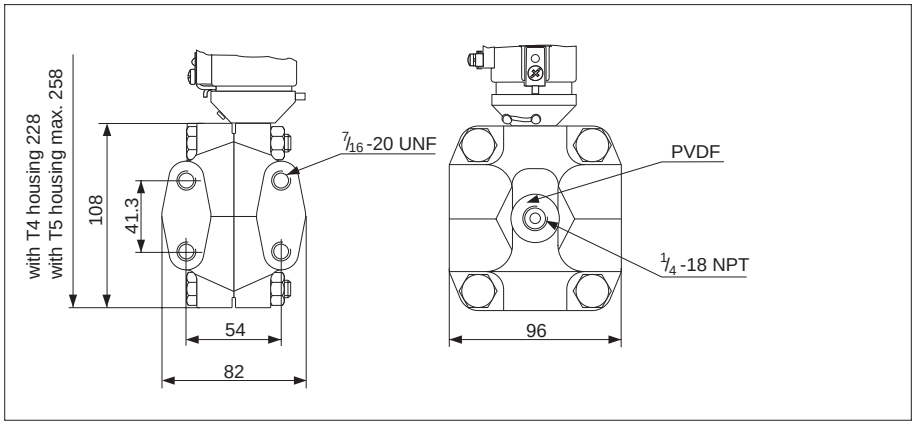
Process connections PMD 230

Oval flange with M10 mounting pin to DIN 19213 and ¼-18 NPT connection
- Version A: Steel C 22.8
- Version C: Steel 1.4435 (SS 316L)

Oval flange with $^{7}/_{16}$ - 20 UNF mounting pin and ¼-18 NPT connection
- Version B: Steel C 22.8
- Version D: Steel 1.4435 (SS 316L)
- Version F: Hastelloy C

Oval flange with $^{7}/_{16}$ - 20 UNF mounting pin and RC ¼" connection

Version L: Steel 1.4435 (SS 316L)



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

Process connections PMD 230

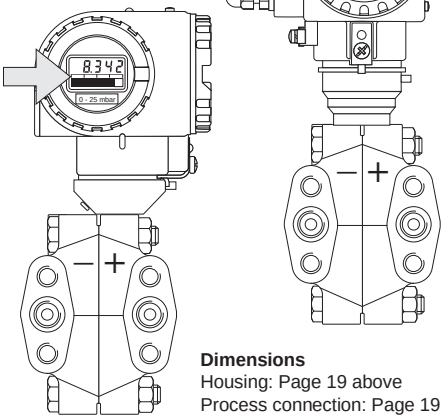
Oval flange with $^{7}/_{16}$ - 20 UNF mounting pin and ¼-18 NPT connection (in centre of flange)
- Version G: PVDF-coated

Product Structure
Deltabar S
PMD 230

Calibration position:
as shown vertical on the oval flange

Housing Type T5
display on top

Housing Type T4
display on side



Dimensions
Housing: Page 19 above
Process connection: Page 19 below

Sensor seal		Lower temperature limit
1, 8	FPM, Viton	–20°C (–4°F)
3	PTFE/Hastelloy	–40°C (–40°F)
4	EPDM	–40°C (–40°F)
6	FPM, Viton grease-free	–10°C (–14°F)
7	Kalrez	+5°C (+41°F)

Note:

Special versions for e.g. sensor, seal etc. on request.

PMD 230 Deltabar S with ceramic sensor. Differential pressure transmitter

Certificate, Cable Entry

A Standard, Pg 13.5
K Standard, M 20 x 1.5
5 Standard, G ½
S Standard, ½ NPT
3 M12 PROFIBUS-PA connector
4 7/8" FF connector
F Harting connector HAN 7D
C EEx ia IIC T4/T6 and ATEX II 1/2 G, Pg 13.5
L EEx ia IIC T4/T6 and ATEX II 1/2 G, M 20x1.5
6 EEx ia IIC T4/T6 and ATEX II 1/2 G, ½ NPT
I EEx ia IIC T4/T6 and ATEX II 1/2 G, M12 PROFIBUS-PA connector
J EEx ia IIC T4/T6 and ATEX II 1/2 G, 7/8" FF connector
U FM (Explosion proof), Cl. I,II, III, Div. 1, Groups A-G, ½ NPT
W FM IS, Cl. I,II, III, Div. 1, ½ NPT
V FM IS, Cl. I,II, III, Div. 1, 7/8" FF connector
2 CSA IS (non incendive), CL. I, II, III, Div.1, Groups A…G, ½ NPT
7 Overspill protection: WHG, Pg 13.5
8 Overspill protection: WHG, M 20x1.5

Housing (Type T5) / Electronics / Communication Protocol / Display**
*** Code for housing Type T4 in brackets, display or cover on side*

With display		*Without display*	
B	4…20 mA / HART (U)	H	4…20 mA / HART (M)
C	4…20 mA (W)	S	4…20 mA (N)
D	PROFIBUS-PA (P)	I	PROFIBUS-PA (X)
F	Foundation Fieldbus (K)	G	Foundation Fieldbus (R)

Ceramic Sensor (Wetted Parts Ceramic Diaphragm):

	Nominal Range	Static Pressure
1B	25 mbar	10 bar
2D	100 mbar	16 bar
3F	500 mbar	100 bar
3H	3 bar	100 bar
88	DELTATOP/-SET	

Nominal Range Calibration, Technical Units

1 mbar/bar
2 kPa/MPa
3 mm H_2O
4 inch H_2O
5 kgf/cm^2
6 psi
8 Calibrated (square root) for DELTATOP/-SET
9 Calibrated from…to…, technical units, linear or square root
E Calibrated from…to…, technical units, linear or square root, calibration report

Equipment

EA No accessories
EB 2 screw plugs
ED 2 drain valves
EG 2 screw plugs, 1 mounting bracket
EH 2 drain valves, 1 mounting bracket
EM 1 bracket for wall and pipe mounting

Sensor Seal (Wetted Part)

1 FPM Viton
3 PTFE-bound Hastelloy C-4 sealing ring, from p_{abs} 900 mbar
4 EPDM
6 FPM Viton oil and grease-free for oxygen applications
T_{max} = 60 °C, p_{max} = 70 bar
8 FPM Viton, oil and grease-free

Process Connection ¼ - 18 NPT (Wetted Part)
Mounting, Material

A Oval flange with M10, steel C 22.8
B Oval flange with $^7/_{16}$ - 20 UNF, steel C 22.8
C Oval flange with M10, steel 1.4435
D Oval flange with $^7/_{16}$ - 20 UNF, steel 1.4435 (SS 316L)
I Oval flange with M10, Hastelloy C
F Oval flange with $^7/_{16}$ - 20 UNF, Hastelloy C
G Oval flange with $^7/_{16}$ - 20 UNF, PVDF
L Oval flange connection RC ¼", with $^7/_{16}$ - 20 UNF, 1.4435 (SS 316L)

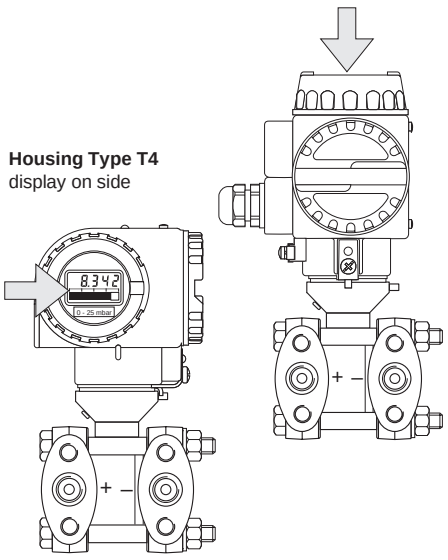
PMD 230 – [ ][ ][ ][ ][ ][ ][ ][ ] Product designation

Product Structure
Deltabar S
PMD 235

Calibration position:
as shown vertical on the process flange

Housing Type T5
display on top

Housing Type T4
display on side



Dimensions
Housing: Page 19 above
Process connections: Page 22

Sensor seal		Lower temperature limit
1, 8	FPM, Viton	–20°C (–4°F)
2	NBR	–20°C (–4°F)
3	PTFE/Hastelloy	–40°C (–40°F)
6	FPM, Viton grease-free	–10°C (–14°F)
H	Copper	–40°C (–40°F)

Note:

Special versions for e.g. sensor, seal etc. on request.

PMD 235 Deltabar S with metallic sensor. Differential pressure transmitter

Certificate, Cable Entry

A Standard, Pg 13.5
K Standard, M 20 x 1.5
5 Standard, G ½
S Standard, ½ NPT
3 M12 PROFIBUS-PA connector
4 7/8" FF connector
F Harting connector HAN 7D
C EEx ia IIC T4/T6 and ATEX II 1/2 G, Pg 13.5
L EEx ia IIC T4/T6 and ATEX II 1/2 G, M 20x1.5
6 EEx ia IIC T4/T6 and ATEX II 1/2 G, ½ NPT
D EEx ia IIC T4/T6 and ATEX II 1/2 G (with flame barrier), Pg 13.5
I EEx ia IIC T4/T6 and ATEX II 1/2 G, M12 PROFIBUS-PA connector
J EEx ia IIC T4/T6 and ATEX II 1/2 G, 7/8" FF connector
E EEx ia IIC T4/T6, Zone 0, overspill protection: VbF, WHG, Pg 13.5
M EEx d IIC T5/T6 and ATEX II 2 G, M 20x1.5
T EEx d IIC T5/T6 and ATEX II 2 G, ½ NPT
U FM Explosion proof Cl. I,II, III, Div. 1, Groups A…G, ½ NPT
W FM IS, Cl. I,II, III, Div. 1, ½ NPT
V FM IS, Cl. I,II, III, Div. 1, 7/8" FF connector
1 CSA Explosion proof CL. I,II, III, Div.1, Groups B…G, ½ NPT
2 CSA IS (non incendive), CL. I, II, III, Div.1, Groups A…G, ½ NPT
P TIIS Ex d IIC T6, G ½ with Ex d cable gland G ½

Housing (Type T5) / Electronics / Communication Protocol / Display**

*** Code for housing Type T4 in brackets, display or cover on side*

With display		*Without display*	
B	4…20 mA / HART (U)	H	4…20 mA / HART (M)
C	4…20 mA (W)	S	4…20 mA (N)
D	PROFIBUS-PA (P)	I	PROFIBUS-PA (X)
F	Foundation Fieldbus (K)	G	Foundation Fieldbus (R)

Metallic Sensor (Wetted Metallic Diaphragm)

Example: **BD** = Diaphragm Hastelloy C-276, 160 bar, 100 mbar

Material of Wetted Parts		Static Pressure	Nominal Range	
B	Diaphragm Hastelloy C-276,	160 bar	A	10 mbar
H	Diaphragm Hastelloy C-276,	420 bar	C	40 mbar
4	Diaphragm steel 1.4401 (SS 316),	160 bar	D	100 mbar*
5	Diaphragm steel 1.4401 (SS 316),	420 bar	F	500 mbar*
D	Diaphragm Monel,	160 bar	H	3 bar*
L	Diaphragm Monel,	420 bar	L	16 bar*
F	Diaphragm tantalum,	160 bar	8	DELTATOP/-SET
N	Diaphragm tantalum,	420 bar	(E	160 mbar, G 1 bar
			K	6 bar, M 40 bar)

* new measuring cell

Nominal Range Calibration, Technical Units

A Nominal calibration 0.05 %, mbar/bar, platinum version
B Nominal calibration 0.05 %, kPa/MPa, platinum version
C Nominal calibration 0.05 %, psi, platinum version
1 mbar/bar 2 kPa/MPa
3 mm H_2O 4 inch H_2O
5 kgf/cm^2 6 psi
8 Calibrated (square root) for DELTATOP/-SET
9 Calibrated from…to…, technical units, linear or square root
E Calibrated from…to…, technical units, linear or square root, calibration report

Equipment

EA No accessories
EB 2 screw plugs (wetted parts)
ED 2 bleed valves (wetted parts)
EG 2 screw plugs (wetted parts),1 mounting set
EH 2 bleed valves (wetted parts),1 mounting set
EM 1 Mounting set with screws for wall or pipe mounting

Sensor Seal (Wetted Part)

1 FPM Viton 2 NBR 3 PTFE
6 FPM Viton for oxygen applications T_{max}=60 °C, p_{max}=70 bar
8 FPM Viton, oil and grease-free
H Copper ring seal
(with process connection for diaphragm seal only, Version H)

Process Connection ¼ - 18 NPT (Wetted Part)
Mounting, Material

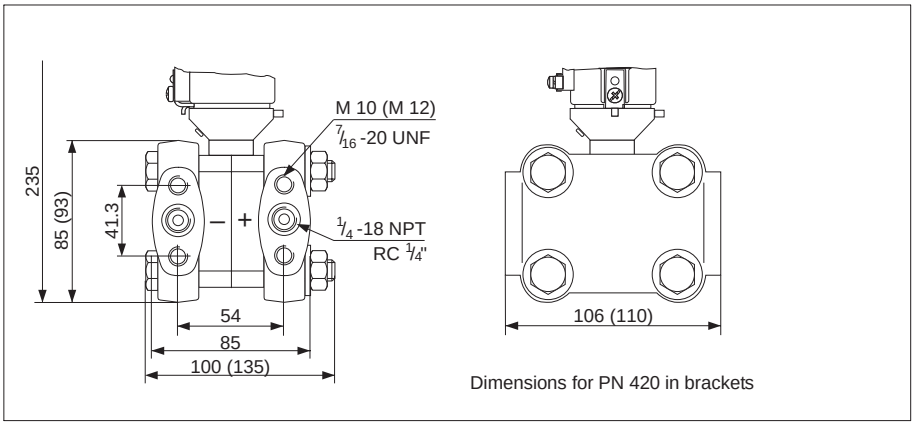
A Oval flange with M10 (M12 for PN 420), steel C 22.8
B Oval flange with $^7/_{16}$ - 20 UNF, steel C 22.8
C Oval flange with M10 (M12 for PN 420), steel 1.4435 (SS 316L)
D Oval flange with $^7/_{16}$ - 20 UNF, steel 1.4435 (SS 316L)
I Oval flange with M10 (M12 for PN 420), Hastelloy C
F Oval flange with $^7/_{16}$ - 20 UNF, Hastelloy C
H Oval flange for diaphragm seal, $^7/_{16}$ - 20 UNF, steel 1.4435 (SS 316L)
L Oval flange RC ¼", $^7/_{16}$ - 20 UNF, steel 1.4435 (SS 316L)

PMD 235 – [ ][ ][ ][ ][ ][ ][ ][ ][ ] Product designation

Dimensions Deltabar S PMD 235

Process connections PMD 235 for small measuring ranges: 10 mbar, 40 mbar

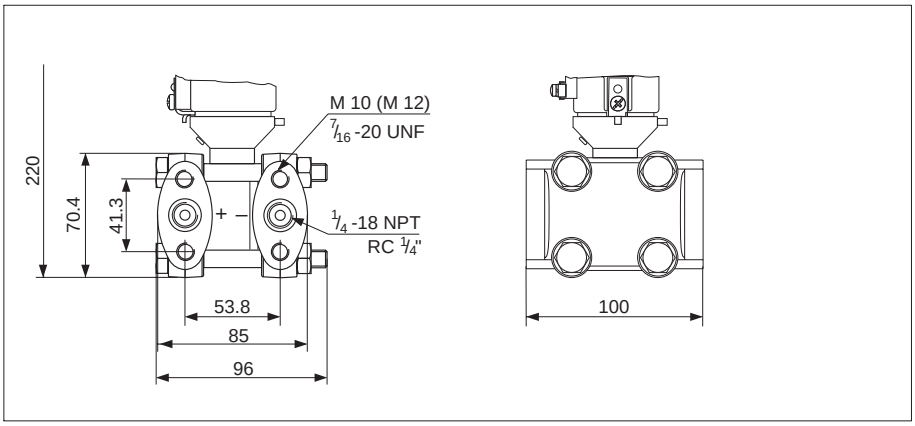
- Oval flange with M10 mounting pin (M12 for PN 420) to DIN 19213 and ¼-18 NPT connection
- Flange with $^{7}/_{16}$ - 20 UNF mounting pin and ¼-18 NPT connection
- Oval flange with $^{7}/_{16}$ - 20 UNF mounting pin and RC ¼" connection



Dimensions for PN 420 in brackets

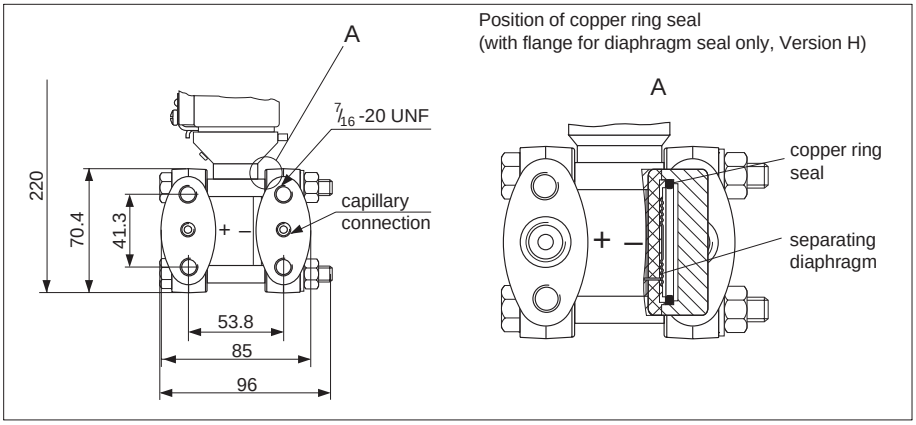
Process connections PMD 235 for standard measuring ranges: 100 mbar, 500 mbar, 3 bar, 16 bar

- Oval flange with M10 mounting pin (M12 for PN 420) to DIN 19213 and ¼-18 NPT connection
- Flange with $^{7}/_{16}$ - 20 UNF mounting pin and ¼-18 NPT connection
- Oval flange with $^{7}/_{16}$ - 20 UNF mounting pin and RC ¼" connection



Process connections PMD 235 for standard measuring ranges: 100 mbar, 500 mbar, 3 bar, 16 bar

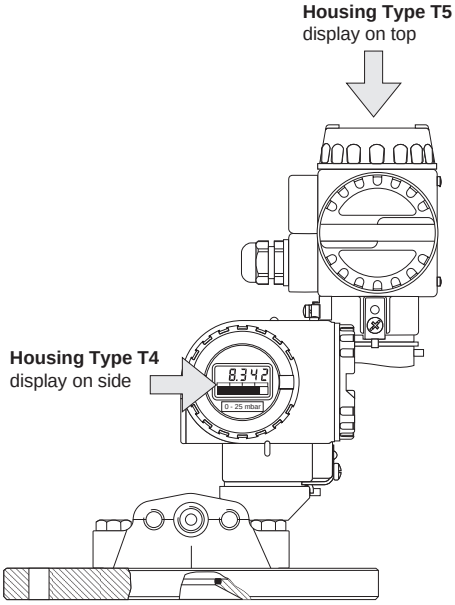
- Oval flange for diaphragm seal with $^{7}/_{16}$ - 20 UNF mounting pin



Product Structure
Deltabar S
FMD 230

Flush-Mounted Ceramic

Calibration position:
as shown vertical on the process flange



Dimensions
Housing: Page 19 above
Process connections: Page 25

Sensor seal		Lower temperature limit
1, 8	FPM, Viton	–20°C (–4°F)
3	PTFE/Hastelloy	–40°C (–40°F)
4	EPDM	–40°C (–40°F)
6	FPM, Viton grease-free	–10°C (–14°F)
7	Kalrez	+5°C (+41°F)

Note:

Special versions for e.g. sensor, seal etc. on request.

FMD 230 Deltabar S differential pressure transmitter with flush-mounted ceramic for level

Certificate, Cable Entry

A Standard, Pg 13.5
K Standard, M 20 x 1.5
5 Standard, G ½
S Standard, ½ NPT
3 M12 PROFIBUS-PA connector
4 7/8" FF connector
C EEx ia IIC T4/T6 and ATEX II 1/2 G, Pg 13.5
L EEx ia IIC T4/T6 and ATEX II 1/2 G, M 20x1.5
6 EEx ia IIC T4/T6 and ATEX II 1/2 G, ½ NPT
I EEx ia IIC T4/T6 and ATEX II 1/2 G, M12 PROFIBUS-PA connector
J EEx ia IIC T4/T6 and ATEX II 1/2 G, 7/8" FF connector
M EEx d IIC T5/T6 and ATEX II 2 G, M 20x1.5
T EEx d IIC T5/T6 and ATEX II 2 G, ½ NPT
W FM IS, Cl. I,II, III, Div. 1, ½ NPT
V FM IS, Cl. I,II, III, Div. 1, 7/8" FF connector
2 CSA IS (non incendive), CL. I, II, III, Div.1, Groups A…G, ½ NPT
7 Overspill protection: WHG, Pg 13.5
8 Overspill protection: WHG, M 20x1.5

Housing (Type T5) / Electronics / Communication Protocol / Display**
*** Code for housing Type T4 in brackets, display or cover on side*

With display		*Without display*	
B	4…20 mA / HART (U)	H	4…20 mA / HART (M)
C	4…20 mA (W)	S	4…20 mA (N)
D	PROFIBUS-PA (P)	I	PROFIBUS-PA (X)
F	Foundation Fieldbus (K)	G	Foundation Fieldbus (R)

Ceramic Sensor (Wetted Parts Ceramic Diaphragm):

	Nominal range	Static Pressure
2D	100 mbar	16 bar
3F	500 mbar	100 bar
3H	3 bar	100 bar

Nominal Range Calibration, Technical Units

1 mbar/bar
2 kPa/MPa
3 mm H_2O
4 inch H_2O
5 kgf/cm^2
6 psi
9 Calibrated from…to…, technical units, linear or square root
E Calibrated from…to…, technical units, linear or square root, calibr. report

Equipment

EA No accessories
EC 1 bleed valve steel 1.4401

Sensor Seal (Wetted Part)

1 FPM Viton
3 PTFE-bound Hastelloy C-4 sealing ring, from p_{abs} 900 mbar
4 EPDM
6 FPM Viton oil and grease-free for oxygen applications
T_{max} = 60 °C, p_{max} =70 bar
7 Kalrez
8 FPM Viton, oil and grease-free

Code for Process Connection (Wetted Parts) / Mounting Pin, Material, See Page 24

Code for Process Connection Positive Side, Material See Page 24

FMD 230 – [ ][ ][ ][ ][ ][ ][ ][ ][ ] Product designation

Product Structure Deltabar S FMD 230 (Continued)

Flush-Mounted Ceramic

FMD 230 Deltabar S differential pressure transmitter with flush-mounted ceramic for level

Process Connection (Wetted Parts) / Mounting, Materials

A with ¼-18 NPT / flange with M 10, steel C 22.8
B with ¼-18 NPT / flange with $^{7}/_{16}$ - 20 UNF, steel C 22.8
C with ¼-18 NPT / flange with M 10, steel 1.4435 (SS 316L)
D with ¼-18 NPT / flange with $^{7}/_{16}$ - 20 UNF, steel 1.4435 (SS 316L)
I with ¼-18 NPT / flange with M 10, Hastelloy C
F with ¼-18 NPT / flange with $^{7}/_{16}$ - 20 UNF, Hastelloy C
L with RC ¼", $^{7}/_{16}$ - 20 UNF, steel 1.4435 (SS 316L)

Process Connection Positive Side, Materials

Flange, DIN 2501 Connection Size
BK Flange DN 80 PN 10-40, steel 1.4435 (SS 316L)
BM Flange DN 80 PN 10-40, ECTFE-coated
BN Flange DN 80 PN 10-40, Hastelloy C
BU Flange DN 100 PN 10-16, steel 1.4435 (SS 316L)
BR Flange DN 100 PN 25-40, steel 1.4435 (SS 316L)
BS Flange DN 100 PN 25-40, ECTFE-coated
BW Flange DN 100 PN 10-16, Hastelloy C
BT Flange DN 100 PN 25-40, Hastelloy C

Flange, ANSI B16.5 Connection Size
DK Flange ANSI 3" 150 lbs, steel 1.4435 (SS 316L)
DM Flange ANSI 3" 150 lbs, ECTFE-coated
DN Flange ANSI 3" 150 lbs, Hastelloy C

Flange, ANSI B16.5 Connection Size
DR Flange ANSI 4" 150 lbs, steel 1.4435 (SS 316L)
DS Flange ANSI 4" 150 lbs, ECTFE-coated
DT Flange ANSI 4" 150 lbs, Hastelloy C

Flange, JIS Connection Size
NK Flange JIS 10K 80 A, steel 1.4435 (SS 316L)
NM Flange JIS 10K 80 A, ECTFE-coated
NN Flange JIS 10K 80 A, Hastelloy C

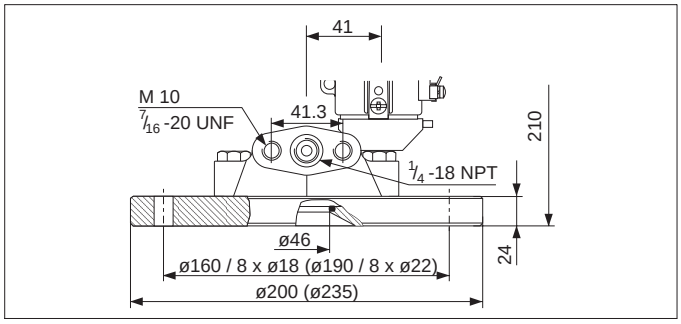
WH Sanitary connection with 2" extension negative side ¼-18 NPT without mounting pin

Code process connection

Dimensions
Deltabar S
FMD 230

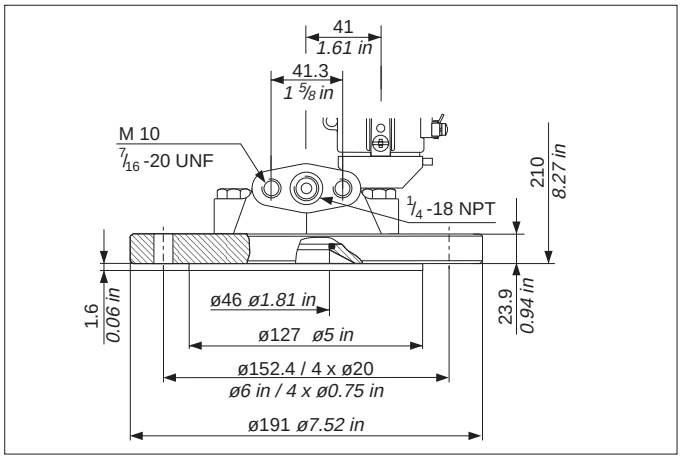
DIN flange DN 80 PN 40
- Version BK: Steel 1.4435 (SS 316L)
- Version BM: ECTFE-coated
- Version BN: Hastelloy C

DIN flange DN 100 PN 40
- Version BR: Steel 1.4435 (SS 316L)
- Version BS: ECTFE-coated
- Version BT: Hastelloy C



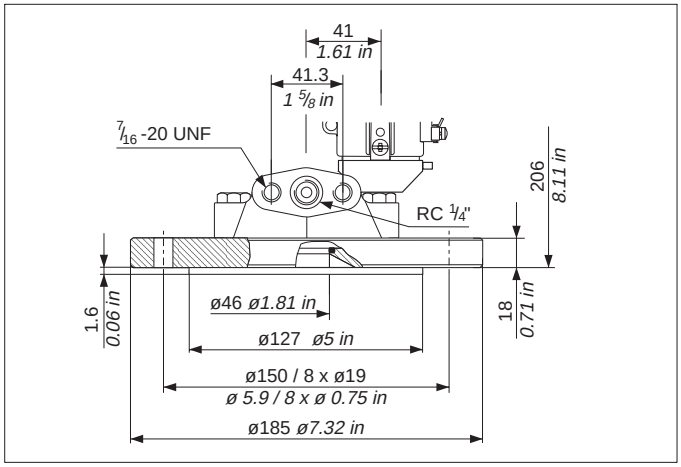
Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm

ANSI flange 3" 150 lbs
- Version DK: Steel 1.4435 (SS 316L)
- Version DM: ECTFE-coated
- Version DN: Hastelloy C



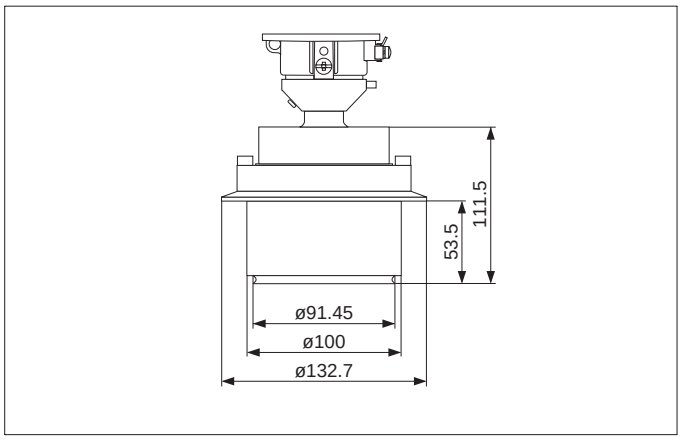
Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm

JIS flange 10K 80 A
- Version NK: Steel 1.4435 (SS 316L)
- Version NM: ECTFE-coated
- Version NN: Hastelloy C



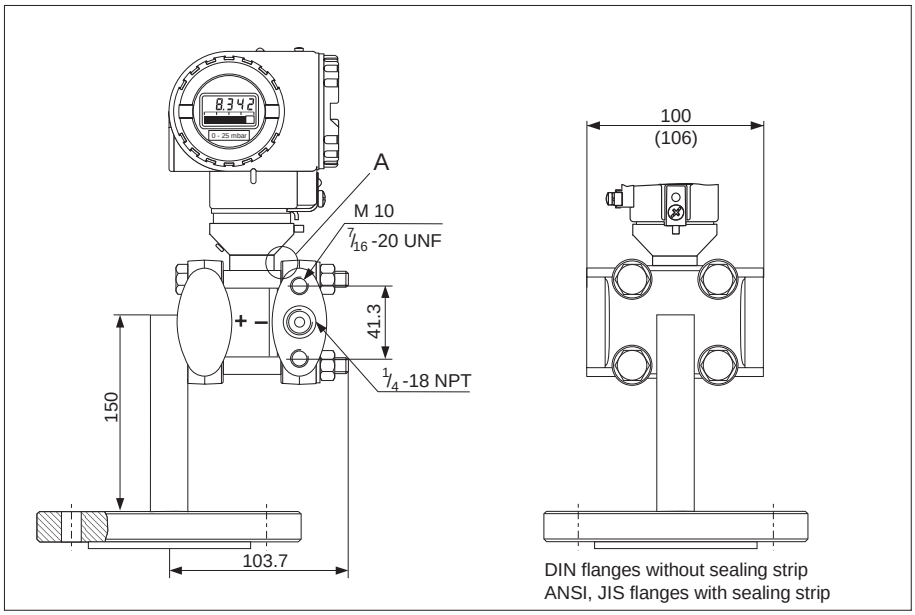
Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm

Sanitary connection with 2" extension
negative side ¼ -18 NPT
- Version WH: steel 1.4435 (SS 316L)



Mechanical Construction with Diaphragm Seal

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

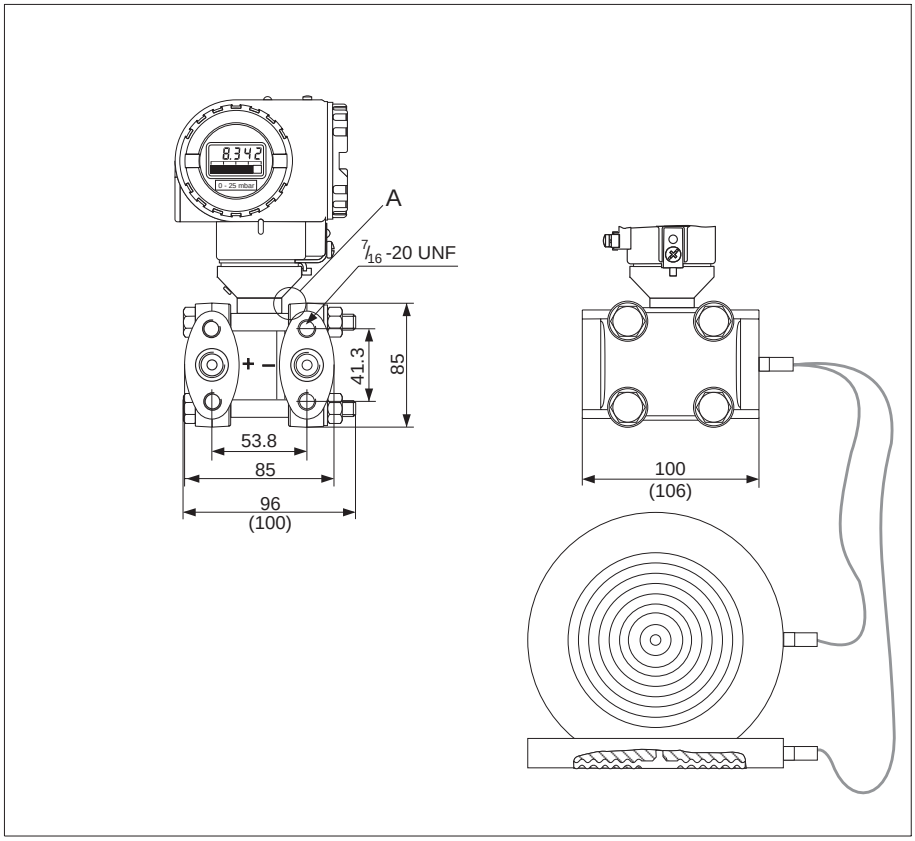


DIN flanges without sealing strip
ANSI, JIS flanges with sealing strip

Deltabar S FMD 630 with direct diaphragm seal
Dimensions
- Housing: Page 19 above
- Process connections: Page 29

Dimensions in brackets for measuring cells:
160 mbar, 1 bar, 6 bar, 40 bar

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

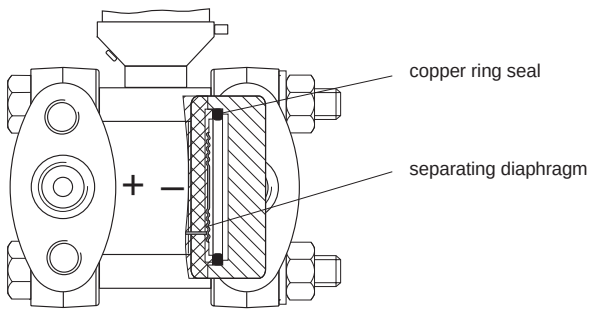


Deltabar S FMD 633 with capillary tubing
Dimensions
- Housing: Page 19 above
- Process connections: Pages 31 and 32

Dimensions in brackets for measuring cells:
160 mbar, 1 bar, 6 bar, 40 bar

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

A Position of the copper ring seal



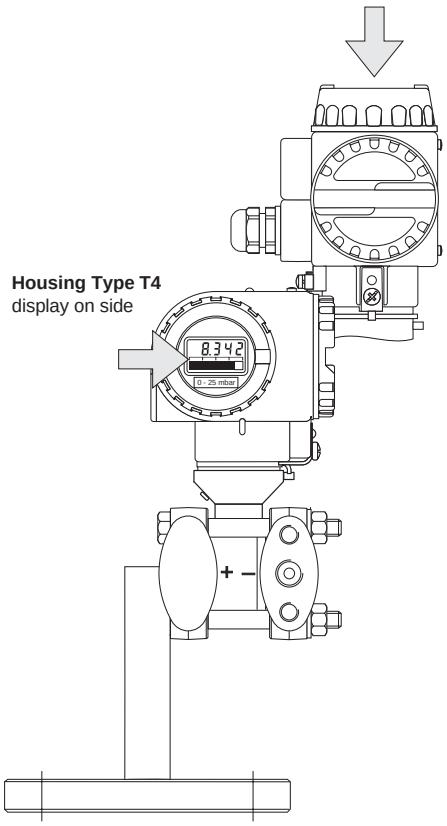
Copper ring seal
for Deltabar S FMD 630, FMD 633

Product Structure
Deltabar S
FMD 630

Calibration position:
as shown vertical on the process flange

Housing Type T5
display on top

Housing Type T4
display on side



Dimensions
Housing: Page 19 above
Process connections: Page 29

Sensor seal		Lower temperature limit
1, 8	FPM, Viton	–20°C (–4°F)
2	NBR	–20°C (–4°F)
3	PTFE/Hastelloy	–40°C (–40°F)
6	FPM, Viton grease-free	–10°C (–14°F)
H	Copper	–40°C (–40°F)

Note:

Special versions for e.g. sensor, seal etc. on request.

FMD 630 Deltabar S differential pressure transmitter with direct diaphragm seal for level

Certificate, Cable Entry

A Standard, Pg 13.5
K Standard, M 20 x 1.5
5 Standard, G ½
S Standard, ½ NPT
3 M12 PROFIBUS-PA connector
4 7/8" FF connector
C EEx ia IIC T4/T6 and ATEX II 1/2 G, Pg 13.5
L EEx ia IIC T4/T6 and ATEX II 1/2 G, M 20 x 1.5
6 EEx ia IIC T4/T6 and ATEX II 1/2 G, ½ NPT
I EEx ia IIC T4/T6 and ATEX II 1/2 G, M12 PROFIBUS-PA connector
J EEx ia IIC T4/T6 and ATEX II 1/2 G, 7/8" FF connector
D EEx ia IIC T4/T6 and ATEX II 1/2 G (with flame barrier), Pg 13.5
E EEx ia IIC T4/T6, Zone 0, overspill protection: VbF, WHG, Pg 13.5
M EEx d IIC T5/T6 and ATEX II 2 G, M 20 x 1.5
T EEx d IIC T5/T6 and ATEX II 2 G, ½ NPT
U FM Explosion proof Cl. I, II, III, Div. 1, Groups A…G, ½ NPT
W FM IS, Cl. I,II, III, Div. 1 , ½ NPT
V FM IS, Cl. I,II, III, Div. 1, 7/8" FF connector
1 CSA Explosion proof CL. I,II, III, Div.1, Groups B…G, ½ NPT
2 CSA IS (non incendive), CL I, II, III, Div.1, Groups A…G, ½ NPT
P TIIS Ex d IIC T6, G ½ with Ex d cable gland G ½

Housing (Type T5) / Electronics / Communication Protocol / Display**

*** Code for housing Type T4 in brackets, display or cover on side*

With display		*Without display*	
B	4…20 mA / HART (U)	H	4…20 mA / HART (M)
C	4…20 mA (W)	S	4…20 mA (N)
D	PROFIBUS-PA (P)	I	PROFIBUS-PA (X)
F	Foundation Fieldbus (K)	G	Foundation Fieldbus (R)

Metallic Sensor (Wetted Metallic Diaphragm on Negative Side)

	Nominal range	Static pressure	
4D	100 mbar*	160 bar	
4F	500 mbar*	160 bar	
4H	3 bar*	160 bar	* new measuring cell
4L	16 bar*	160 bar	
(4E	160 mbar, 4G 1000 mbar, 4K 6 bar)		

Nominal Range Calibration, Technical Units

1 mbar/bar
2 kPa/MPa
3 mm H_2O
4 inch H_2O
5 kgf/cm^2
6 psi
9 Calibrated from…to…, technical units, linear or square root
E Calibrated from…to…, technical units, linear or square root, calibration report

Equipment

EA No accessories
EC 1 bleed valve, steel 1.4401 (SS 316)

Sensor Seal (Wetted Part)

1 FPM Viton
2 NBR
3 PTFE
6 FPM Viton, oil and grease-free for oxygen applications
T_{max} = 60 °C, p_{max} = 70 bar
8 FPM Viton, oil and grease-free
H Copper ring seal
(only with process connection for diaphragm seal, version H)

Code for Process Connection $^1/_4$ - 18 NPT, Wetted Parts, See Page 28

Code for Process Connection Positive Side (Wetted Parts, 1.4435 / 1.4571), See Page 29

Structures are given in the table on Page 29
(Column »Code«)

Diaphragm Seal: Diaphragm Material and Filling Fluid (Always with Extension in 1.4435/SS 316L), See Page 28

FMD 630 – [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] Product designation

Product Structure Deltabar S FMD 630 (Continued)

FMD 630 Deltabar S differential pressure transmitter with direct diaphragm seal for level

Process Connection $^{1}/_{4}$ - 18 NPT, Wetted Parts Material

- A Flange with M 10, steel C 22.8
- B Flange with $^{7}/_{16}$ - 20 UNF, steel C 22.8
- C Flange with M 10, steel 1.4435 (SS 316L)
- D Flange with $^{7}/_{16}$ - 20 UNF, steel 1.4435 (SS 316L)
- H Flange for diaphragm seal, steel 1.4435 (SS 316L)
- L Flange RC ¼", $^{7}/_{16}$ - 20 UNF, steel 1.4435 (SS 316L)

Process Connection Positive Side (Wetted Parts: 1.4435/1.4571; SS 316L/SS 316Ti)

Structures are given in the table on Page 29 (Column »Code«)

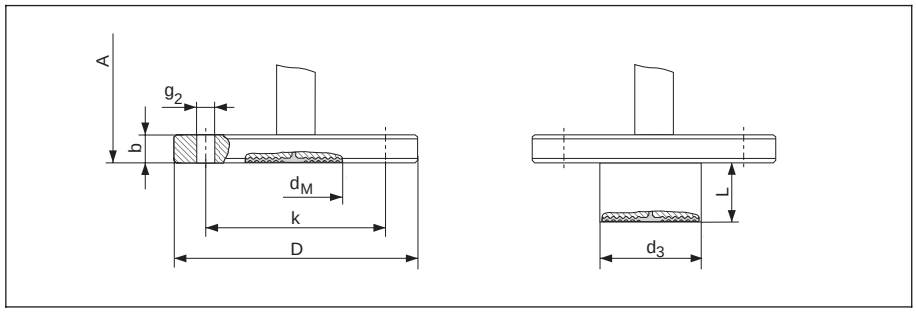
Diaphragm Seal: Diaphragm Material and Filling Fluid (always 1.4435; SS 316Ti with Extension)

- A Hastelloy, silicone oil
- D Hastelloy, high-temperature oil
- F Tantalum, silicone oil
- G Tantalum, high-temperature oil
- 1 1.4435 (SS 316L), silicone oil
- 2 1.4435 (SS 316L), vegetable oil
- 3 1.4435 (SS 316L), glycerine
- 4 1.4435 (SS 316L), high-temperature oil
- 5 1.4435 (SS 316L), oil for oxygen applications

Product designation

Dimensions
Deltabar S
FMD 630

Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar



Diaphragm seal flange, DIN 2501 connection, material 1.4435 (SS 316L)

Instrument	Code	Pipe	Flange					Bores			Diaphragm seal			
		Nominal diameter	Nominal pressure	Diameter	Thickness	Extension length	Extension diameter	Number	Diameter	Hole circle	Diaphragm diameter	Temperature coefficient (for silicone oil, for other oils see page 12)	Height	Weight FMD 630
		DN	PN	D	b	L	d_3		g_2	k	d_M	Tk	A	
		mm	bar	mm	mm	mm	mm		mm	mm	mm	mbar/10 K	mm	kg
FMD 630	A	50	10–40	165	17.8	—	—	4	18	125	50	+2.5	360	9
FMD 630	C	80	10–40	200	23.8	—	—	8	18	160	89	+1.5	360	11
FMD 630	D	80	10–40	200	24	50	77	8	18	160	71.5	+1.5	360	13
FMD 630	E	80	10–40	200	24	100	76	8	18	160	75	+2	360	15
FMD 630	F	80	10–40	200	24	200	77	8	18	160	71.5	+2	360	18
FMD 630	H	100	10–25	220	20	—	—	8	18	180	80	+1	360	13
FMD 630	G	100	25–40	235	24	—	—	8	22	190	80	+1	360	13

Diaphragm seal flange, ANSI B 16.5 connection, material 1.4435 (SS 316L)

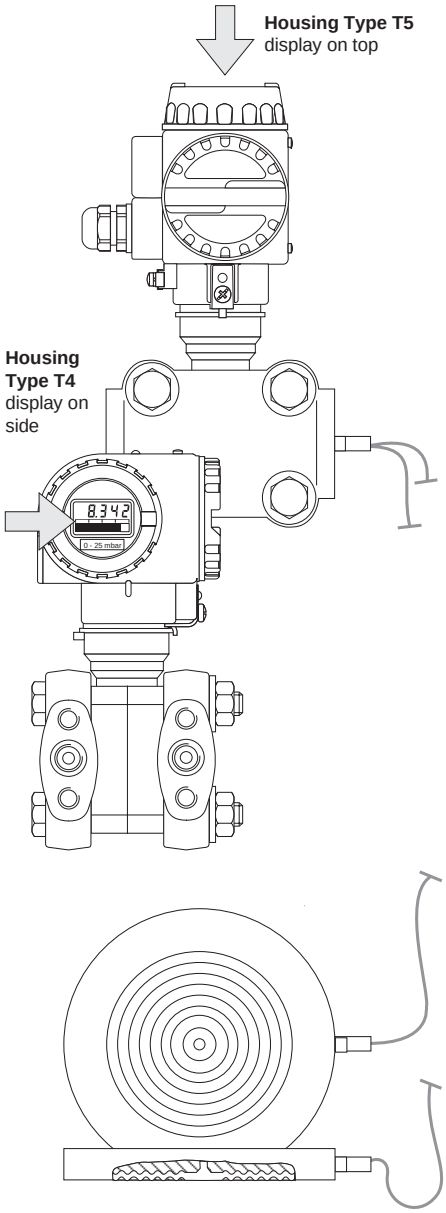
Instrument	Code	Pipe	Flange					Bores			Diaphragm seal			
		Nominal diameter	Nominal pressure	Diameter	Thickness	Extension length	Extension diameter	Number	Diameter	Hole circle	Diaphragm diameter	Temperature coefficient (for silicone oil, for other oils see page 12)	Height	Weight FMD 630
		DN	PN	D	b	L	d_3		g_2	k	d_M	Tk	A	
		in	*lb/sq. in*	*in*	*in*	*in*	*in*		*in*	*in*	*in*	*psi/10°F*	*in*	*kg*
				mm	mm	mm	mm		mm	mm	mm	mbar/10 K	mm	
FMD 630	P	*2*	*150*	*6*	*3/4*	—	—	*4*	*3/4*	*4 3/4*	*1 3/4*		*14.2*	*9*
				152.4	19.1				19.1	120.7	50	+2.5	360	
FMD 630	R	*3*	*150*	*8.25*	*15/16*	—	—	*4*	*3/4*	*6*	*2 3/4*		*14.2*	*11*
				190.5	23.9				19.1	152.4	89	+1.5	360	
FMD 630	S	*3*	*150*	*8.25*	*15/16*	*2*	*3*	*4*	*3/4*	*6*	*2 3/4*		*14.2*	*13*
				190.5	23.9	50.8	76		19.1	152.4	71.5	+1.5	360	
FMD 630	T	*3*	*150*	*8.25*	*15/16*	*4*	*3*	*4*	*3/4*	*6*	*2 3/4*		*14.2*	*15*
				190.5	23.9	101.6	76		19.1	152.4	71.5	+2	360	
FMD 630	U	*3*	*150*	*8.25*	*15/16*	*8*	*3*	*4*	*3/4*	*6*	*2 3/4*		*14.2*	*18*
				190.5	23.9	203.2	76		19.1	152.4	71.5	+2	360	
FMD 630	W	*4*	*300*	*10*	*1 1/2*	—	—	*8*	*14/16*	*6*	*2 3/4*		*14.2*	*13*
				254	31.8				22.4	200.1	80	+1	360	

Diaphragm seal flange, JIS B 2210 connection, material 1.4435 (SS 316L)

Instrument	Code	Pipe	Flange					Bores			Diaphragm seal			
		Nominal diameter	Nominal pressure	Diameter	Thickness	Extension length	Extension diameter	Number	Diameter	Hole circle	Diaphragm diameter	Temperature coefficient (for silicone oil, for other oils see page 12)	Height	Weight FMD 630
		DN	PN	D	b	L	d_3		g_2	k	d_M	Tk	A	
		mm		mm	mm	mm	mm		mm	mm	mm	mbar/10 K	mm	kg
FMD 630	1	50	10 K	155	16	—	—	4	19	120	46	+ 2.5	356	9
FMD 630	2	80	10 K	185	18	—	—	8	19	150	70	+ 1.5	358	11
FMD 630	3	100	10 K	210	18	—	—	8	19	175	70	+ 1	358	13

Product Structure
Deltabar S
FMD 633

Calibration position:
Vertical with diaphragm seals at the same height



Other dimensions
Housing: Page 19 above
Process connections: Pages 31 and 32

Note:

Special versions for e.g. sensor, seal etc. on request.

FMD 633 Deltabar S differential pressure transmitter, with capillary tubing for level

Certificate, Cable Entry

A Standard, Pg 13.5
K Standard, M 20 x 1.5
5 Standard, G ½
S Standard, ½ NPT
3 M12 PROFIBUS-PA connector
4 7/8" FF connector
C EEx ia IIC T4/T6 und ATEX II 1/2 G, Pg 13.5
L EEx ia IIC T4/T6 und ATEX II 1/2 G, M 20 x 1.5
6 EEx ia IIC T4/T6 und ATEX II 1/2 G, ½ NPT
D EEx ia IIC T4/T6 und ATEX II 1/2 G (with flame barrier), Pg 13.5
I EEx ia IIC T4/T6 und ATEX II 1/2 G, M12 PROFIBUS-PA connector
J EEx ia IIC T4/T6 und ATEX II 1/2 G, 7/8" FF connector
E EEx ia IIC T4/T6, Zone 0, overspill protection: VbF, WHG, Pg 13.5
M EEx d IIC T5/T6 und ATEX II 2 G, M 20 x 1.5
T EEx d IIC T5/T6 und ATEX II 2 G, ½ NPT
U FM Explosion proof Cl. I, II, III, Div. 1, Groups A…G, ½ NPT
W FM IS, Cl. I,II, III, Div. 1, ½ NPT
V FM IS, Cl. I,II, III, Div. 1, 7/8" FF connector
1 CSA Explosion proof CL. I,II, III, Div.1, Groups B…G, ½ NPT
2 CSA IS (non incendive), CL I, II, III, Div.1, Groups A…G, ½ NPT
P TIIS Ex d IIC T6, G ½ with Ex d cable gland G ½

Housing (Type T5) / Electronics / Communication Protocol / Display**

*** Code for housing Type T4 in brackets, display or cover on side*

	With display		*Without display*
B	4…20 mA / HART (U)	H	4…20 mA / HART (M)
C	4…20 mA (W)	S	4…20 mA (N)
D	PROFIBUS-PA (P)	I	PROFIBUS-PA (X)
F	Foundation Fieldbus (K)	G	Foundation Fieldbus (R)

Metallic Sensor (Wetted Metallic Diaphragm)

	Nominal Range	Static Pressure
4D	100 mbar*	160 bar
4F	500 mbar*	160 bar
4H	3 bar*	160 bar
4L	16 bar*	160 bar
4E	160 mbar	160 bar
4G	1000 mbar	160 bar
4K	6 bar	160 bar

* new measuring cell

Nominal Range Calibration, Technical Units

1 mbar/bar
2 kPa/MPa
3 mm H_2O
4 inch H_2O
5 kgf/cm^2
6 psi
9 Calibrated from…to…, technical units, linear or square root
E Calibrated from…to…, technical units, linear or square root, calibration report

Equipment

EA No accessories
EM 1 Mounting set with screws for wall or pipe mounting
EP 4 Mounting screws $^7/_{16}$ UNF, length: 1 ½"

Process Connection
(Wetted Parts, 1.4435/SS 316L and Diaphragm Material)

Structures are given in the tables on Pages 31 and 32
(Column "Code")

Capillary Length and Filling Fluid

11 1 m (3.28 ft) capillary tubing with silicone oil
12 2 m (5.56 ft) capillary tubing with silicone oil
14 4 m (13.1 ft) capillary tubing with silicone oil
18 8 m (26.2 ft) capillary tubing with silicone oil
21 1 m (3.28 ft) capillary tubing with vegetable oil
22 2 m (5.56 ft) capillary tubing with vegetable oil
24 4 m (13.1 ft) capillary tubing with vegetable oil
28 8 m (26.2 ft) capillary tubing with vegetable oil
31 1 m (3.28 ft) capillary tubing with high-temperature oil
32 2 m (5.56 ft) capillary tubing with high-temperature oil
34 4 m (13.1 ft) capillary tubing with high-temperature oil
41 1 m (3.28 ft) capillary tubing with oil for oxygen applications
42 2 m (5.56 ft) capillary tubing with oil for oxygen applications
44 4 m (13.1 ft) capillary tubing with oil for oxygen applications
48 8 m (26.2 ft) capillary tubing with oil for oxygen applications
99 Other capillary tubing and filling fluid

FMD 633 – | | | | | | | | | | Product designation

Dimensions Deltabar S FMD 633

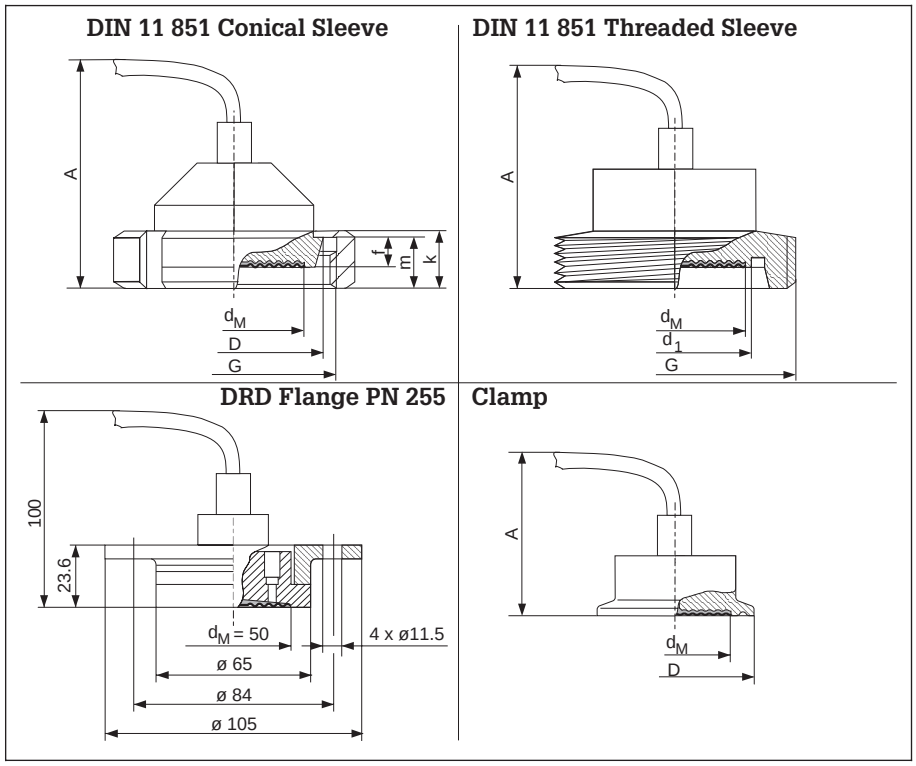
DIN 11 851

Clamp

DRD Flange

Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar

Code KE
DRD flange
- T_K one-sided
  1.5 mbar/10 K
- T_K two-sided
  0.25 mbar/10 K
- Weight for two diaphragm seals
  1.5 kg



Diaphragm seal conical sleeve with groove nut, DIN 11 851 (sanitary connection)

Instrument	Code	Pipe	Conical sleeve			Groove nut			Diaphragm seal				
		Nominal diameter	Nominal pressure	Diameter	Collar height	Thread	Height	Height	Diaphragm diameter	One-sided / Temperature coefficient (for silicone oil, for other oils see page 12) / Two-sided		Minimum interval	Weight for two diaphragm seals
		DN	PN	D	f	G	k	m	d_M	T_k		A	
		mm	bar	mm	mm		mm	mm	mm	mbar/10 K		mm	kg
FMD 633	FA	50	25	68,5	11	Rd 78 x 1/6"	22	19	50	+3.0	+0.5	120	2.2
FMD 633	FE	65	25	86	12	Rd 95 x 1/6"	25	21	52	+1.0	+0.2	120	4.0
FMD 633	FK	80	25	100	12	Rd 110 x 1/4"	30	26	63	+0.7	+0.1	120	5.1

Diaphragm seal thread adapter, DIN 11 851 (sanitary connection)

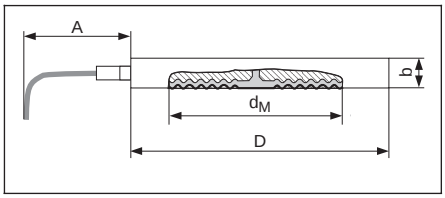
Instrument	Code	Pipe	Thread adapter			Diaphragm seal				
		Nominal diameter	Nominal pressure	Diameter	Thread	Diaphragm diameter	One-sided / Temperature coefficient (for silicone oil, for other oils see page 12) / Two-sided		Minimum interval	Weight for two diaphragm seals
		DN	PN	d1	G	d_M	T_k		A	
		mm	bar	mm		mm	mbar/10 K		mm	kg
FMD 633	GA	50	25	54	Rd 78 x 1/6"	48	+3.0	+0.5	110	1.8
FMD 633	GE	65	25	71	Rd 95 x 1/6"	59	+1.0	+0.2	110	3.4
FMD 633	GK	80	25	85	Rd 110 x 1/4"	80	+0.7	+0.1	110	4.0

Diaphragm seal Clamp

Instrument	Code	Pipe	Clamp adapter		Diaphragm seal				
		Nominal diameter	Nominal pressure	Diameter	Diaphragm diameter	One-sided / Temperature coefficient (for silicone oil, for other oils see page 12) / Two-sided		Minimum interval	Weight for two diaphragm seals
		DN	PN	D	d_M	T_k		A	
		mm	bar	mm	mm	mbar/10 K		mm	kg
FMD 633	HA	2"	40	64	45	+3.0	+0.5	100	1.4
FMD 633	HK	3"	40	91	71.5	+0.7	+0.1	100	2.4

Materials of wetted parts
for all versions:
Diaphragm 1.4435
(SS 316L)
Body 1.4571 (SS 316Ti)

Dimensions
Deltabar S
FMD 633



Conversion factors
- 1 mm = 0.039 in
  1 in = 25.4 mm
- 1 kg = 2.2 lbs
  1 lbs = 0.45 kg
- 1 bar = 14.5 psi
  1 psi = 0.069 bar

DIN Cell

ANSI Cell

Materials of wetted parts
for all versions:
Bodies 1.4435 (SS 316L)
Diaphragm:
see tables

Diaphragm seal cell design, DIN 2501 connection

Instrument	Code		Pipe	Flange			Diaphragm seal				
		Diaphragm material	Nominal diameter	Nominal pressure	Diameter	Thickness	Diaphragm diameter	One-sided / Temperature coefficient / Two-sided		Minimum interval	Weight for two diaphragm seals
			DN	PN	D	b	d_M	T_k		A	
			mm	bar	mm	mm	mm	mbar/10 K		mm	kg
FMD 633	AA	1.4435 (SS 316L)	50	16/400	102	20	52	+3.0	+0.5	130	2.6
FMD 633	AB	Hastelloy C									
FMD 633	AC	Tantalum									
FMD 633	AK	1.4435 (SS 316L)	80	16/400	138	20	89	+0.7	+0.1	130	4.6
FMD 633	AM	PTFE film 0.09 mm on 1.4435 (SS 316L)									
FMD 633	AN	Hastelloy C	80	16/400	136	20	80	+0.7	+0.1	130	4.6
FMD 633	AP	Tantalum									
FMD 633	AR	1.4435 (SS 316L)	100	16/400	162	20	89	+0.7	+0.1	130	6.2

Diaphragm seal flange cell design, ANSI B 16.5 connection

Instrument	Code		Pipe	Flange			Diaphragm seal				
		Diaphragm material	Nominal diameter	Nominal pressure	Diameter	Thickness	Diaphragm diameter	One-sided / Temperature coefficient / Two-sided		Minimum interval	Weight for two diaphragm seals
			DN	PN	D	b	d_M	T_k		A	
			in	*lb/sq. in*	*in*	*in*	*in*	*psi/10 °F*		*in*	*kg*
					mm	mm	mm	mbar/10 K		mm	
FMD 633	CK	AISI 316L	*3*	*150/2500*	*5.35*	3/4	*2 3/4*	*+0.0056*	*+0.0008*	*5*	*4.5*
					127	20	89	+0.7	+0.1	130	
FMD 633	CR	AISI 316L	*4*	*150/2500*	*6.22*	3/4	2 3/4	+0.0056	*+0.0008*	*5*	*6.2*
					158	20	80	+0.7	+0.1	130	

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