

Pressure transmitter PASCAL Ci4

with threaded connection

Type series CI410.



Application area

- Plant and mechanical engineering
- Chemical and petrochemical industry
- General process technology

Application

The digital pressure transmitter PASCAL Ci4 is suitable for measuring the relative and absolute pressure of gases, vapors and liquids. Due to the design the transmitter is suitable for highest requirements. The 4 operation buttons allow an easy and fast parameterisation.

Especially for use in hydrogen applications a calculation tool is available with which the suitable sensor diaphragm material (with/without gold plating) can be determined on the basis of the available process data.

Features

- Pressure transmitter for the measuring of relative and absolute pressures of gases, vapors and liquids
- Stainless steel case in sturdy design, degree of protection IP 65/67
- Accuracy $\leq 0.1\%$
- High-resolution graphic display with Intuitive 4-button operation and backlight
- Comprehensive parameterising functions
- Comprehensive simulation and diagnostic functions
- Quick access to device data
- Development according to SIL2
- Nominal range 0.25 bar to 1050 bar
- Turndown up to 100:1
- Measuring rate up to 100 Hz
- Output signal 4...20 mA with HART® protocol
- Configuration memory
- Digital communication via PDM/EDD, FDT/DTM, 375/475 Field Communicator
- Output functions: linear, invers, square root, table function with up to 64 support points
- Media temperature $-40 \dots 100\text{ }^{\circ}\text{C}$
- Wetted parts stainless steel
- Case design:
 - process connection bottom
 - process connection at back
- Process connections: various screw-in thread with internal diaphragm
- Approved according to NAMUR 95

Options

- Accuracy $\leq 0.075\%$
- Gold coating of sensor diaphragm (thickness 6 μm)
- Thin film sensor for H₂-applications
- Approvals / Certificates
 - Explosion protection (ATEX/IECEX/UKEX) for gases and dust
 - Classification per SIL2
 - Material certificate per EN 10204-3.1
 - Calibration certificate per EN 10204-3.1
 - Certificate for hydrogen resistance per EN 10204-3.1
- As per UKCA regulations
- Operating software LAB4Level for level measurements
- Removable display and control unit
- Degree of protection IP 69K
- Oxygen free of oil and grease

Technical data

Measuring ranges

Up to a turndown of 100:1 the measuring span can be freely selected.

Nominal range	Measuring span		Overload limit	Higher overload (option)	Lower measuring range limit **	Sensor type
	min	max				
0...1 bar *	0.01 bar	2 bar	3 bar	-	100 mbar abs	piezoresistive
0...4 bar *	0.04 bar	5 bar	10 bar	-	100 mbar abs	
0...16 bar *	0.16 bar	17 bar	60 bar	-	100 mbar abs	
0...40 bar *	0.4 bar	41 bar	100 bar	-	100 mbar abs	
0...100 bar *	1 bar	101 bar	200 bar	-	100 mbar abs	
-0.25...0.25 bar	0.0025 bar	0.5 bar	1 bar	6 bar	750 mbar abs	
-1...1 bar	0.01 bar	2 bar	3 bar	10 bar	30 mbar abs	
-1...4 bar	0.04 bar	5 bar	10 bar	25 bar	30 mbar abs	
-1...16 bar	0.16 bar	17 bar	60 bar	120 bar	30 mbar abs	
-1...40 bar	0.4 bar	41 bar	100 bar	120 bar	30 mbar abs	
-1...100 bar	1 bar	101 bar	200 bar	-	30 mbar abs	
-1...100 bar	1 bar	101 bar	200 bar	-	0 mbar abs	thin film for H ₂ -applications
-1...400 bar	4 bar	401 bar	see table A	-	0 mbar abs	
-1...600 bar	6 bar	601 bar	see table A	-	0 mbar abs	
-1...1050 bar	10,5 bar	1051 bar	see table A	-	0 mbar abs	
-1...100 bar	1 bar	101 bar	200 bar	-	0 mbar abs	thin film
-1...400 bar	4 bar	401 bar	see table B	-	0 mbar abs	
0...1 bar abs	0.01 bar abs	1 bar abs	3 bar abs	-	30 mbar abs	piezoresistive
0...4 bar abs	0.04 bar abs	4 bar abs	10 bar abs	-	30 mbar abs	
0...16 bar abs	0.16 bar abs	16 bar abs	60 bar abs	-	30 mbar abs	
0...40 bar abs	0.4 bar abs	40 bar abs	120 bar abs	-	30 mbar abs	

Table A: Overload limit (UE) for nominal range -1...400, -1...600 bar and -1...1050 bar depending on process connection

Process connection (s. order details)	Overload limit
K1010, K1002, K1070, K1072	1050 bar
K1024	640 bar

Table B: Overload limit (UE) for nominal range -1...400 bar depending on process connection

Process connection (s. order details)	Overload limit
K1010, K1002, K1070, K1072	600 bar
K1024	640 bar

* Short term or sporadic measurement in vacuum range permitted up to lower measuring limit. Lower range value up to -1 bar rel. adjustable

** Vacuum-proof designs are available upon request

For information on definitions of terms regarding the Pressure Equipment Directive, see Technical Instruction TA_068.

Constructional design / case

Design: Two-chamber case, continuously rotatable by $\pm 170^\circ$

Case surface blasted

Material case: ■ Stainless steel mat.no. 1.4301/1.4305 (304/303)
■ Stainless steel mat.no. 1.4404 (316L)

Material front cover: ■ Stainless steel mat.no. 1.4305 (303)
■ Stainless steel mat.no. 1.4404 (316L)
■ Polypropylene, black

Gaskets: Silicone / NBR

Degree of protection per EN 60529: IP 65 / IP 67
Option: IP 69K

Climatic category: 4K4H per EN 60721 3-4

Vibration resistance per EN 61298-3:

10...60 Hz: ± 0.35 mm
60...1000 Hz: 5 g

Material window:

- Non-splintering glass (requires front cover of stainless steel)
- Polycarbonate

Elec. connection:

- Circular connector M12
- Cable gland M16x1.5, PA black
- Cable gland M16x1.5, stainless steel
- Cable gland M20x1.5, PA black
- Cable gland M20x1.5, stainless steel
- 1/2" NPT, PA black

Further connections upon request

Terminal blocks:

- Spring clamp terminals up to 1.5 mm²
- Pole terminals up to 2.5 mm²
- Screw terminals up to 2.5 mm²

Weight:

Approx. 1.4 kg

Type plate:

Laser marking

Process connection

- Position: ■ bottom
■ back *

* Flush mounting upon request

- Design: ■ G 1/2 B per DIN EN 837-1
■ G 1/4 B per DIN EN 837-1
■ G1/4 A per DIN EN ISO 1179-2 (DIN 3852-11) model E
■ 1/2 " NPT
■ 1/4 " NPT

Further process connections upon request

Material wetted parts

Sensor	Material diaphragm	Material socket
Piezoresistive	1.4404/1.4435 (316L) optional: gold-coated (6 µm)	1.4404/1.4435 (316L)
Thin film	1.4542 (630)	1.4301/1.4542 (304/630)
Thin film for H ₂ -applications	Stainless steel	Stainless steel

Measuring system

Sensor	System filling
Piezoresistive	Synthetic oil, free of silicone FD1, FDA listed
Thin Film	dry
Thin film for H ₂ -applications	dry

Accuracy

- Reference cond. per EN 61298-1: $T_U = \text{const. (15...25) } ^\circ\text{C}$
 $\varphi = \text{const. (45...75) \% r.F.}$
 $p_U = \text{const. (860...1060) mbar}$
 $U_B = 24 \text{ V DC } (\pm 3 \text{ V DC})$
 $R_B = 50 \Omega$, HART: 250 Ω
 Ground connected
 $MBA = 0 \text{ bar}$
- Calibration position: Process connection bottom: vertical
 Process connection back: horizontal

Reference accuracy:

Per EN 60770 incl. non-linearity, hysteresis and repeatability refer to the adjusted measuring span:

For piezoresistive sensor and thin film sensor		
Nominal range	Turndown ≤ 5:1	Turndown > 5:1
1 - 400 bar	≤ 0.1 %	≤ 0.02 % x TD
0.25 bar	≤ 0.15 %	≤ 0.03 % x TD

For thin film sensor for H ₂ applications		
Nominal range	Turndown ≤ 5:1	Turndown > 5:1
100 - 1050 bar	≤ 0.15 %	≤ 0.03 % x TD

Option for piezoresistive sensor:

Nominal range	Turndown ≤ 3,75:1	Turndown > 3,75:1
1 - 40 bar	≤ 0.075 %	≤ 0.02 % x TD

Option for thin film sensor for H₂ application:

Nominal range	Turndown ≤ 3,75:1	Turndown > 3,75:1
1050 bar	≤ 0.1 %	≤ 0.02 % x TD

Long-term drift:

Refer to nominal range:

Nominal range	Piezoresistive / thin film sensor	Thin film sensor for H ₂ application
100 bar	≤ 0.1 %/Jahr	≤ 0.2 %/Jahr
400 bar		≤ 0.25 %/Jahr
600 bar	/	≤ 0.2 %/Jahr
1050 bar		

Operational availability: < 12 s

Response time t_{90} at current output: For 20 Hz measuring rate: typ. 120 ms
 For 100 Hz measuring rate: typ. 50 ms

Temperature influence, case:

For piezoresistive sensor and thin film sensor		
Nominal range	Temp. -20...80 °C	Temp. -40...-20 °C
1 - 400 bar	≤ 0.1 %/10K , max. 0.3 %	typical ≤ 0.2 %/10K
0.25 bar	≤ 0.15 %/10K, max. 0.4 %	

For thin film sensor for H ₂ applications		
Nominal range	Temp. -20...80 °C	Temp. -40...-20 °C
100 - 1050 bar	≤ 0.2 %/10K , max. 0.3 %	typical ≤ 0.6 %/10K

Indication

- Display: - High-resolution graphic display with backlight
 - 4-button operation
 - Freely configurable display modes
 - continuously rotatable
 - Optional: Remote display and control unit (max. 10 m)

Configuration memory: All parameterisation data can be copied from the device into the configuration memory in the display module. The data is permanently stored there, even in the event of power failure.
 The parameters can be transferred simply and quickly to other devices.

Output

Signal:	2-wire technology	4...20 mA
	Lower limit	3.8...4 mA
	Upper limit	20...21 mA
	Lower alarm current	< 3.6 mA
	Upper alarm current	> 21 mA
	Current limitation	22 mA
	Digital communication:	HART ® protocol, version 7
	Device driver:	
	■ EDD für SIMATIC PDM	
	■ DTM for PACTware or compatible systems (FDT compliance)	
	■ EDD for 375 / 475 Field Communicator	
Function:	■ linear	
	■ inverse response	
	■ by square root	
	■ table function with up to 64 support points	
Turndown:	Max. 100:1	
Damping:	0...999.9 s selectable in steps of 0.1 s	
Measuring rate:	20 Hz, switchable to 100 Hz	
Resolution:	0.5 µA	
Current sensing func.	3.55...21.5 mA selectable in steps of 0.001 mA	
Load R:	$R \leq (U-12V \text{ DC})/0.022 \text{ A } [\Omega]$ U = supply voltage for HART ® communication $R \geq 230 \Omega$	

Supply voltage

Functional range:	12...30 V DC, protected against polarity reversal
Ripple:	< 5 %

Temperature ranges

Ambient:	-40...80 °C (Display visibility is limited at temperatures below - 30 °C)
Media:	-40...100 °C
Storage:	-40...80 °C

Tests and certificates

Ex approvals

ATEX:	TÜV 13 ATEX 120264 X Ex II 1/2G Ex ia IIC TX Ga/Gb Ex II 1/2D Ex ia IIIC Txx °C Da/Db Ex II 2G Ex ia IIC TX Gb Ex II 2D Ex ia IIIC Txx °C Db
IECEx:	IECEx TUN 13.0018X Ex ia IIC TX Ga/Gb Ex ia IIIC Txx °C Da/Db Ex ia IIC TX Gb Ex ia IIIC Txx °C Db
UKEX:	CML 21UKEX21179X Ex II 1/2G Ex ia IIC TX Ga/Gb Ex II 1/2D Ex ia IIIC Txx °C Da/Db Ex II 2G Ex ia IIC TX Gb Ex II 2D Ex ia IIIC Txx °C Db

Detailed information can be found in the Ex instructions XA_010 and XA_011 (depending on the Ex versions, see order details).

EMC *:	Per DIN EN 61326-1, NAMUR NE21 * A deviation of accuracy due to EMC influence up to 0.25 % is impossible for a design with process connection at the back.
SIL 2:	Functional safety per EN 61508, classification per SIL2 For detailed information see SIL instruction SA_001
NAMUR:	Approved according to NE95, Test report TP14033 available upon request

Parameterisation, simulation and adjustment

Parameterisation

Parameter	Values	Default setting
Device		
device ID	16 digits, freely selectable	LABOM PASCAL Ci4
lower range value	at any value within nominal range	0 bar respectively 0 bar abs.
upper range value	at any value within nominal range	end of nominal range
measuring rate	20 Hz, 100 Hz	20 Hz
damping	0.0...999.9 s	0.0 s
Display and control unit		
pressure unit	mbar, bar, Pa, hPa, kPa, MPa, g/cm ² , kg/cm ² , psi, atm, Torr, mmH ₂ O, mH ₂ O, inH ₂ O, ftH ₂ O, mmHg, inHg	bar
temperature unit	°C, °F, °R, K	°C
lighting	on, off	on
language	English, German	German
	English, Chinese	as ordered
	English, Spanish, French	as ordered
	English, Polish, German	as ordered
	English, Turkish, German	as ordered
decimal point	auto, x.xxxx, xx.xxx, xxx.xx, xxxx.x, xxxxx	auto
display mode	five values, four values, three values, two values, big display	four values
main value	pressure, current (%), current (mA)	pressure
secondary values	pressure, current (%), current (mA), sensor temperature, device ID, HART-TAG, HART descriptor, <empty>	current (%), current (mA), device ID
Current output		
output function	linear, inverse response, by square root, table function	linear
table function	% of m.r., output current	depends on device
number of table points	2...64	2 (0 % ≡ 4 mA, 100 % ≡ 20 mA)
lower current limit	3.8...4.0 mA	3.8 mA
upper current limit	20...21 mA	20.5 mA
alarm current	low (<3.6 mA), high (> 21.0 mA)	low (<3.6 mA)
position correction (mounting position)	on, off	off
Maintenance counter		
maintenance interval	0...9999 days	0 days
status	on, off	off
HART data		
HART address	0...63	0
number of response preambels	5...20	5
current mode	proportional, constant	proportional

Diagnostic functions

Self- diagnosis	Description	Value range
RAM-Test	Permanent check of the read/write memory	/
ROM-Test	Permanent check of the checksum via the program memory	/
Bridge circuit test	Permanent check of the bridge circuit	/
CRC parameterisation test	Permanent check of the checksum via the parameter memory	/
Electronics temperature monitoring	Permanent check of the electronics temperature	/
Process diagnostics		
Maintenance timer	Check of the maintenance cycles	/
Operating hours counter	Capture of operating hours	/
Min/Max values	For process pressure and sensor temperature	/
Measuring circuit diagnostics		
loop-test	Setting of a fixed current value at the output	3.55...21.5 mA
pressure simulation	Setting a fixed pressure value, it also considers damping and tabular function unlike the current simulation	Nominal range

Adjustment

Type	Description
zero point correction	adjusts reading to zero at ambient pressure (for differential and gauge pressure devices)
position correction	adjusts reading of mounted device to zero at ambient pressure
lower adjustment	adjusts reading to applied pressure (affects zero point + span)
upper adjustment	adjusts reading to applied pressure (affects span only)
current adjustment	adjusts current output to achieve 4 resp. 20 mA at the end of the measurement chain

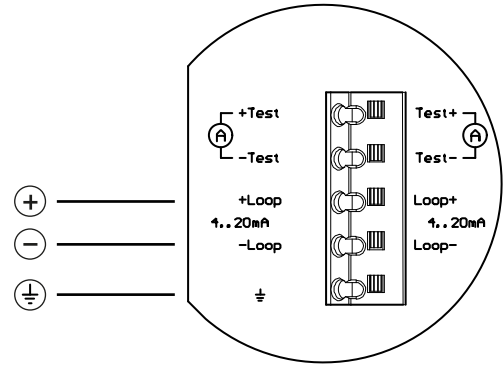
Alternative and additional possibilities of parameterisation for devices with level software LAB4Level

Parameter	Values	Default setting
Display and control unit		
filling height unit	mm, cm, m, ft, in, yd	m
volume unit	l, hl, m³, in³, ft³, gal	l
weight unit (mass)	g, kg, t, lb	kg
density unit	g/cm³, kg/cm³, t/m³, kg/l, lb/in³, lb/ft³	g/cm³
display mode	level 4 values, level 2 values, five values, four values, three values, two values, big display	level 4 values
main value	filling height, volume, weight, pressure, current in %, current in mA	filling height
secondary values	filling height, volumen, weight, pressure, static pressure, current in %, current in mA, sensor temperature, density, device ID, HART-TAG, HART-Descriptor, <leer>	current in %, current in mA, device ID
Level		
density	0.1...20 g/cm³	1 g/cm³
offset height	max 99.999 m	0 m
tank shape table	on/off	off (= linear)
table function	64 support points (filling heights/volume)	
Current output		
measured value	height, volume, weight, pressure (equal 4...20 mA)	height
number of table points	0 / 2...64	0

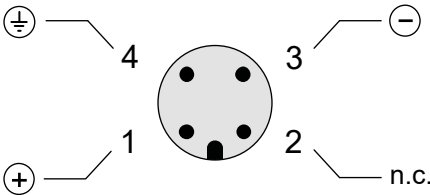
Diagnostic functions

Measuring circuit diagnostics		
simulation function	pressure, filling height, volume, weight (mass), current	/
min/max values	for process pressure, sensor temperature, filling height, volume and weight	/

Connection diagram



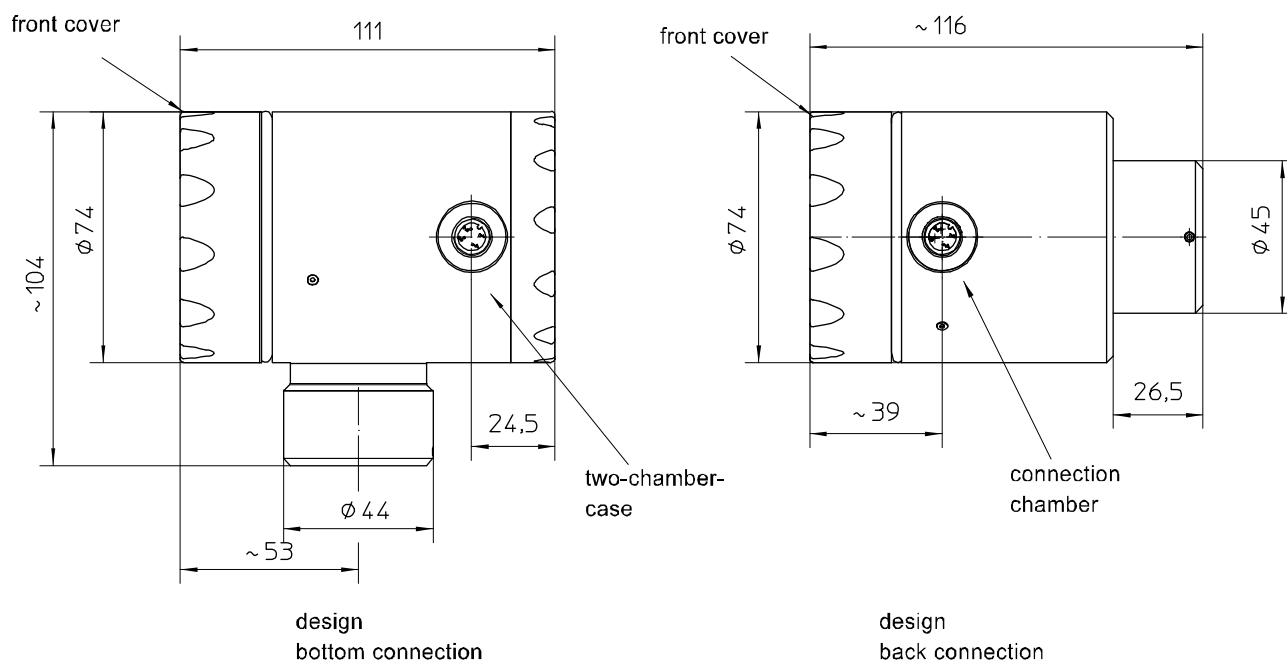
Cable gland



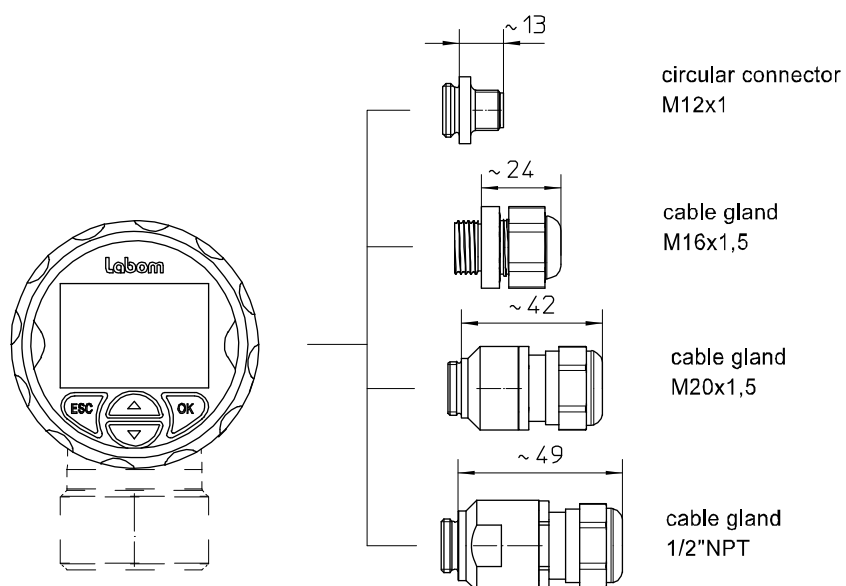
Circular connector M12 x 1

Dimensions

Case

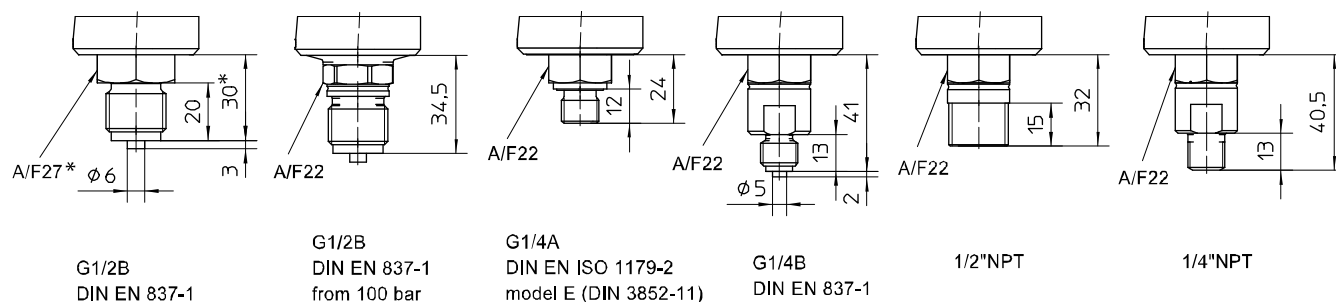


Electrical connections



All dimensions are in mm

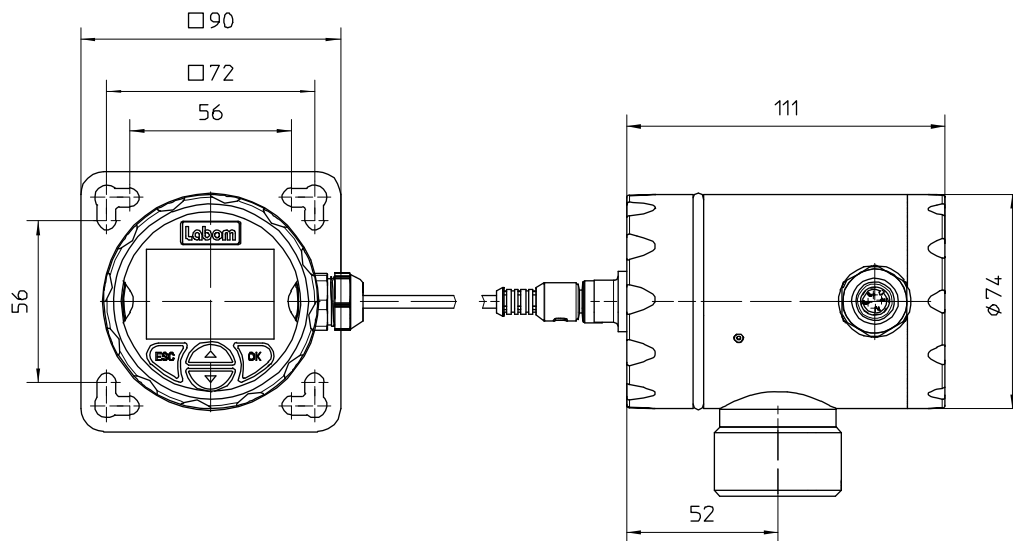
Process connections



* Deviations possible due to design

All dimensions are in millimeters

Remote display and control unit (Type series MC1140)



All dimensions are in mm

Order details

Pressure transmitter PASCAL Ci4 with threaded connection									
CI4100	process connection bottom								
CI4103	process connection back								
	nominal range	turndown	overload limit [bar]	higher overload limit [bar]	Ex marking (see below)	sensor type			
A1053	0...1 bar	TD up to 100:1	3	-	S62 / S77 / S87	piezoresistive			
A1056	0...4 bar		10	-					
A1059	0...16 bar		60	-					
A1061	0...40 bar		100	-					
A1063	0...100 bar		200	-					
A1178	-0.25...0.25 bar		1	-					
A1153	-1...1 bar		3	-					
A1156	-1...4 bar		10	-					
A1159	-1...16 bar		60	-					
A1161	-1...40 bar		100	-					
A1163	-1...100 bar		200	-					
A1178.1	-0.25...0.25 bar		-	6					
A1153.1	-1...1 bar		-	10					
A1156.1	-1...4 bar		-	25					
A1159.1	-1...16 bar		-	120					
A1161.1	-1...40 bar		-	120					
A3163.6	-1...100 bar		200	-	S66 / S76 / S86	thin film for H ₂ -applications			
A3166.6	-1...400 bar		see table A ¹	-					
A3168.6	-1...600 bar		see table A ¹	-					
A3173.6	-1...1050 bar		see table A ¹	-					
A3163	-1...100 bar		200	-		thin film			
A3166	-1...400 bar		see table B ²	-					
B1053	0...1 bar abs			3	-	S62 / S77 / S87	piezoresistive		
B1056	0...4 bar abs			10	-				
B1059	0...16 bar abs			60	-				
B1061	0...40 bar abs			120	-				
F1	parameterisation	factory settings (standard)							
F2		as per customer's specification (pls. specify)							
H21	output signal	4...20 mA, with HART-protocol							
Y1.	material case	stainless steel mat.-no. 1.4301 (304/303)							
Y2.		stainless steel mat.-no. 1.4404 (316)							
1	material front cover	polypropylene (black), window polycarbonate							
2		stainless steel like case, window non splintering glass							
3		stainless steel like case, closed, without window							
				default language	available language				
	display	High-resolution graphic display with backlight, intuitive 4-button operation and quick access to device data		German (standard)	English, German				
M21.1				English					
M22.1				English	English, Chinese				
M22.2				Chinese					
M23.1				English	English, Spanish, French				
M23.2				Spanish					
M23.3				French					
M25.1				English	English, Polish, German				
M25.2				Polish					
M25.3				German					
M26.1				English	English, Turkish, German				
M26.2				Turkish					
M26.3				German					
M1					without display				

T20.	electrical connection	cable gland	M16 x 1.5 polyamide, for cable Ø 4.5-10 mm
T22.			M16 x 1.5 stainless steel mat.-no. 1.4404 (316L), for cable Ø 5-9 mm
T15.			M20 x 1.5 polyamide, for cable Ø 7-13 mm
T17.			M20 x 1.5 stainless steel mat.-no. 1.4404 (316L), for cable Ø 8-13 mm
T27.			1/2" NPT polyamide, for cable Ø 6-12 mm
0		cable clamps	spring clamp terminals up to 1.5 mm ²
5			pole terminals 2.5 mm ²
6			screwed terminals 2.5 mm ²
T30	process connection	circular connector M12 x 1 (4-pin)	
K1010		G1/2 B per EN 837-1	
K1002		G1/4 B per EN 837-1	
K1024		G1/4 A per DIN EN ISO 1179-2 (DIN 3852-11) model E	
K1070		1/2" NPT	
K1072		1/4" NPT	
K9999		as per indication	

Additional features (to be indicated if required)			
J304	coating	gold coating of internal sensor diaphragm (thickness 6 µm), for hydrogen applications ³	
Q1	accuracy	≤ 0,1 % ^{4, 5}	
Q11		≤ 0.075 ⁵	
S66	Ex marking ⁶ (Details see Ex Instruction XA_010)	ATEX	 II 1/2G, II 2G Ex ia IIC TX Ga/Gb, Gb
			 II 1/2D, II 2D Ex ia IIIC Txx°C Da/Db, Db
IECEX		Ex ia IIC TX Ga/Gb, Gb	
		Ex ia IIIC Txx°C Da/Db, Db	
S86		UKEX	 II 1/2G, II 2G Ex ia IIC TX Ga/Gb, Gb
			 II 1/2D, II 2D Ex ia IIIC Txx°C Da/Db, Db
S62		ATEX	 II 1/2G, II 2G Ex ia IIC TX Ga/Gb, Gb
			 II 1/2D, II 2D Ex ia IIIC Txx°C Da/Db, Db
S77	IECEX	Ex ia IIC TX Ga/Gb, Gb	
		Ex ia IIIC Txx°C Da/Db, Db	
S87	UKEX	 II 1/2G, II 2G Ex ia IIC TX Ga/Gb, Gb	
		 II 1/2D, II 2D Ex ia IIIC Txx°C Da/Db, Db	
T4	degree of protection	IP 69K ⁶	
X4	operating software LAB4Level for level applications		
W1020	material certificate	per EN 10204-3.1, wetted parts ⁷	
W1201	calibration certificate	per EN 10204-3.1, 5 measuring points	
W1251	certificate	per EN 10204-3.1, for hydrogen applications	
W2602	functional safety per EN 61508, classification per SIL2		
W2660	as per UKCA regulations		
W4001	oxygen free of oil and grease ⁸		

Accessories		
MC1140	PASCAL Ci4 remote display and control unit including wall bracket	
	material stainless steel, incl. front ring with seal and blind cap with circular connector M12x1	
A1.	connection cable	length: 10 m, material: PUR, with circular connector M12 x1 (further lengths upon request)
1	Internal cable clamps	spring clamp terminals up to 1.5 mm ²
2		pole terminals 2.5 mm ²
3		screwed terminals 2.5 mm ²
T1	degree of protection	IP 65 / IP 67 (standard)

Order code (example): CI4100 – A1056 – F1 – H21 – Y12 – T200 – K1010

¹ Overload limit (UE) depending on process connection (see table A under Technical Data).

² Overload limit (UE) depending on process connection (see table B under Technical Data).

³ Possible for piezoresistive nominal ranges up to 100 bar only.

⁴ Optional for thin film sensor for H₂ applications with nominal range 1050 bar (order code A3173.6).

⁵ For nominal ranges 1 bar, 40 bar, 1050 bar and 16 bar abs at a turndown of ≤ 3.75:1 only.

⁶ Requires front cover of stainless steel.

⁷ Not possible with thin film sensors (order code A3163 and A3166 and A3163.6, A3166.6, A3168.6 and A3173.6).

⁸ Operating conditions for the option "Oxygen free of oil and grease" depending on process connection and sensor type (see table C).

Table C: Operating conditions for the option "Oxygen free of oil and grease" depending on process connection and sensor type

Process connection + sensor type (s. order details)	Restriction temperature	Restriction pressure
K1010, K1002, K1070, K1072 + piezoresistiv	Tmax ≤ 85 °C	Pmax ≤ 90 bar
K1010, K1002, K1070, K1072 + thin film	none	none
K1010, K1002, K1070, K1072 + thin film for H ₂ applications	Tmax ≤ 85 °C	Pmax ≤ 90 bar
K1024 + piezoresistiv / thin film / thin film for H ₂ applications	Tmax ≤ 60 °C	Pmax ≤ 40 bar

Other temperature and pressure ranges on request.