Operating Manual

MHDS - Differential Pressure Transmitter -HART- 0200

MHDS

Overview Documents

- Data sheet MHDS
- Operating manual MHDS-M (this document)

Content

1 Safety Instructions

1.1 Used Signs

Warning!
Non-compliance can cause injuries or device demolition.

Attention!
Non-compliance can cause faulty device operation.

Information!
Non-compliance can influence device operation or cause unintentional device reactions.

1.2 Mounting, Start-Up

The MHDS is a differential pressure transmitter for flow, level and differential pressure measuring. The manufacturer of the device is not liable for defects resulting from incorrect use or use other than designated.

The pressure transmitter is state-of-the-art and meets the relevant regulations and EU standards. When usage is not appropriate or deviates from requirements, the device can cause application-related dangers,, e. g. a fluid leakage when mounted or adjusted wrong.

Non-compliance of safety regulations valid for this application may cause serious injuries and/or damages. Only qualified personnel authorised by the operator is allowed to carry out mounting, electrical connection, start-up, operation and maintenance of the pressure transmitter.

Qualified personnel must have read and understood this operating manual. The instructions included in the manual have to be complied with.

Only conduct modifications and repairs when this documention expressively allows it.

2 Mounting

Before Mounting:

2.1 Acceptance

- Check packaging and contents for damage when receiving goods.
- Check delivery for completeness (e. g. compare delivery note with order)

2.2 Storage

- Store the device in a dry and clean area. Protect the device against damage from impact.
- Storage temperature: -40...+85 °C

2.3 Identification

- The product label shows the maximum working pressure (P_{max} = MWP = maximum working pressure). This value refers to a reference temperature of 20 °C.
- Allowed pressure values at higher temperatures can be found in the relevant standards.
- The test pressure of the device corresponds to the overload pressure (see table on page 17).
- The abbreviation used in the pressure equipment directive (2014/68/EU) corresponds to the MWP of this device. (Maximum working pressure = P_{max})

Product label details (these details may vary):

Type: name of the device = MHDS
TAG-No: indentification number within the installation
Date: date of completion
P_{max}: = MWP = maximum working pressure)
Input: kind of pressure (differential pressure)
Supply: voltage supply = 15...45 VDC
Output: output signal = 4...20 mA HART
Range: measuring range (adjusted)
Order number / item number: 200-xxxxx (x = variable)
SN: serial number
Protection class: IP65

2.4 Scope of Delivery

The delivery includes:

- differential pressure transmitter MHDS
- mount for wall- and tube mounting
- accessories (option)

Supplied documents:

- this operating manual MHDS-M
- option: final inspection and test report
- option: factory calibration form
- option: operating manual for programming software

2.5 Mounting

- Mounting dimensions see page 17

2.6 Notes for Mounting

- The fitting position of the MHDS may cause a zero point offset. E. g. with an empty container, the measurement value will not be 0. This can be corrected by shifting the zero point directly with the configuration keys on the device or by using the external configuration software. See page 10...12 or programming software manual.
- Usage of a 3- or 5-valve block allows for mounting, start-up and maintenance without process interruption.
- When laying differential pressure pipes outside, provide for appropriate frost protection, e. g. by using pipe trace heating.
- The relevant standards (national or international) can give recommendations for the laying of differential pressure pipes (e. g. DIN 19210).
- Differential pressure pipes with a constant drop have to be layed with a gradient of at least 10%.
- The electronics casing can be rotated up to 360°. This makes the display of the electronics insert very readable. See also page 7.
- A mount for wall and tube mounting is included in the scope of delivery.

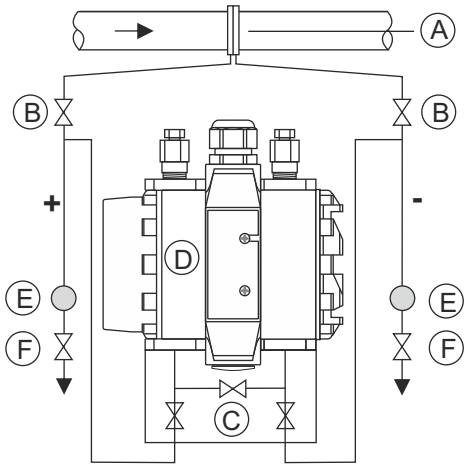
2.7 Mounting for Flow Measurement

Flow Measurement in Liquids

A: Pitot tube / orifice plate
B: Stop valve
C: 3-valve block
D: MHDS
E: Separator
F: Drain valve

Mount the pressure sensor MHDS below the measuring point. This way the differential pressure pipes will always be filled with fluids and possible gas bubbles can rise up into the process pipework.

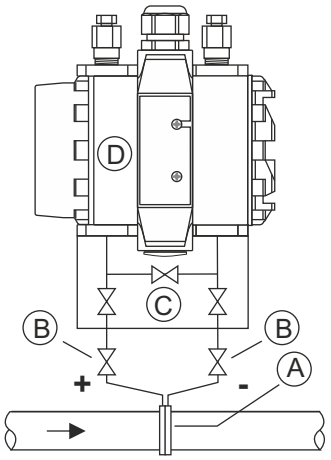
Separators and drain valves are useful if the medium contains solid parts. They will remove these deposits.



Flow Measurement in Gases

A: Pitot tube / orifice plate
B: Stop valve
C: 3-valve block
D: MHDS

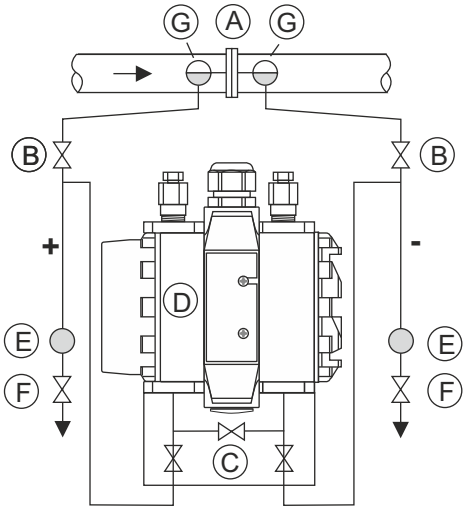
Mount the pressure sensor MHDS above the measuring point. Possible existing condensate can run off into the process pipework.



2.7 Mounting for Flow Measurement (Continued)

Steam Flow Measurement

A: Pitot tube / orifice plate
B: Stop valve
C: 3-valve block
D: MHDS
E: Separator
F: Drain valve
G: Condensate trap



Mount the pressure sensor MHDS below the measuring point.

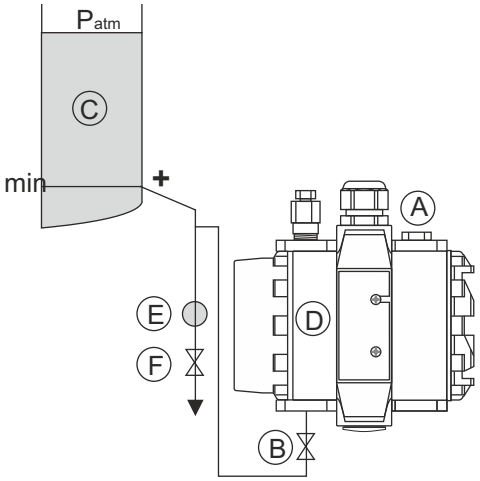
Mount the condensate trap at the same level as the tapping point and at the same distance to the MHDS.

Before start-up, fill the differential pressure pipes to the height of the condensate traps.

2.8 Mounting for Leavel Measurement

Level Measurement with Open Vessel

A: Minus side is open to atmosphere
B: Stop valve
C: Vessel
D: MHDS
E: Separator
F: Drain valve

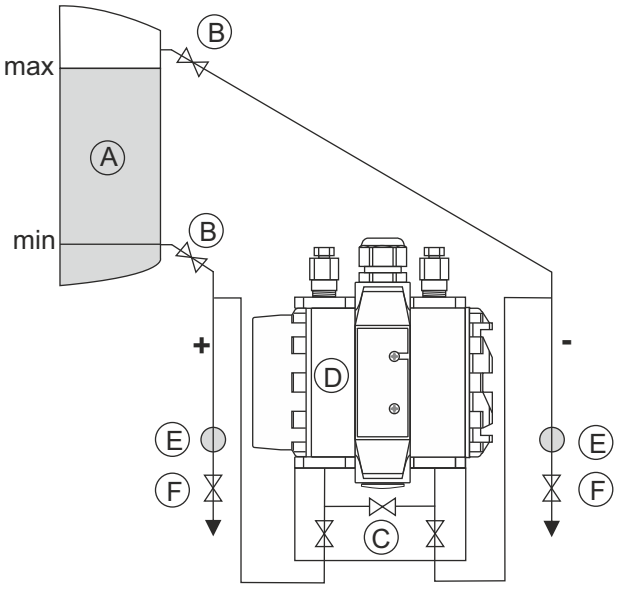


Mount the pressure sensor MHDS below the measuring point. This way the differential pressure pipes will always be filled with fluids.

Minus side is open to atmosphere.

Level Measurement with Closed Vessel

A: Vessel
B: Stop valve
C: 3-valve block
D: MHDS
E: Separator
F: Drain valve



Mount the pressure sensor MHDS below the measuring point. This way the differential pressure pipes will always be filled with fluids.

Minus side has to be connected above the maximum level.

Separators and drain valves are useful if the medium contains solid parts. They will remove these deposits.

2.8 Mounting for Level Measurement (Continued)

Level Measurement with Closed Vessel and Superimposed Steam

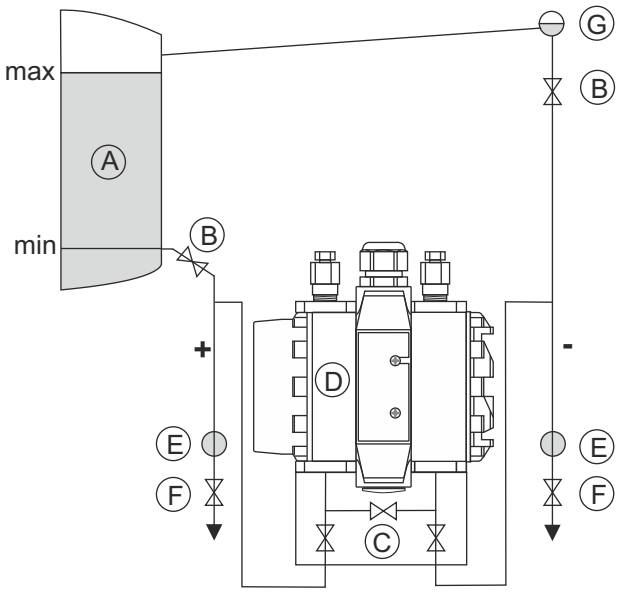
A: Vessel
B: Stop valve
C: 3-valve block
D: MHDS
E: Separator
F: Drain valve
G: Condensate trap

Mount the pressure sensor MHDS below the measuring point. This way the differential pressure pipes will always be filled with fluids.

Minus side has to be connected above the maximum level.

Separators and drain valves are useful if the medium contains solid parts. They will remove these deposits.

The condensate trap ensures a constant pressure on the minus side.



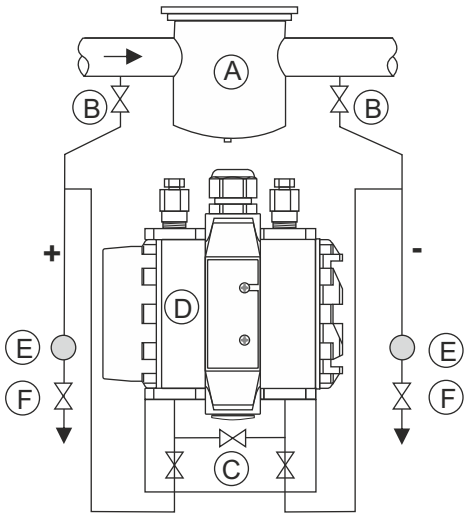
2.9 Mounting for Differential Pressure Measurement

Differential Pressure Measurement with Fluids

A: Filter (example)
B: Stop valve
C: 3-valve block
D: MHDS
E: Separator
F: Drain valve

Mount the pressure sensor MHDS below the measuring point. This way the differential pressure pipes will always be filled with fluids and possible gas bubbles can rise up into the process pipework.

Separators and drain valves are useful if the medium contains solid parts. They will remove these deposits.

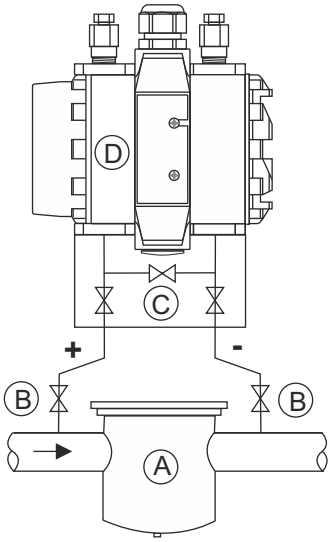


2.9 Mounting for Differential Pressure Measurement (Continued)

Differential Pressure Measurement with Steam and Gases

A: Filter (example)
B: Stop valve
C: 3-valve block
D: MHDS

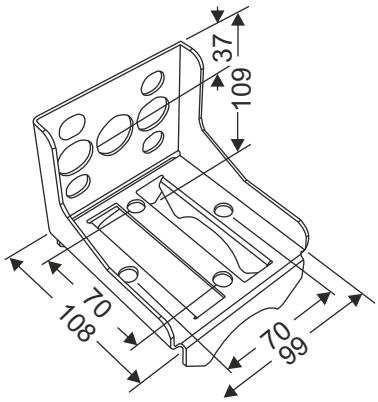
Mount the pressure sensor MHDS above the measuring point. Possible existing condensate can run off into the process pipework.



2.10 Wall and Tube Mounting

A stainless steel mount for mounting the device on walls or tubes is included in the scope of delivery.

Scope of delivery: Mount, fixing clamp with nuts and washers.



dimensions in mm

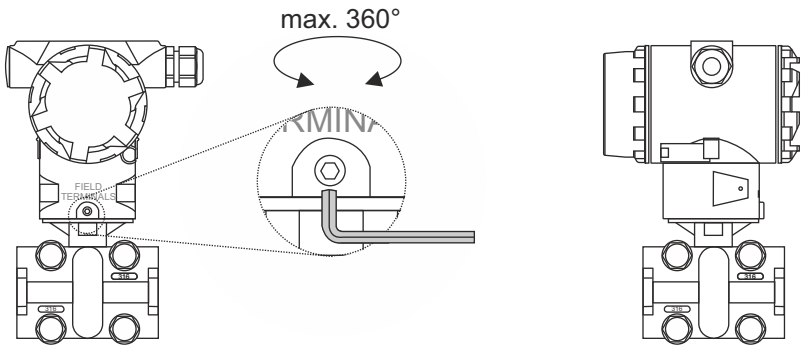
i If you use a valve block, you will have to take its dimensions into account.
Please note when mounting:
- To avoid seazing, lubricate the temporary bolts with a multi-purpose grease before mounting.

i - When conducting tube mounting, fasten the nuts of the mounting bracket with a torque of at least 20 Nm.

2.11 Casing Rotation

After unscrewing the M6 Allen screw the casing can be rotated up to 360°.

- release the screw with a 3 mm hexagon key
- rotate casing (up to 360°)
- fasten screw again



2.12 Mounting Control

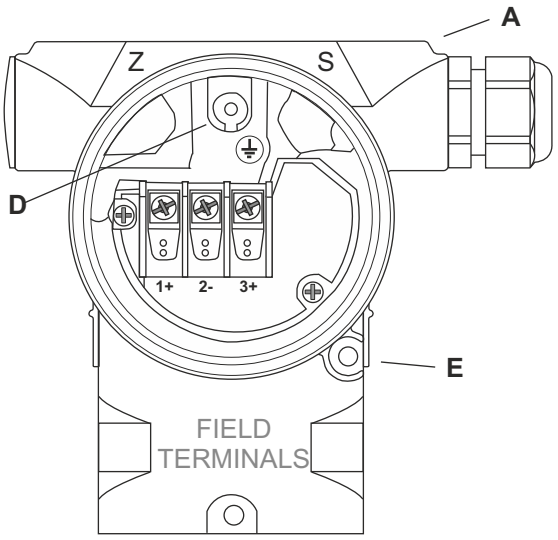
After mounting the transmitter, carry out the following checks:

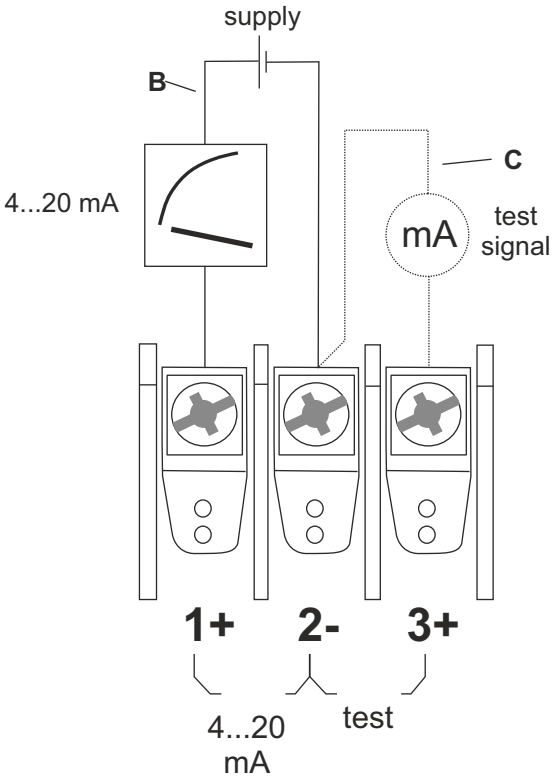
- Check if all screws are tightened firmly.
- Check if transmitter covers are screwed in.
- Check if screw plugs / vent valves are tightened firmly.

3 Electrical Connection

3.1 Device Connection

- The supply voltage has to match the voltage supply given on the product label. See also page 3: Identification
- Switch off the power supply before connecting the device.
- Unscrew the connection compartment cover.
- Insert the cable through the gland (see below for specification).
- Make the connection as per the diagram below.
- Screw cover on.
- Switch on supply voltage.





Electrical connection 4...20 mA HART

A: Casing

B: Supply voltage 15...45 VDC (terminal 1 (+) and 2 (-))

C: 4...20 mA test signal between - (2) and test connection (3)

D: Internal earthing terminal

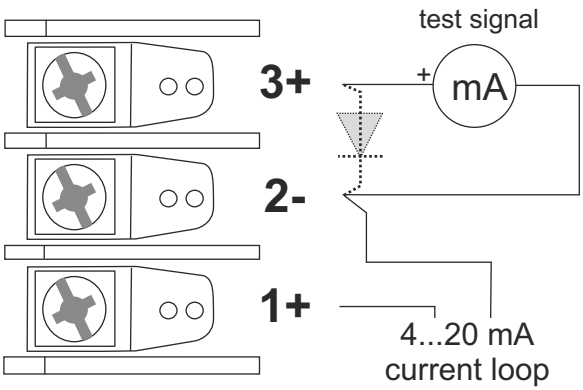
E: External earthing terminal

The device has protective circuitry to safeguard against overvoltage peaks, RFIs and reverse voltage.
Supply voltage: Between 15....45 VDC
Cable entry: Metal cable gland M20x1,5
Cable: Outer diameter: 6...12 mm
Wire cross section: 0,5...1,5 mm²
Shielded and twisted 2-wire cable (recommended)
Residual ripple: No influence on mA-signal, up to 5% within nominal range

3.2 Tapping 4...20 mA Test Signal

The 4...20 mA test can be measured without interruption of the low-potential circuit between terminal 3(+) and terminal 2(-). The output current is measured with an ammeter for mA across a diode in the output circuit.

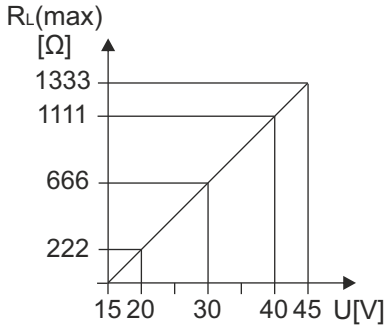
The internal resistance of the ammeter should be less than 0,7 Ω to keep the measurement error below 0,1%



3 Electrical Connection (Continued)

3.3 Output (Load)

Load: R_{Lmax} = (U - 15 V) / 0,0228 A



Voltage supply: 15...45 VDC

R_{Lmax}: Maximum load resistance
U: Voltage supply

i Please note: When communicating via HART-modem, a communication resistance of 250 Ω has to be taken into account.

Resolution: Current output: 16 bit
Indication: Adjustable (factory setting: 0...100%)

Read cycle: HART commands every 200 ms.

Damping: Continuously adjustable from 0 to 160 µA via electronics insert inside the device, hand-held equipment or PC-software. Factory configuration: 0 µA

3.4 Shielding and Potential Equalization

An optimal shielding against disturbing actions is achievable by connecting cable shielding on both sides (transmitter and switch cabinet). If potential equalization currents can occur in the plant, ground the shielding only on one side, preferable at transmitter side. An installation of potential equalization is not necessary.

3.5 Connection Check

After completion of the electrical installation, conduct the following checks:
- Check if supply voltage matches the specifications on the product label.
- Check if the device is connected as per page 8.
- Check if all screws are tightened firmly.
- Check if cover is screwed on tight.

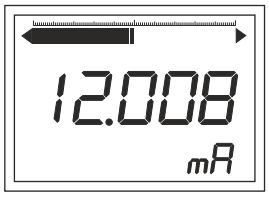
After switching on the supply voltage, the backlighting of the electronics insert will light up.

4 Operation

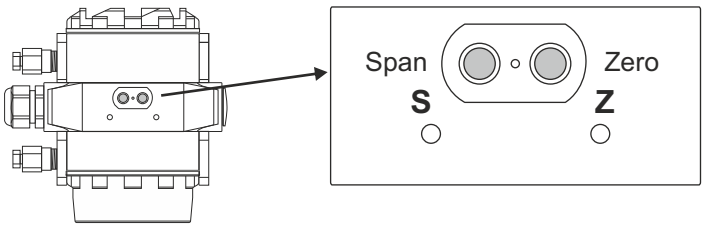
4.1 On-Site Display

A 3-line display (LCD) serves as on-site display. It can display measured values and dialog texts.

Funktions: 5-digit measured value display (including sign and decimal point), unit indication and a bargraph for current indication.



4.2 Operating Elements



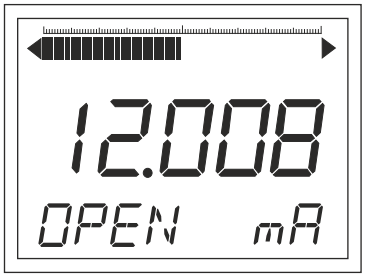
There are 2 key buttons below the product label for easy configuration of zero point, span, zero point offset compensation and device reset. The key layout of the 2 keys is marked on the casing with **S** and **Z**.

The electronics insert with display has 3 keys (P, F1, F2) for transmitter configuration. The keys are accessible after unscrewing the cover.

4.3 On-Site Operation (External Keys)

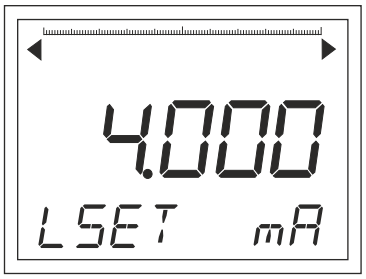
Below the product label you can find 2 external keys for easy configuration. Configurable are:
- Zero point (lower range value)
- Span (upper range value)
- Zero point offset compensation
- Reset

The key layout is marked with **S** and **Z** on the casing.



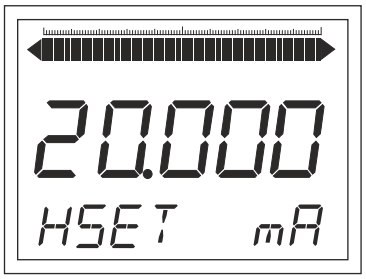
Open Programming Lock

Press the keys **S** and **Z** at the same time and hold them down for 5 seconds. When the lock is open, the LCDscreen will display **OPEN**.



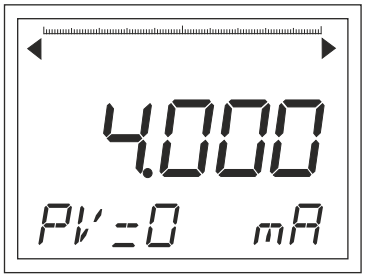
Input Pressure for 4 mA Output Signal (Zero Point)

Set the input pressure to zero reference level. Press key **Z** for 2 seconds and the output of the transmitter is 4,000 mA. The LCD screen is showing **LSET**.



Input Pressure for 20 mA Output Signal (Span)

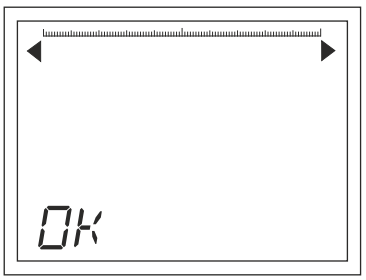
Set the input pressure to span reference level. Press key **S** for 2 seconds and the output of the transmitter is 20,000 mA. The LCD screen will show **HSET**.



Zero Point Offset Compensation (Position Compensation)

Set the input pressure level to zero (pressure value = 0 = atmosphere). Press keys **S** and **Z** for 2 seconds simultaneously and the output of the transmitter is 4,000 mA. The LCD screen will show **PV=0**.

Note: If pressure value / pressure range is >0,5, the zero point offset compensation is not possible. The LCD screen will show **PVER**.



Reset

Switch off supply. Press key **Z** and switch on supply again. Hold key **Z** for another 5 seconds. When the transmitter has been reset, the LCD screen will show **OK**.

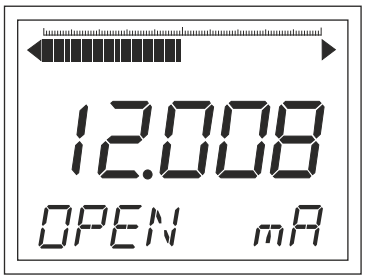
4.4 On-Site Operation (Internal Keys)

The display is rotatable by approx. 330°.

The electronics inserts has 3 keys for configuration.
Configurable are:

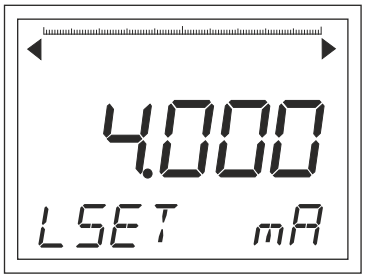
- Zero point (lower range value)
- Zero point offset compensation (position compensation)
- Rescaling lower range value
- Damping
- Fixed current output
- Span (upper range value)
- Reset
- Rescaling upper range value
- Unit (mA, bar, %)

To adjust settings, unscrew and remove cover.



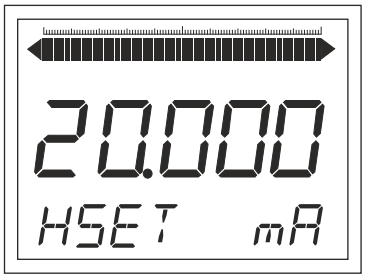
Open Programming Lock

Press the keys **F1** and **F2** at the same time and hold them down for 5 seconds. When the lock is open, the LCD screen will display **OPEN**.



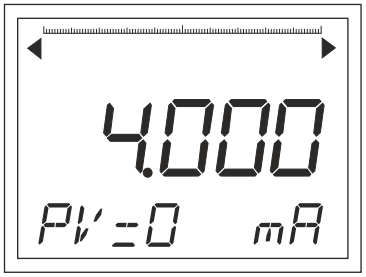
Input Pressure for 4 mA Output Signal (Zero Point)

Set the input pressure to zero reference level. Press key **F2** for 2 seconds and the output of the transmitter is 4,000 mA. The LCD screen is showing **LSET**.



Input Pressure for 20 mA Output Signal (Span)

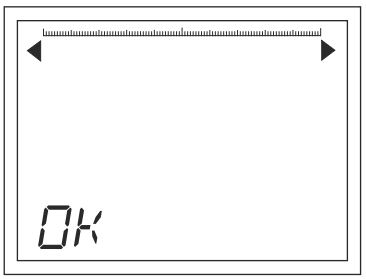
Set the input pressure to span reference level. Press key **F1** for 2 seconds and the output of the transmitter is 20,000 mA. The LCD screen will show **HSET**.



Zero Point Offset Compensation (Position Compensation)

Set the input pressure level to zero (pressure value = 0 = atmosphere). Press keys **F1** and **F2** for 2 seconds simultaneously and the output of the transmitter is 4,000 mA. The LCD screen will show **PV=0**.

Note: If pressure value / pressure range is >0,5, the zero point offset compensation is not possible. The LCD screen will show **PVER**.

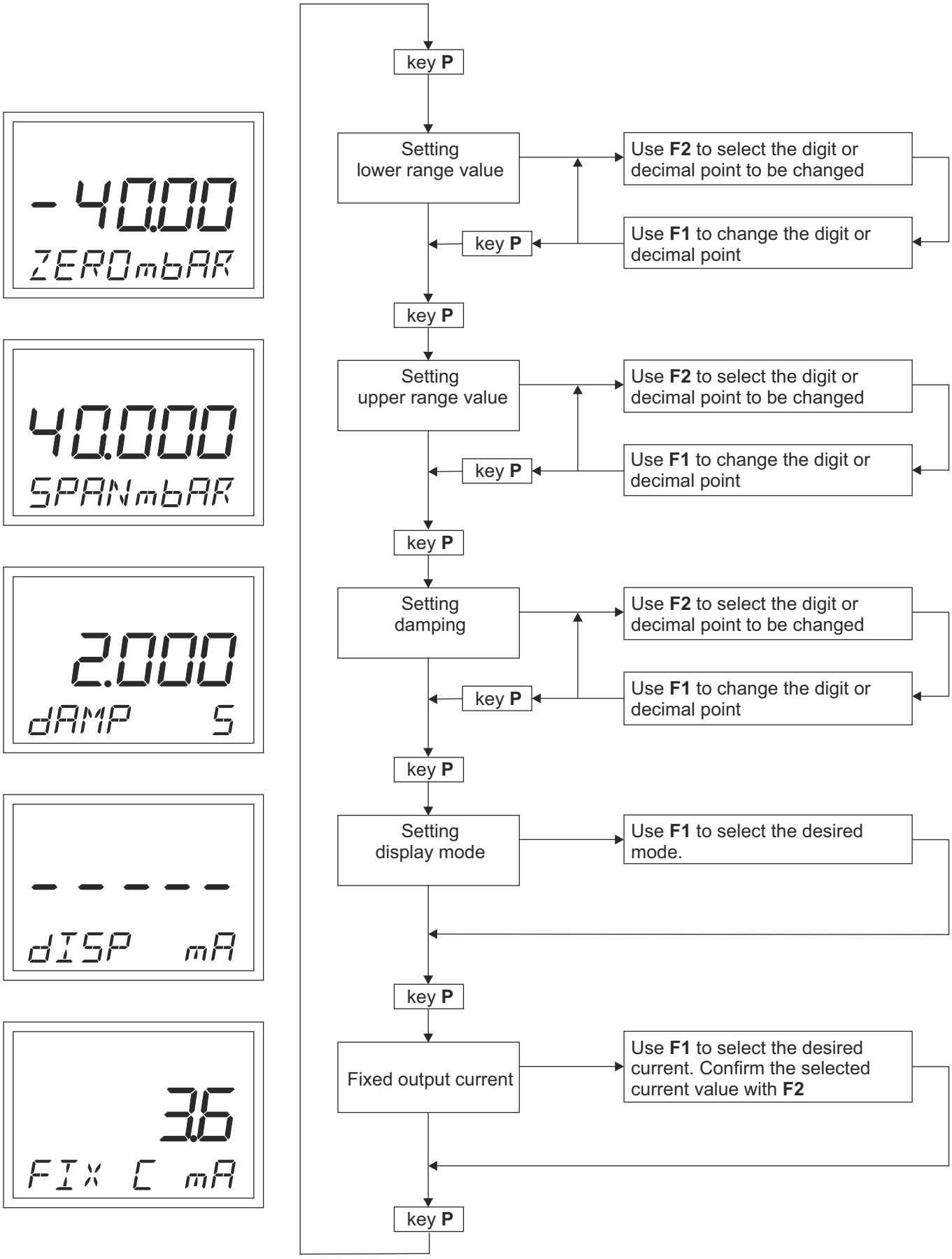


Reset

Switch off supply. Press key **F2** and switch on supply again. Hold key **F2** for another 5 seconds. When the transmitter has been reset, the LCD screen will show **OK**.

4.4 On-Site Operation (Internal Keys) Continued

Key functions:
P: Select function / store adjusted value
F1: Change digit or decimal point / select characteristic
F2: Select digit or decimal point to be changed / confirm selected characteristic



5 Start-Up

Before start-up, conduct mounting and connection checks. (See page 7 and 9)

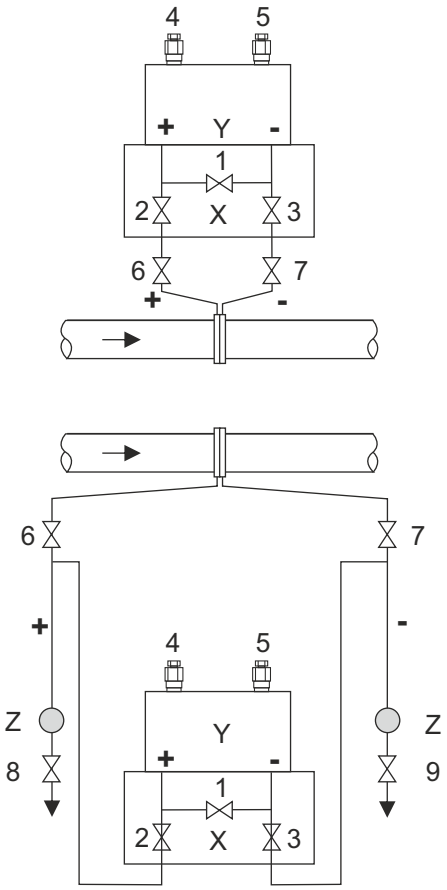
5.1 Position Compensation (Zero Point Offset Compensation)

The fitting position can cause a shift of the measured value. The indicated measured value with unconnected differential pressure pipes will not be 0, the indication with an empty vessel will not be 0.

5.2 Flow Measurement

	Valves	Meaning
1	Close valve 1	
2	Fill system with medium	
	Open valves 2, 3, 6, 7	Medium flows in
3	If 5 valves are available, clean the differential pressure pipes (if required) - Gases: Blow out gases with compressed air - Fluids: By rinsing	
	Close valves 2 and 3	Device is locked
	Open valves 8 and 9	Blow out / rinse the differential pressure pipes
	Close valves 8 and 9	Close valves after cleaning
4	Ventilate system	
	Open valves 2 and 3	Inject medium
	Close valve 3	Close minus side
	Open valve 1	Equalize plus and minus side
	Open valves 4 and 5 briefly and close immediately afterwards	System fills with medium (air escapes)
5	Position compensation: Carry out only if the process can not be locked and the pressure connection points (valves 6 and 7) are on the same geodetic level. Compensation see page 10...12 In the other case the position compensation has to be conducted at step 7.	
6	Set the system for operation	
	Close valve 1	Disconnect plus and minus side
	Open valve 3	Connect minus side
	Closed valves: 1, 4, 5, 8, 9 Opened valves: 2, 3, 6, 7	
7	Position compensation: Carry out only if the process can be locked. If the process can be locked, do not carry out step 5. (see pages 10...12)	
8	Adjust system (see pages 10...12)	

Installation (prefered)



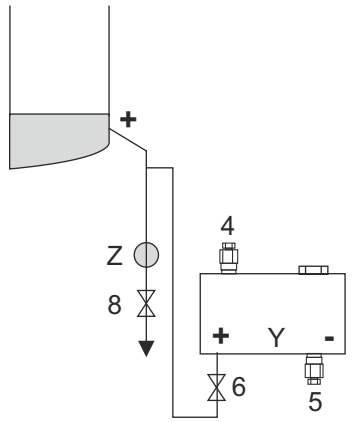
Above: Installation for gases
Below: Installation for fluids
X: 3-valve block
Y: MHDS
Z: Separator

1: Equalizing valve
2; 3: Inlet valves
4, 5: Vent valve
6, 7: Stop valve
8, 9: Drain valve

5.3 Level Measurement (Open Vessel)

	Valves	Meaning
1	Fill vessel up to a level above the lower tap	
2	Fill system with medium	
	Open valve 6	Medium flows in
3	Ventilate system	
	Open valve 4 briefly and close immediately afterwards	System fills with medium (air escapes)
4	Set system for operation	
	Closed valves: 4, 8 Opened valve: 6	
7	Adjust system (see pages 10...12)	

Installation (prefered)

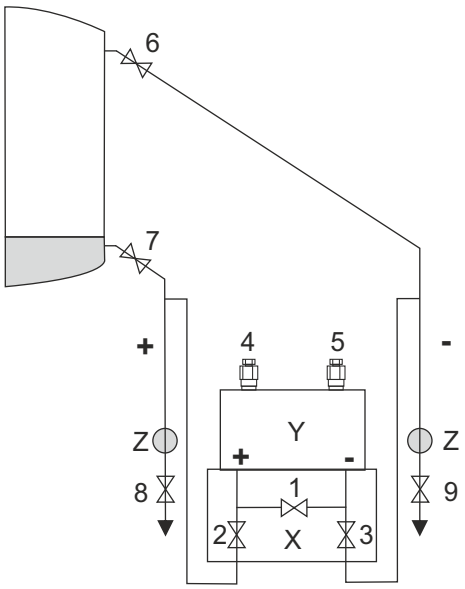


Y: MHDS
Z: Separator
4, 5: Vent valves
6: Stop valve
8: Drain valve

5.4 Level Measurement (Closed Vessel)

	Valves	Meaning
1	Fill vessel up to a level above the lower tap	
2	Fill system with medium	
	Close valve 1	Disconnect plus and minus side
	Open valves 6 and 7	Open stop valves
3	Ventilate plus side (if necessary, drain minus side)	
	Open valves 2 and 3 briefly	Plus side fills with medium
	Open valves 4 and 5 briefly and close immediately afterwards	Plus side is filled with medium completely (air escapes)
4	Set system for operation	
	Closed valves: 1, 4, 5, 8, 9 Opened valves: 2, 3, 6, 7	
5	Adjust system (see pages 10...12)	

Installation (prefered)



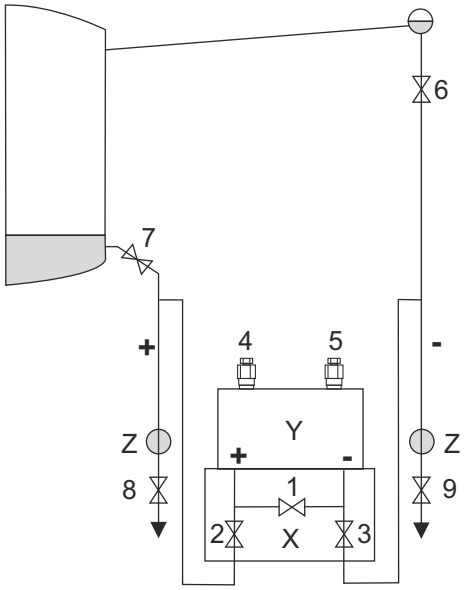
X: 3-valve block
Y: MHDS
Z: Separator

1: Equalizing valve
2; 3: Inlet valves
4, 5: Vent valves
6, 7: Stop valves
8, 9: Drain valves

5.5 Level Measurement (Closed Vessel with Superimposed Steam)

	Valves	Meaning
1	Fill vessel up to a level above the lower tap	
2	Fill system with medium	
	Open valves 6 and 7	Stop valves open
	Fill differential pressure pipe on minus side up to the level of the condensate trap	
3	Ventilate system	
	Open valves 2 and 3	Medium flows in
	Open valve 1	Equalize plus and minus side
	Open valves 4 and 5 briefly and close immediately afterwards	System is filled with medium completely (air escapes)
4	Set system for operation	
	Close valve 1	Disconnect plus and minus side
	Open valve 4	
	Closed valves: 1, 4, 5, 8, 9 Open valves: 2, 3, 6, 7	
5	Adjust system (see pages 10...12)	

Installation (prefered)



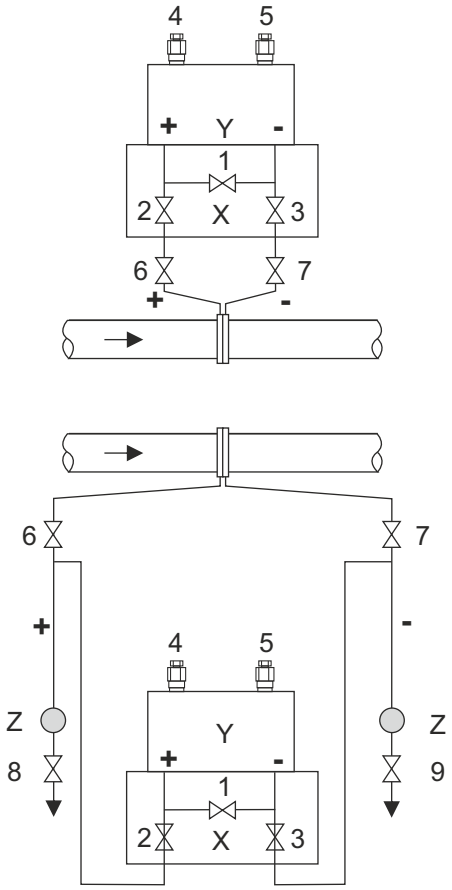
X: 3-valve block
Y: MHDS
Z: Separator

1: Equalizing valve
2; 3: Inlet valves
4, 5: Vent valves
6, 7: Stop valves
8, 9: Drain valves

5.6 Differential Pressure Measurement

Valves		Meaning
1	Close valve 1	
2	Fill system with medium	
	Open valves 2, 3, 6, 7	Medium flows in
3	If 5 valves are available, clean the differential pressure pipes (if required) - Gases: Blow out gases with compressed air - Fluids: By rinsing	
	Close valves 2 and 3	Device is locked
	Open valves 8 and 9	Blow out / rinse the differential pressure pipes
	Close valves 8 and 9	Close valves after cleaning
4	Ventilate system	
	Close valves 2 and 3	Inject medium
	Close valve 3	Close minus side
	Open valve 1	Equalize plus and minus side
	Open valves 4 and 5 briefly and close immediately afterwards	System is filled with medium completely (air escapes)
5	Position compensation: Carry out only if the process can not be locked and the pressure connection points (valves 6 and 7) are on the same geodetic level. Compensation see page 10...12 In the other case the position compensation has to be conducted at step 7.	
6	Set system for operation	
	Close valve 1	Disconnect plus and minus side
	Open valve 3	Connect minus side
	Closed valves: 1, 4, 5, 8, 9 Opened valves: 2, 3, 6, 7	
7	Position compensation: Carry out only if the process can be locked. If the process can be locked, do not carry out step 5. (see pages 10...12)	
8	Adjust system (see pages 10...12)	

Installation (prefered)



Above: Installation for gases
Below: Installation for fluids
X: 3-valve block
Y: MHDS
Z: Separator

1: Equalizing valve
2; 3: Inlet valves
4, 5: Vent valves
6, 7: Stop valves
8, 9: Drain valves

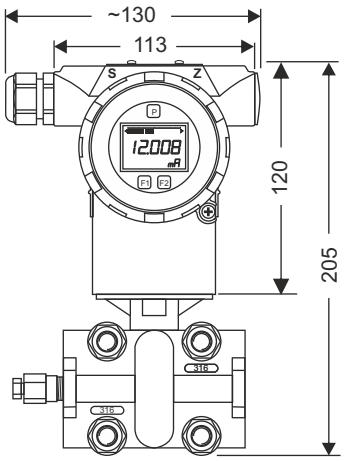
6 *Input*

Measurand: Differential pressure
derived from this: Flow (volume and mass flow)
Level (level, volume, Masse)

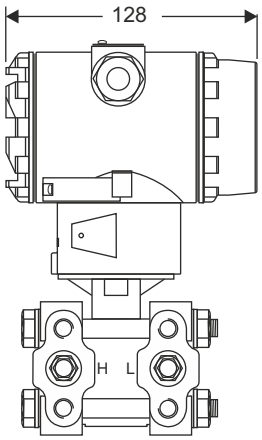
Measurement range: 10 mbar up to 100 bar

Nominal range [mbar]	Lower measuring limit (LRL) [mbar]	Upper measuring limit (URL) [mbar]	Smallest adjustable measuring span [mbar]	Overload [bar]
10	-10	+10	0,2	160
60	-60	+60	0,6	160
400	-400	+400	4	160
2500	-2500	+2500	25	160
20000	-20000	+20000	200	400
100000	-100000	+100000	1000	400

7 *Dimensions*

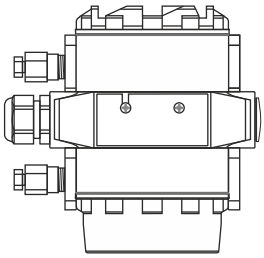


view front



view side

dimensions in mm


view top

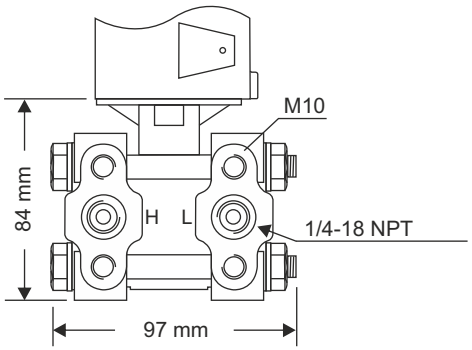
8 *Process Connection*

Pressure Connection:
1/4-18 NPT AISI 316L (1.4435)

Measuring membrane:
Stainless steel 1.4435

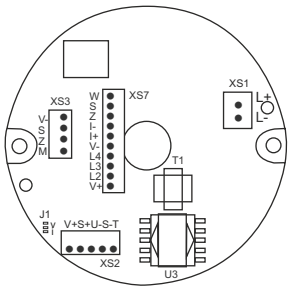
Mounting:
M10

Supplied accessories:
2 vent valves AISI 316L (1.4435)



9 Electronics

- XS1 supply voltage 15...45 V
- XS2 sensor connection
- XS3 external keys
- XS7 display
- J1 solder bridge for sensor supply selection



10 HART Communication

HART Tool:

The HART tool is a graphical user interface for the MH series with a menu-driven program for configuration. It can be used for start-up, configuration, signal analysis, data backup and device documentation. Operating systems: Windows 2000, Windows XP, Windows 7, 8.1 and 10.

Functions:

- Device configuration during online-operation
- Loading and storing of device data (upload / download)
- Linearization of the curve
- Measuring point documentation

Connection Options:

- HART interface (modem) with serial interface to PC
- HART interface (modem) with USB interface to PC
- Hand-held HART communicator

11 Technical Data

Input

Differential pressure:	10 mbar / 60 mbar / 400 mbar / 2,5 bar / 20 bar / 100 bar
Static pressure:	160 bar / 400 bar (see pressure table, page 17)

Output

Analog:	4...20 mA, 2-wire, with superimposed communication signal (HART-protocol)
Signal range:	3,6...22,8 mA
Fault:	Signal 3,6 mA

Accuracy

Type 10 mbar / 60 mbar:

0,1% of terminal value up to a range spread of 5:1

±(0,1+0,01*URL/URV) at a range spread of 5:1 up to 50:1

Types 400 mbar / 2,5 bar / 20 bar / 100 bar:

0,075% of terminal value up to a range spread of 10:1

±(0,0751+0,00751*URL/URV) at range spread 10:1 up to 100:1

Influences:

Static pressure:	Zero point: ±0,1%/70 bar
Range:	±0,2%/70 bar
Supply:	<0,005% of nominal range/1V
Vibration:	<0,01% of nominal range/g at 200 Hz
Fitting position:	Zero point offset, compensable
Range shift:	without
Temperature:	<0,45%/55°C
Stability:	±0,1% of nominal range / 1 year

Settings

Switch-on delay:	5 s
Cycle time, update:	0,25 s
Damping:	200 ms (without consideration for electronics damping)
Filter setting:	0...160µA

Display

Visible range:	32,5x22,5 mm
Indication:	5 digits, 7 segments, 8 mm / 8 digits, 14 segments, 5 mm / bargraph with 2% resolution
Range:	-19999...99999

Supply

Voltage:	15...45 VDC (current loop)
Insulation resistance:	>250 MΩ
Short-circuit strength:	Permanent
Reverse voltage protection:	Yes (no function, no damage)
Overvoltage protection:	500 V

Environmental Conditions

Operating temperature:	-20...70°C
Ambient temperature:	-20...70°C
Temperature medium:	-40...104°C
Storage temperature:	-40...+85°C
Humidity:	5...98% relative humidity

Mechanics

Material:

Electronics casing:	Diecast aluminum
Measuring membrane:	Stainless steel 1.4435 / Option: Hastelloy
Vent / drain valve:	Stainless steel 1.4435
Joint pieces:	Stainless steel 1.4435
O-ring in contact with medium:	Viton (FKM, FPM)
Flange screws:	unalloyed, zinc-coated steel
Product label:	Stainless steel 1.4301
Sight glass:	Laminated safety glass

Process connection:	1/4-18 NPT
Dimensions:	see page 17
Protection class:	IP65
Weight:	approx. 3,8 kg
Connection:	Terminal screws (max. 1,5 mm²) via M20x1,5 cable gland
Measuring principle:	Capacitive
Standards:	IEC 61000-4-3 / pressure equipment directive 2014/68/EU