

144FP Intelligent d/p Transmitter for Liquid Level, Interface and Density - Flange mounted



These intelligent transmitters are designed to perform measurements for liquid level, interface or density of liquids. The measurement is based on the hydrostatic pressure principle. Easy remote configuration and supervision with PC or Universal Handterminal. The devices also can be operated conventionally using the local keys. Total I/A Series measurement integration is possible through FOXCOM communication protocol. The transmitters are approved for use in hazardous areas.

FEATURES

- Communication HART or FOXCOM
- Conventional operation with local keys
- Easy adaptation to the measuring point without calibration at the workshop
- Backdocumentation of measuring point
- Continuous self-diagnostics
- Configurable safety value
- Software lock for local keys and reconfiguration
- Simulation of analog output for loop-check
- Local display in %, mA or physical units
- Signal noise suppression by Smart Smoothing
- Linear or customized characteristic
- Process temperature from $-50\text{ }^{\circ}\text{C}$ to $+120\text{ }^{\circ}\text{C}$ ($-58\text{ }^{\circ}\text{F}$ to $+248\text{ }^{\circ}\text{F}$)
- Materials for use with aggressive media
- Micro sintermetal sensor technology
- Separate mounting of sensor and amplifier with remote amplifier mounting kit

TECHNICAL DATA

In accordance with standard DIN IEC 770, data refer to the sensor material Type 316L (1.4404)

Input

Measuring span ¹⁾	
Differential pressure	3.2 ... 4 000 mbar (1.28 ... 1 606 inch H ₂ O)
Characteristic	linear oder customized with 32 setpoints max. ²⁾

Output

HART and FOXCOM Analog Mode

Lower range value	continuously adjustable within the measuring limits
Turn-down	1:1 ... 1:20 ³⁾
Signal range	4 ... 20 mA / 20 ... 4 mA
Operating range	3.8 ... 20.5 mA
Admissible load	$R_{Lmax} = (U_S - 12 V) / 0.023 A$ ($U_S =$ Supply voltage)

Accuracy ⁴⁾

Analog output	$\pm 0.1 \% ^{5)}$
Digital output	$\pm 0.075 \% ^{5)}$
Transfer function	linear

FOXCOM Digital Mode

Output current const.	approx. 12 mA
Admissible load	$R_{Lmax} = (U_S - 12 V) / 0.012 A$

Indicator

LCD-display	5 digits, configurable in phys. units, % or mA
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Additional error of display ⁶⁾

Display in phys. units	$\pm 0.005 \%$
Display in %	$\pm 0.05 \%$
Display in mA	$\pm 0.032 \%$

Failure handling

HART

Substitute value	last value or safety value
Safety value	3.6 ... 23 mA, adjustable
Reset substitute value	automatically or manual
Select messages	Internal calibration failed, Pressure peaks $\geq 150 \%$, Over range $\geq 110 \%$, Data access failed, Ambient temp. out of limits, Process temp. out of limits, Measuring range invalid

FOXCOM Analog Mode

Substitute value	safety value
Safety value	3.6 or 23 mA
Reset substitute value	automatically or manual after Ambient temp. out of limits or Process temp. out of limits
Select messages	Pressure peaks $\geq 150 \% ^{7)}$, Ambient temp. out of limits, Process temp. out of limits

Power supply ⁸⁾

Supply voltage	DC 12 ... 42 V
Permitted ripple V_{pp}	$\leq 1 \%$

Operating conditions ⁸⁾

Process temperature ⁹⁾	-40 ... +120 °C (-40 ... +248 °F)
Pressure rating	
acc. DIN	PN 16 / 40
acc. ANSI	Class 150 / 300
Vacuum	applicable up to 80 °C (176 °F)
Ambient temperature ⁹⁾	
without indicator	-40 ... +85 °C (-40 ... +185 °F)
with indicator	-40 ... +70 °C (-40 ... +158 °F) ¹⁰⁾
Relative humidity	$\leq 100 \%$
Condensation	permitted
Transportation- / storage temperature	-50 ... +85 °C (-58 ... +185 °F)
Protection	IP 66 (acc. DIN 40050)

The device can be operated at a class D2 location in accordance with DIN IEC 654, part 1.

Operation condition effects

Ambient temperature

-10 ... +70 °C (+14 ... +158 °F)

Zero $\leq 0.03 \%/10 K ^{11)}$

Span $\leq 0.07 \%/10 K$

Total

$$\left(0.03 \frac{\text{max. sp.}}{\text{adjusted sp.}} \pm 0.07 \frac{\text{measured value}}{\text{adjusted sp.}} \right) \% / 10K$$

(sp. = measuring span)

< -10 °C / > +70 °C

(< +14 °F / > +158 °F) . . . twice the values

Process temperature $\leq 0.1 \%/10 K ^{11)}$

Operating pressure no influence

Mechanical vibrations

up to 500 Hz and to 2 g. $\leq 0.2 \% ^{11)}$

Transitional behavior

Dynamic behavior

Damping (63%-time) 0 ... 32 s

Switch-on time 7 s

Step response (63%-time)

with damping 0 s 250 ms ¹²⁾

Update rate 10/s

Long term stability $\leq 0.2 \%/12$ months at 20 °C ¹¹⁾

Noise suppression

Common mode voltage $\leq AC 250 V_{eff}$

Common mode rejection 120 dB

Series mode rejection 50 dB

Mains synchronization 50 Hz / 60 Hz

Filter Smart Smoothing

1) Depending on sensor

2) Customized only with HART device

3) 1:50 with reduced technical data

4) Accuracy according to ANSI / ISA - S51.1 - 1979

5) Increased accuracy with customized adjustment

6) Additional to accuracy of digital output

7) Reset of substitute value after pressure peaks automatically

8) For explosionproof instruments please obey the certificates

9) -50 °C (-58 °F) on request

10) Display invisible at $T < -30 °C (-22 °F)$

11) For max. measuring span

12) With fill fluid silicone oil, with inert fill fluid up to 3 s
Inert fill fluids with shorter response times on request

Electromagnetic compatibility EMV

Operating conditions	industrial environment
Immunity according to EN 50082-2	fulfilled ¹⁾
Emission according to EN 55011, Group 1, Class A	fulfilled
EN 50081-2	fulfilled
NAMUR recommendation . . .	Status May 1993 fulfilled

Electrical connection

Cable entry thread	PG 13.5 or M 20 x 1.5 or 1/2 - 14 NPT
Cable gland and plug	PG 13.5 Polyamide with NBR seal and plug or PG 13.5 of Stainless Steel WNr. 1.4305 with FPM seal and plug
Cable diameter	6 ... 12 mm
Screw terminals	wire cross-section 2.5 mm ² max.
Test sockets	Ø 2 mm

Weight

Transmitter	
DN 50 / 2 inch	8 ... 10 kg
DN 80 / 3 inch	8.5 ... 10.5 kg
DN 100 / 4 inch	11.5 ... 13.5 kg

Communication

Communication standard HART	
Minimum load	250 Ω
Software	ABO991, WPP991, PC20
Hardware	Modem MOD991 for PC, IBM compatible
Handterminal	HT991
see also Product Specifications PSS EMO0100 A-(en) "Accessories for Devices with HART Protocol"	
Communication standard FOXCOM	
Minimum load	200 Ω
Software	PC10, PC20
Hardware	Modem PC10
Handterminal	HHT

Materials²⁾

Sensor	
Diaphragm	316L (1.4404 / 1.4435) or Hastelloy C
Fill fluid	Silicone oil or inert fill fluid
Filling volume	app. 1 cm ³
Sealings (O-rings) ^{3) 4)}	
Application limits	FPM / FKM (Viton ®) (-20 ... +120 °C / -4 ... +248 °F), NBR (Perbunan ®) (-30 ... +100 °C / -22 ... +212 °F), PTFE (-40 ... +120 °C / -40 ... +248 °F) or EPDM (-40 ... +120 °C / -40 ... +248 °F), suitable for Ammonia NH ₃
Flange	316 (1.4404 / 1.4571), Hastelloy C on request
Bolts	A2
Nuts	A2
Amplifier housing	Aluminium (Alloy No GD-Al Si 12), Polyurethan coated

For Sour Gas applications according to NACE Standard MR-0175-92:

Diaphragm	Hastelloy C
Flange	316 (1.4404 / 1.4571)

Mounting / Process Connection

Mounting method	flange mounted
according to DIN	DN 50, 80, 100; PN 16 / 40
according to ANSI	2 inch, 3 inch or 4 inch; Class 150 / 300
for extended diaphragms see page 13	
Minus-Side	according to DIN 19 213 Form B2 / M10
Remote Amplifier	
Mounting Kit	cable with terminals for sensor and amplifier
Cable length	3 m or 10 m

1) Short time deviations up to 0.5 % are possible

2) Material Comparison Table see page 5

3) Material for O-rings must be selected in accordance to the chemical reaction and the temperature of the process medium.

4) Obey the application conditions

National Certification “Zone 0”

Certification according to ElexV and VbF for use in Zone 0 of vessels and pipes for all combustible liquids and gases of explosion groupes IIA and IIB.

Sensor

Type BIA 418A EEx ia IIB T5

Certificate

of construction licence. applied

National Certification “Zone 10”

Type BST 408 St Ex Zone 10

For HART communication only

Certificates

of Conformity applied

Other National Certificates in preparation

- Overfill protection according to VbF
- Overfill protection according to WH
- GOST metrological certification

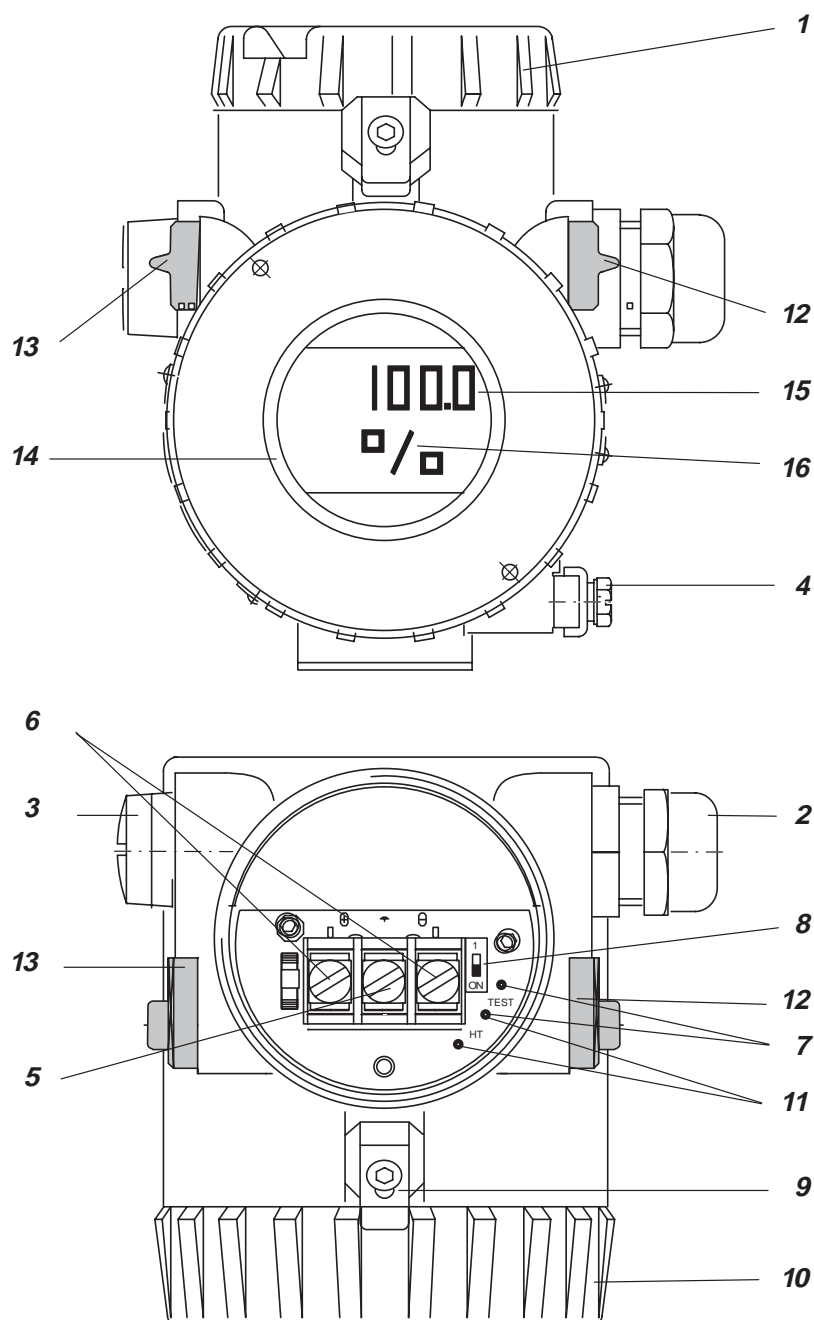
MEASURING RANGES

Span Code	Measuring span		Measuring limits	Overload limit (one side)	Overload limit (both sides)
	min.	max.			
-A	3.2 mbar 1.28 in H ₂ O	64 mbar 25.7 in H ₂ O	-64 ... 64 mbar -25.7 ... 25.7 in H ₂ O	max. Pressure Rating - Flange PN 16 / 40, Class 150 / 300	
-B	32 mbar 12.8 in H ₂ O	640 mbar 258 in H ₂ O	-640 ... 640 mbar -258 ... 258 in H ₂ O		
-C	200 mbar 80.3 in H ₂ O	4 000 mbar 1 606 in H ₂ O	-4 000 ... 4 000 mbar -1 606 ... 1 606 in H ₂ O		

Material Comparison Table

Code	Wnr	DIN	Remarks	equivalent to
A2	1.4541	267 part 13	bolts and nuts -196 ... +400 °C; -321 ... +752 °F	ASTM A 193 B 8 M ASTM A 194 B 8 M
X6 CrNiTi 18 10	1.4541	17 440		ASTM Typ 321
X6 CrNiMoTi 17 12 2	1.4571		~ ASTM Typ 316Ti	
X2 CrNiMo 17 13 2	1.4404		ASTM Typ 316L	
X2 CrNiMo 18 14 3	1.4435			
NiMo 16 Cr 15 W	2.4819	17 744	equivalent to Hastelloy C-4 VdTÜV - Wbl. 400	UNS N 12 276
GD - AISi 12	3.2582.05	17 007	Al - Diecasting	

CONNECTIONS, OPERATIONAL ELEMENTS



1 Cover for terminal compartment

2 Cable gland

3 Plug, interchangeable by Pos. **2**

4 External ground connection

5 Internal ground connection

6 Terminals Signal circuit (+ / -)

7 Test sockets for signal current, \varnothing 2 mm

8 Switch to activate the test sockets

9 Security lock for EEx d version

10 Cover for amplifier housing
(with / without local display)

11 Connection sockets for communication, \varnothing 2 mm

12 Local key for lower range value / zero

13 Local key for upper range value / damping

14 LCD indicator (option)

15 Measuring variable

16 Engineering unit

EXAMPLES FOR DIFFERENT APPLICATIONS

Intelligent d/p Transmitter for Liquid Level, Interface and Density - Flange mounted

Measuring arrangements for open vessels		
<p>Liquid level measurement</p> <p>Lower range value: $p_A = 0$ (at fitting height $h_a = 0$) $p_A = h_a \cdot \rho \cdot g$ (elevated by h_a)</p> <p>Span: $p_{Sp} = h \cdot \rho \cdot g$</p>	<p>Interface measurement</p> <p>Lower range value: $p_A = (h_a \cdot \rho_1 \cdot g) + (h \cdot \rho_2 \cdot g)$</p> <p>Span: $p_{Sp} = h \cdot (\rho_1 - \rho_2) \cdot g$</p>	<p>Density measurement</p> <p>Lower range value: $p_A = h \cdot \rho_{min.} \cdot g$</p> <p>Span: $p_{Sp} = h \cdot (\rho_{max.} - \rho_{min.}) \cdot g$</p>
Measuring arrangement for closed vessels		
<p>Liquid level measurement</p> <p>Lower range value: $\Delta p_A = (h_a \cdot \rho \cdot g) + (h_s - h_a) \cdot \rho_2 \cdot g - (h_s \cdot \rho'_2 \cdot g)$</p> <p>Span: $\Delta p_{Sp} = h \cdot (\rho - \rho_2) \cdot g$</p>	<p>Liquid level measurement</p> <p>Lower range value: $\Delta p_A = (h_a \cdot \rho \cdot g) + (h_s - h_a) \cdot \rho_2 \cdot g - (h_s \cdot \rho' \cdot g)$</p> <p>Span: $\Delta p_{Sp} = h \cdot (\rho - \rho_2) \cdot g$</p>	<p>Interface measurement</p> <p>Lower range value: $\Delta p_A = (h_a \cdot \rho_1 \cdot g) + (h_s - h_a) \cdot \rho_2 \cdot g - (h_s \cdot \rho'_2 \cdot g)$</p> <p>Span: $\Delta p_{Sp} = h \cdot (\rho_1 - \rho_2) \cdot g$</p>

Key to symbol:

$p_{Sp}, \Delta p_{Sp}$ = Span in Pa (1 mbar = 100 Pa)
 $p_A, \Delta p_A$ = Lower range value in Pa (1 mbar = 100 Pa)
 (Values with a negative sign correspond to a zero elevation)

h = Span in m
 h_0 = Non measurable level in m
 h_a = Lower range value in m
 h_s = Distance between process connections in m
 g = Local gravitational acceleration in m/s²

ρ = Density of process medium in the vessel in kg/m³
 ρ' = Density of liquid in the minus pressure pipe in kg/m³, according to the temperature in the minus press. pipe
 ρ_1 = Density of lower fluid in kg/m³ with interface measurement
 ρ_2 = Density of upper fluid in kg/m³ with interface measurement or of gas / vapour in kg/m³ with liquid level measurement
 ρ'_2 = Density of upper fluid in kg/m³ with interface measurement or of gas / vapour in kg/m³ with liquid level measurement according to the temperature in the minus pressure pipe

MODEL CODES (continued)

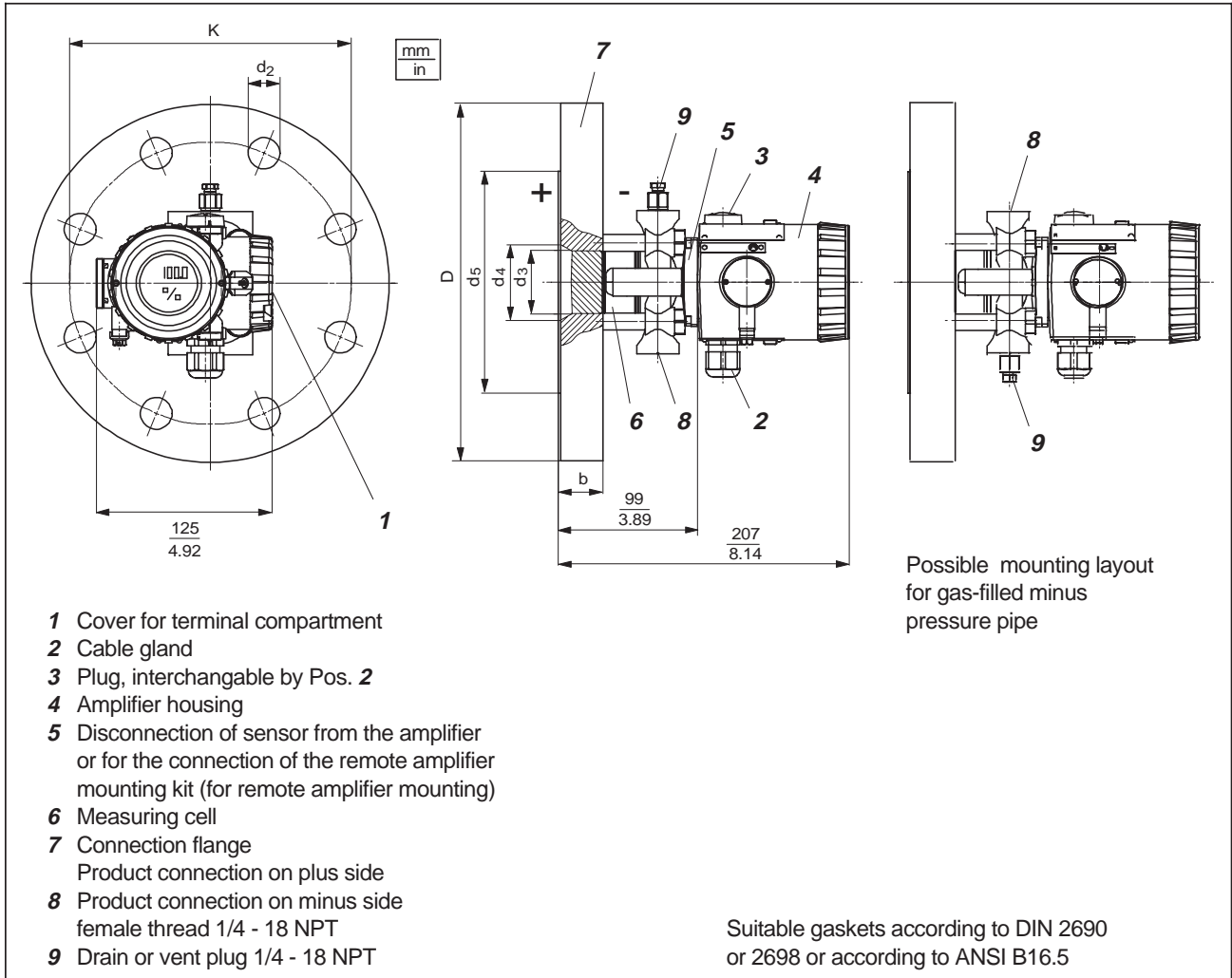
Optional Features	
LCD Indicator	-A
Oxygen Service cleaned (not available with Fill Fluid Code 1)	-O
Custom Configuration	-T
Remote Amplifier Mounting Kit (3m), mounted (b)	-R
Remote Amplifier Mounting Kit (10m), mounted (b)	-B
Tag.No. Labeling	
Stamped with weather resistant colour	-S
Stainless steel label fixed with wire	-L
Stainless steel label, fixed on amplifier	-F
National Certificates	
Zone 0 (available with el. class. code EA4 only)	-E
Overfill protection per VbF for flammable fluids (available with optional feature -E only)	-U
Overfill protect. per WHG environmental pollution fluids (with el. class. EA4, NSP or ZZZ only)	-V
Dust-ignitionproof per Zone 10 (available with el. class. code EA4 only)	-X
GOST metrological certification	-G
Certificates	
EN 10204-2.1 (DIN 50 049-2.1)	-1
EN 10204-2.3 (DIN 50 049-2.3)	-2
EN 10204-3.1B (DIN 50 049-3.1B)	-3
comply with NACE Standard MR-01-75 (with diaphragm material Hastelloy C only)	-6

Example: 144FP -B 11 C 0 S S V 1 EA4 A P3 H -AE

Footnotes
 (a) Available with cable entry N1 and M1 only
 (b) Not available with EDZ, FDZ or CDZ

DIMENSIONS

144FP Flange mounted



Types of connection flanges

All dimensions in mm according to DIN 2501 sheet 1 or ANSI 16.5

Connection flange			D	d ₃ *	d ₄	d ₅	b **	K	d ₂	Bolts	
Nominal width	Rated pressure	Quantity								Thread	
DIN	DN 50	PN 16 / 40	165	46	56	102	20	125	18	4	M16
	DN 80	PN 16 / 40	200		73	138	24	160			
	DN 100	PN 16	220		65	158	20	180	22	8	20
235			73		162	24	190				
ANSI	2 inch	Class 150	152		54	92	19	121	19	4	(M16)
		Class 300	165				22	127			
	3 inch	Class 150	191		73	127	24	152	22	8	(M20)
		Class 300	210	82	28		168				
	4 inch	Class 150	229	73	157	24	190	19		(M16)	
		Class 300	254	89		32	200				22

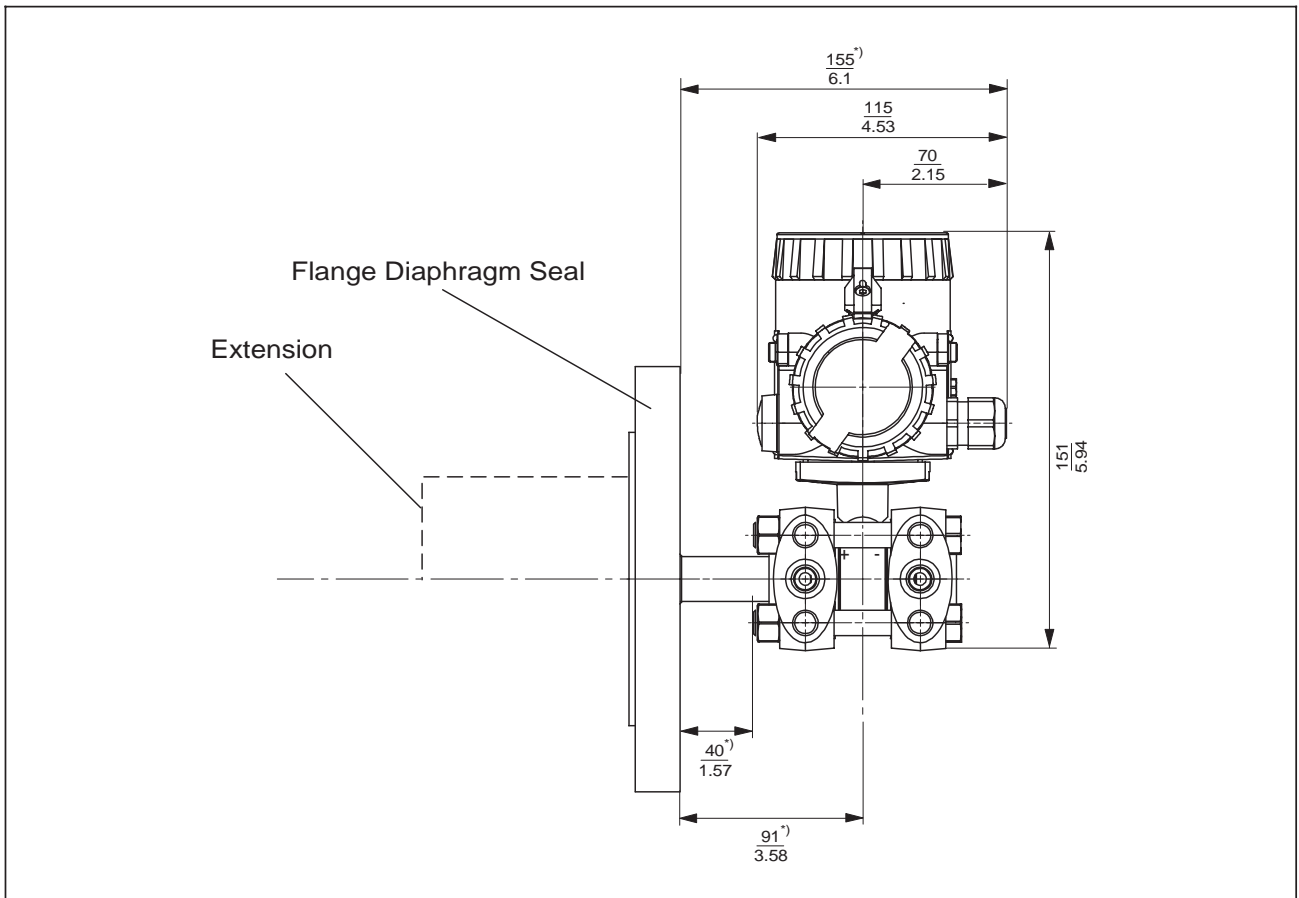
* Diaphragm or measuring cell diameter

** For contact face Type C (DIN) or RF (ANSI)

DIMENSIONS

143DP Prepared for direct pressure seal mounting

Process Connection, Model Code 4, 5, 6 and 7



*) For process temperatur up to +120 °C / +248 °F

For Flange Diaphragm Seal see Product Specifications PSS EMP9002 A-(en),
for Intelligent d/p Transmitter see Product Specifications PSS EMP0630 A-(en)

Process Connection

Model Code for Process Connection	+ Side		- Side	
	Version	Connection Flange - Measuring cell	Version	Connection Flange - Measuring cell
4	for direct mounting	welded	1/4 - 18 NPT	screwed
5		screwed		
6		welded	for capillary mounting	welded
7		screwed		screwed

Control volume and dead volume, prepared for pressure seal mounting, connection flange - measuring cell screwed

Model Code for measuring span	Control volume	Dead volume	
		Flange	Measuring cell
-A	0.12 cm ³	3 cm ³	0.5 cm ³
-B	0.1 cm ³	3 cm ³	0.5 cm ³
-C	0.1 cm ³	3 cm ³	0.5 cm ³

For welded type additional 0,5 cm³ for dead volume, because of absent seals.

Product Specifications for Intelligent Transmitters

PSS EMP0610 A-(en)	141GP	Intelligent Gauge Pressure Transmitter
PSS EMP0620 A-(en)	142AP	Intelligent Absolute Pressure Transmitter
PSS EMP0630 A-(en)	143DP	Intelligent d/p Transmitter
PSS EMP9001 A-(en)	S990A	Diaphragm Seal for Pressure + d/p Transmitter
PSS EMP9002 A-(en)	S990B	Flange Diaphragm Seal for Pressure + d/p Transmitter
PSS EML0610 A-(en)	144LD	Intelligent Buoyancy Transmitter with Torque Tube for Liquid Level, Interface and Density
PSS EML1610 A-(en)	144LVD	Intelligent Buoyancy Transmitter for Liquid Level, Interface and Density
PSS EML2610 A-(en)	144FP	Intelligent d/p Transmitter for Liquid Level, Interface and Density - Flange mounted
PSS EML0900 A-(en)	104..	Accessories for Buoyancy Transmitters
PSS EMO0100 A-(en)		Accessories for Devices with HART-Protocol

Intelligent Transmitter 140 Series

Standard Configuration

FOXC0M Protocol

Measuring range 0 to 100 %
 Damping 0 sec (0,8 sec) ¹⁾
 Characteristic linear
 Substitute value safety value 3,6 mA
 Reset substitute value automatically

 Selected message pressure peaks ≥ 150 %

 Local keys active
 Indicator display in %
 Mains frequency 50 Hz

HART Protocol

Measuring range 0 to 100 %
 Damping 0 sec (0,8 sec) ¹⁾
 Characteristic linear
 Substitute value. safety value 3,6 mA
 Reset substitute value automatically
 Selected message. Internal calibration failed,
 Pressure peaks ≥ 150 %
 Data access failed

 Local keys. active
 Indicator no display
 Mains frequency 50 Hz
 HART address 0

Configuration according to customer

When ordering configuration differing the standard, please fill in form below:

Measuring point			
TAG number	<input type="text"/>		
Description	<input type="text"/>	2)	
Date of input	<input type="text"/>	3)	
Transmitter adaption			
<input type="checkbox"/> DMS Sensor			
Physical unit	<input type="text"/>		
Transmitter type			
<input type="checkbox"/> Gauge pressure			
<input type="checkbox"/> Absolute pressure			
<input type="checkbox"/> Differential pressure			
<input type="checkbox"/> Hydrostatic pressure			
<input type="checkbox"/> Level buoyancy			
Measuring task			
<input type="checkbox"/> Pressure			
<input type="checkbox"/> Differential pressure			
<input type="checkbox"/> Flow			
<input type="checkbox"/> Liquid level			
Density [kg/m ³]	<input type="text"/>		
<input type="checkbox"/> Liquid interface			
Density above [kg/m ³] . .	<input type="text"/>		
Density below [kg/m ³] . . .	<input type="text"/>		
<input type="checkbox"/> Density			
Characteristic			
<input type="checkbox"/> Square root input ⁴⁾			
<input type="checkbox"/> Customized input ⁴⁾			
<input type="checkbox"/> Analog output square root ⁵⁾ with low flow cut off			
Output			
<input type="checkbox"/> Measuring range			
Lower range value	<input type="text"/>		
Upper range value	<input type="text"/>		
Damping (max. 32 sec)	<input type="text"/>		
Failure handling			
<input type="checkbox"/> Analog output			
Substitute value			
Last value	-	<input type="checkbox"/>	
Safety value	23 mA	<input type="checkbox"/>	
Reset substitute value			
manual	<input type="checkbox"/> ⁶⁾	<input type="checkbox"/>	
<input type="checkbox"/> Selected message			
Internal calibration failed.	-	<input type="checkbox"/>	
Pressure peaks ≥ 150 %	no	<input type="checkbox"/>	
Data access failed	-	<input type="checkbox"/>	
Over range ≥ 110 %	-	<input type="checkbox"/>	
Ambient temp. out of limits. . .	<input type="checkbox"/>	<input type="checkbox"/>	
Process temp. out of limits . . .	<input type="checkbox"/>	<input type="checkbox"/>	
Measuring range invalid.	-	<input type="checkbox"/>	
Others			
<input type="checkbox"/> Lower / upper range keys			
upper range disabled	<input type="checkbox"/>	<input type="checkbox"/>	
lower and upper range			
disabled.	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Indicator			
display in phys. units	<input type="checkbox"/>	<input type="checkbox"/>	
display in %	<input type="checkbox"/>	<input type="checkbox"/>	
display in mA	<input type="checkbox"/>	<input type="checkbox"/>	
no indicator	-	<input type="checkbox"/>	
<input type="checkbox"/> Mains frequency 60 Hz.			
<input type="checkbox"/> Message			
(max. 32			
char.) ⁴⁾			

1) For buoyancy transmitters 0,8 sec
 2) Corresponds TAG Name at FOXC0M device (max. 14 symbols)
 3) Is set automatically when configuring the FOXC0M device
 4) Only with HART device

5) With FOXC0M device the characteristic influences the analog output and the digital mode
 6) Only after temp. out of limits



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