HOTTINGER BALDWIN MESSTECHNIK
HBM Mess- und Systemtechnik GmbH

Electrical
measurement
of mechanical
quantities

Operating manual

Absolute pressure transducer

P3MB

B 22.P3MB.10 e

Contents **Page**

Safety instructions

Use in accordance with the regulations

The P3MB pressure transducer is to be used exclusively for pressure measurement and directly related control tasks. Any other use is deemed to be not as prescribed.

To ensure safe operation, the transducer must only be used in accordance with the specifications in the operating Manual. It is also essential to comply with the statutory and safety regulations relevant to the particular application. This also applies to the use of accessories.

The pressure transducer is not a safety device as defined in the regulations for use. The perfectly safe operation of this pressure transducer requires suitable transport as well as technically correct storage, installation and assembly coupled with careful operation.

General dangers due to non-observance of the safety instructions

The P3MB pressure transducer corresponds to the state of the art and fail safe. The pressure transducer can give rise to residual danger if improperly installed and operated by untrained personnel.

All personnel involved in the installation, commissioning, maintenance or repair of the pressure transducer must have read and understood the operating Manual and in particular the technical safety instructions.

Accident prevention

Care must be taken to ensure that when the pressure transducer is being installed or removed, there is no pressure in the circuit.

Residual dangers

The scope of the capabilities and components provided with the transducer covers only a part of pressure measurement technology. Equipment planners, installers and operators must plan, carry out and accept responsibility for the safety engineering aspects of pressure measurement technology in such a way that residual dangers are kept to a minimum. All existing regulations must be complied with. There must be reference to the residual dangers connected with pressure measurement technology.

Residual dangers are highlighted in this operating manual with the following symbols :

Symbol:  **DANGER**

Meaning: **Maximum danger level**

Warns of an **imminently** dangerous situation in which failure to comply with safety requirements **will result in** death or serious physical injury.

Symbol:  **WARNING**

Meaning: **Potentially dangerous situation**

Warns of a **potentially** dangerous situation in which failure to comply with safety requirements **can result in** death or serious physical injury.

Symbol:  **CAUTION**

Meaning: **Potentially dangerous situation**

Warns of a **potentially** dangerous situation in which failure to comply with safety requirements **could result in** damage to property or some form of physical injury.

Symbol:  **NOTE**

Means that important information about the product or its handling is being given.

Symbol: CE

Meaning: **CE mark**

The CE mark enables the manufacturer to guarantee that the product complies with the requirements of the relevant EC directives (see Declaration of Conformity at the end of this document).

Conversions and modifications

The P3MB pressure transducer must not be modified from the design or safety-engineering point of view without our express agreement. Any modification precludes liability on our part for any damage resulting therefrom.

Qualified personnel

The pressure transducer must only be installed and operated by qualified personnel strictly in accordance with the technical data relating to the safety requirements and safety rules and regulations listed. It is also essential to comply with the statutory and safety regulations relevant to the particular application. This also applies to the use of accessories.

”Qualified personnel” means persons familiar with the installation, assembly, commissioning and operation of the product who possess the qualifications appropriate to their function.

1 List of components supplied

P3MB pressure transducer, operating manual

P3MB/...1 to 200bar:	1 USIT[1)] gasket U 12.7x20x1,5
P3MB/... 500 and 3000bar:	1 double-cone seal from corrosion-resistant steel, material no. 1.4305

Also available:

- Cable socket HK6S (for variants with HS6P connector[2)]) — Order no. 3-3312.0095
- Unterminated connector cable (for variants with HS6P connector[2)]) — Order no. 1-KAB405.30A-3
- Greenline connecting plug — Order no. 1-MS3106PEMV
- 15-pin D-connector — Order no. 3-3312.0182
- Adapter for process port
  - M20 to 500bar — Order no. 1-P3M/500/M20
  - G1/2 to 500bar — Order no. 1-P3M/500/R1/2

1) The USIT-gasket as delivered is a standard version supplied by C. Freudenberg, 69469 Weinheim. It consists of mineral oil-based synthetic rubber and corrosion-resistant steel, and can be used from –30 to +100° C.

2) Corresponds to PT06E-10-6S, supplied by Bendix or UPT06J-10-6S, supplied by Canon

2 Application

The pressure transducers are suitable for measuring static and dynamic pressures in fluids and gases. They are available for various measuring ranges in steps from 1 to 3000bar and with various electrical connection options, see Chapter 10 ”Options”.

Any fluid or gas (vapour) that does not attack these steels is a suitable measurement medium. The pressure transducer’s threaded connection piece is used for the pressure connection; the transducer can be mounted in any position.. In particular cases there are specific instructions in Chapter 4 ”Mounting” which must be followed!

2.1 Use in potentially explosive atmospheres

Transducers are available on request for use in atmospheres of group I and II, where there is an explosion hazard, in conjunction with intrinsically safe circuits in accordance with DIN EN 50014 and DIN EN 50020 as intrinsically safe apparatus.

3 Construction and operating mode

The transducers for the measuring ranges of 0..1 and 0.. 5bar work on the basis of the piezoresistive principle of measurement. Transducers for the ranges of 0..1bar and 0..3000bar use the strain-gauge principle. Transducers for the ranges of 0..5bar can be used to measure absolute pressure (P3MB/A) or gauge pressure (P3MB/R), transducers for the range of 10...3000bar measure absolute pressure.

On the transducers from 10 to 3000bar, the internal measurement tube has strain gauges that are connected to a Wheatstone bridge.

The SG application is located in a hermetically sealed reference chamber on the side of the tube that is averted from the measurement medium. This protects it from ambient effects.

The transducer housings are made from stainless steel, and seal the measuring system hermetically against all harmful influences, so that even continuous harsh operating conditions do not adversely affect the reliability and precision of the transducers.

Parts in contact with the medium of transducers up to 5bar are made of 1.4401 and 1.4301 stainless steel, those of transducers up to 200bar are made of 1.4301 and 1.4542 stainless steel. In the case of the series P3MB/ 500bar to P3MB/ 3000bar, they are made from 1.4542 stainless steel.

4 Assembly

Pressure transducers can be screwed into place in any location. If a transducer is used for measuring dynamic pressure trends in fluids, it must be installed with the pressure connector upwards so that an air-bulge cannot form in the measurement tube.

The connecting pin and threaded connector M 12x1.5 or M 20x1.5 on type P3MB/3000bar correspond to DIN 16288.

CAUTION

When tightening, the wrench (size 27) must only be applied to the clamping area of the mounting flange, and not to the housing or cable entry. The permitted tightening torque is 30Nm.

Special attention must be paid to the sealing on the thread of the connecting pin. In some cases the appropriate type of sealing will depend on the pressurised medium and the respective mounting position. Some possible seals are shown below.

Fig. 4.1: The USIT ring U 12.7x20x1.5 is supplied as an accessory for the P3MB transducer (to 200bar full scale value). For a perfect seal the bearing surfaces must be substantially flat and free from tooling marks. The pin hole must have no spot-facing and should be only lightly deburred, since the pressure of the measurement medium forces the packing lips against the transducer and the bearing surface.

Fig. 4.2: Transducers from 500 to 3000bar full scale value are delivered complete with double-cone seal made from stainless, acid-resistant steel, material no. 1.4305. It makes a perfect seal even under high static and dynamic pressure.

a) P3MB/ 500bar to P3MB/ 2000bar

Connection aperture and installation of seal.

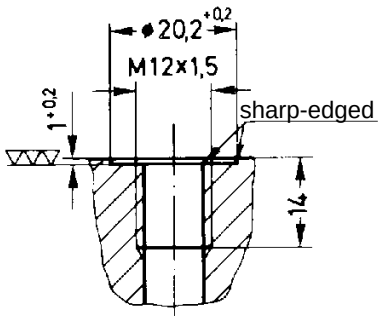
b) P3MB/ 3000bar
Connection aperture with relief aperture and installation of the seal.

Fig. 4.3: When using this type of sealing with diaphragms in accordance with DIN 16258, only discs made from non-metallic materials should be used. If the corresponding metallic discs are used, the permitted tightening torque of 30Nm is not sufficient to achieve the necessary surface pressure for a perfect sealing.

DANGER

Before the P3MB pressure transducer is installed or removed, care must be taken to ensure that there is no pressure in the circuit.

Fig.4.1



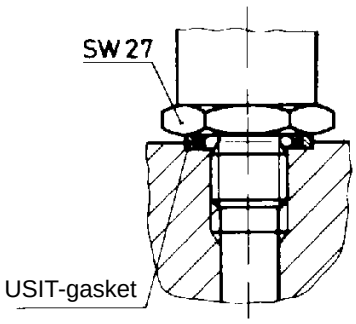
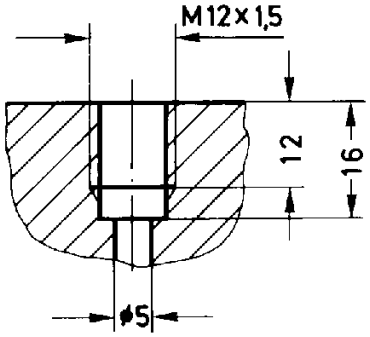
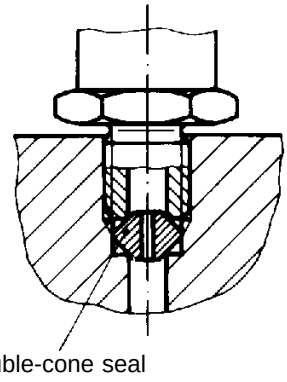
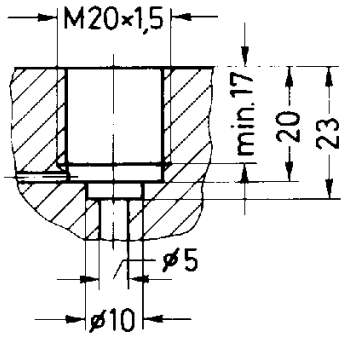


Fig.4.2 a)





b)



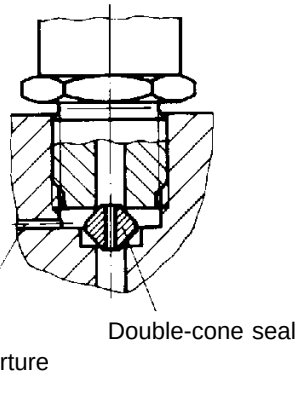
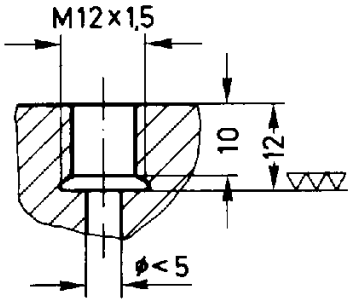


Fig.4.3



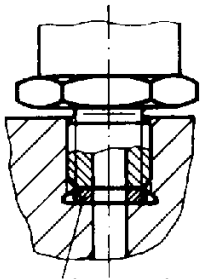


Fig. 4.1 to 4.3: Installing the pressure transducer. Legends for the individual diagrams on the previous page.

5 Electrical connection

Pressure transducers can be connected to carrier-frequency and DC voltage amplifiers.

In the standard version, pressure transducers are fitted with a 3m-long unterminated connector cable.

As an option, they are also available with an MS-connector, a D-15 connector or an integral HS6P connector; see also Chapter 10 ”Options”.

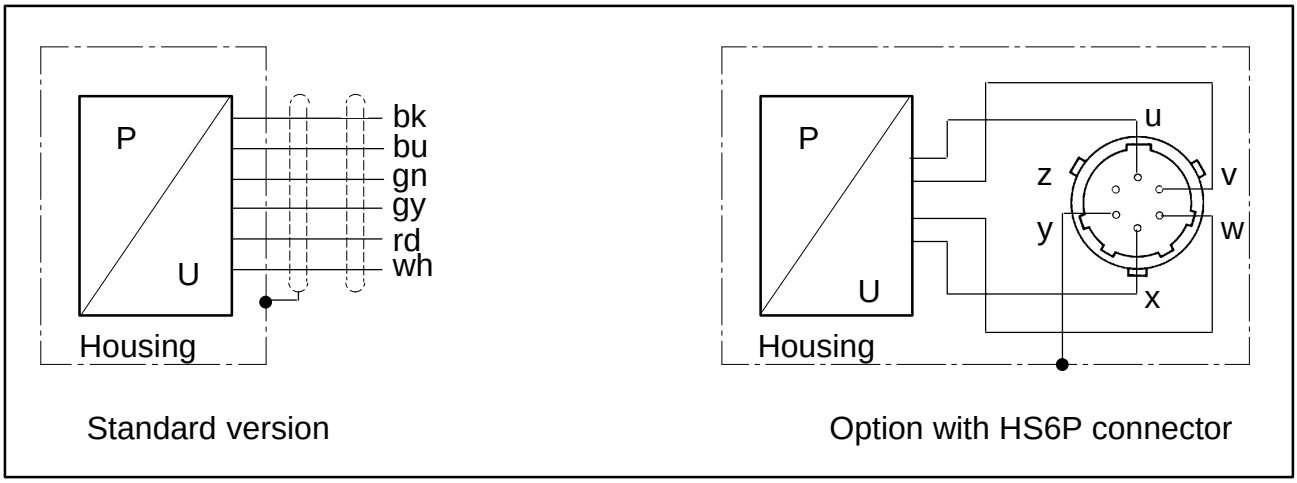


Fig. 5.1: Electrical connections of the P3MB pressure transducer. Standard version with unterminated connector cable, and option with an integral HS6P connector

Pin assignment is shown in Table 5.1. The cable shielding is connected to the transducer housing (see ”Greenline shielding design”, xxxG36.35.0).

Pin assignment			Standard version		HS6P connector
Bridge excitation voltage	U_B	(+)	blue	(bu)	U
Bridge excitation voltage	U_B	(–)	black	(bk)	X
Measuring signal pressure	U_A	(+)	white	(wh)	V
Measuring signal pressure	U_A	(–)	red	(rd)	W
Sensor circuit		(+)	green	(gn)	–
Sensor circuit		(–)	grey	(gy)	–
Housing/Ground			Cable shielding		Y

Tab.5.1: Pin assignment for P3MB pressure transducer with connector cable and HS6P connector

NOTE

If the measuring system has no other connection to ground, earth or mains supply, its zero potential can be connected to the transducer ground by soldering an insulated flexible stranded wire from the cable shielding to jack Y in the HK6S cable socket.

To open the HK6S cable socket, release the clamping screw (size 14) from the sleeve (size 15) and pull the jack assembly complete with cable backwards out of the sleeve.

The cable complete with gasket can then be moved forwards with the split clamping sleeve and spacer until the soldering tags and cable shielding are accessible. When dismantling the cable socket, please do not pull on the white jack assembly.

5.1 Cable extension

Use shielded, low-capacitance extension cable. Above all the excitation circuits must have large cross-sections. HBM supplies its recommended extension cable and measuring cable by the metre.

When extending cable, ensure perfect connection with lowest possible contact resistance and good insulation between the circuits and ground. For this reason all connections must be soldered, or at least made with safe, stable terminals, and installed so that they are watertight. In the open air and/or in a damp environment, terminal boxes must be sealed.

If the order includes a longer cable to be factory-fitted to the transducer, this is taken into account in the calibration just as for the 3m-long standard cable.

Measuring cables should not be laid parallel to high-tension and control circuits (e.g. in common cable shafts). If this cannot be arranged, protect the measuring cable with steel conduit and keep it at least 50cm away from other cables. Stray fields from transformers, motors and protective contacts are to be avoided.

6 Differential pressure measurement circuit

Two transducers with the same full scale value can be connected together without any problem in order to determine the corresponding differential pressure signals. For this purpose the excitation voltage contacts are connected in parallel and the measurement voltage contacts are connected in crossover. The resulting resistance is then 175Ω.

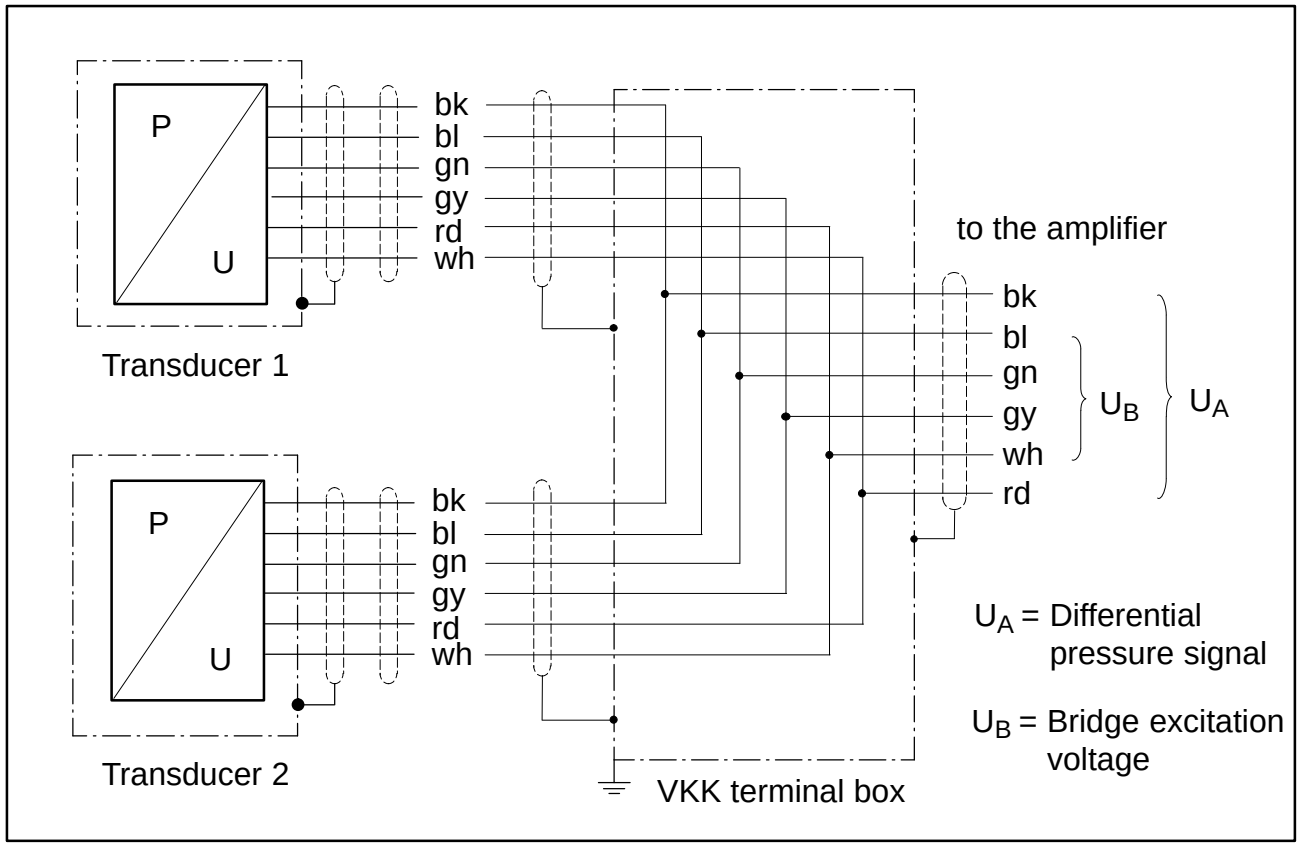


Fig. 6.1: Circuit diagram for differential pressure measurement

	Excitation voltage		**Measurement voltage**	
Transducer 1	bk	bu	wh	rd
	with	with	with	with
Transducer 2	bk	bu	rd	wh

The differential pressure signal fed is to: $U_A = 1/2 \cdot (U_{A1} – U_{A2})$

7 Measuring

To get perfect results whenever you are measuring pressure, it is indispensable to take into account the correlation between **absolute pressure, gauge pressure** and **atmospheric pressure**, when setting up the measuring system.

Due to their mechanical construction with the hermetically sealed reference chamber, transducers for the measuring ranges of 10...3000bar measure absolute pressure only. Under certain conditions it is also possible to measure gauge pressure with an absolute pressure transducer. The atmospheric pressure is then removed by electrical taring. Transducers for the measuring ranges of 0...5bar also measure gauge pressure.

Dead volume and any fluid or gas volume present on the user side can also lead to a false measurement result.

7.1 Measuring dynamic pressures

Calibration by reference to static pressures also applies when measuring dynamic pressures. Please note that in the case of measurement frequencies in the natural frequency range, amplitude reinforcements have to be taken into account.

When there is dynamic loading, maximum pressure must not exceed the nominal pressure. The vibration bandwidth (peak-to-peak) of the permitted pressure fluctuation must not exceed 70% of the fulll scale value.

8 Specifications (acc. to DIN 16 086)

8.1 0...50bar

Type		**1-P3MB/A**		**1-P3MB/R**		**1-P3MB**		
Accuracy class		0.2		0.2		0.2	0.15	0.2
Mechanical input characteristics								
Pressure type		Absolute pressure		Gauge pressure		Absolute pressure		
Measuring range, 0bar...	bar	1	5	1	5	10	20	50
Initial value	bar	0		Ambient air pressure		0		
Mechanical values in accordance with VDI/VDE 2600, with reference to full scale value								
Operating range for reference temperature	%	0...100				0...200		
Overload limit for reference temperature	%	300				250		
Test pressure	%	300				250		
Destructive range	%	600				>250		
Permissible pressure with dyn. loading	%	100				100		
Permissible vibration bandwidth with dyn. loading acc. to DIN 50100	%	70				70		
Natural frequency of the membrane	kHz	12	25	12	25	13	15	26
Dead volume	mm^3	350				2000		
Control volume	mm^3	–				9	7	
Material								
– internal surface (threaded piece/ pressure connection/housing)		1.4401				1.4301, 1.4542		
– external surface (threaded piece/pressure connection/housing)		1.4401/1.4301				1.4542, 1.4301, nickel-plated brass, rubber, silicone		
– membrane		Hastelloy C						
– fluid		Carbon halide oil						
Output characteristics								
Output signal span	mV/V	2.000 ± 1% Exact value on the transducer (Tolerance ≤0.1%)				2 ± 0.15%		
Linearity variation incl. hysteresis	%	± 0.1				± 0.2	± 0.15	± 0.2

Repeatability in accordance with DIN 1319	%	±0.05		±0.05
Temperature effect per 10K in the nominal range of the excitation voltage on the sensitivity, related to the actual value				
in the nominal temperature range	%	±0.15		±0.1
in the service temperature range	%	±0.20		±0.2
Temperature effect per 10K in the nominal range of the excitation voltage on the zero signal, related to the actual value				
in the nominal temperature range	%	±0.15		±0.1
in the service temperature range	%	±0.20		±0.15
Nominal range of the excitation voltage (r.m.s. value)	V	0.5...12		0.5...12
Input resistance for reference temperature	Ω	570...2200		350 ±2.5
Output resistance for reference temperature	Ω	300...700		350 ±1.5
Insulation resistance at 100V AC	GΩ	5		
Ambient conditions				
Reference temperature	°C	23		23
Nominal temperature range	°C	–20...+80		–10...+80
Limiting temperature range	°C	–40...+125		–40...+100 (...120°C up to 24 hours)
Storage temperature range	°C	–40...+125		–50...+100
Degree of protection (in accordance with DIN 40050, IEC 529)		IP67	IP65	IP67
Mechanical specifications				
Pressure connection 1-P3MB		M12x1.5		M12x1.5
Electrical connection		Cable, 3m, unterminated		Cable, 3m, unterminated
1-P3MB				
1-P3MBP		Device connector HS6P		Device connector HS6P
Weight without cable, approx.	g	100		200

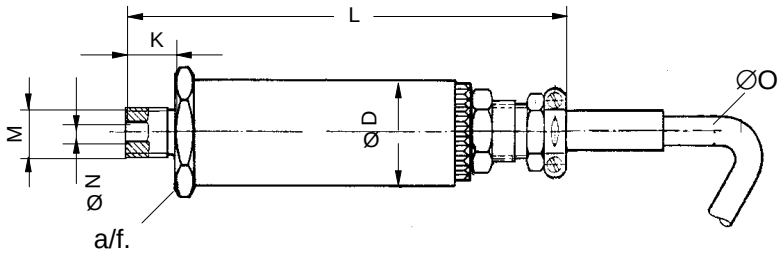
8.2 100...3000bar

Type		**1-P3MB**					
Accuracy class		0.15		0.1		0.2	
Mechanical input characteristics							
Pressure type		Absolute pressure					
Measuring range, 0bar...	bar	100	200	500	1000	2000	3000
Initial value	bar	0					
Mechanical values in accordance with VDI/ VDE 2600, with reference to full scale value							
Operating range for reference temperature	%	0...200		0...150			
Overload limit for reference temperature	%	250		200			
Test pressure	%	250				200	150
Destructive range	%	>250					
Natural frequency of the membrane	kHz	38	67	>100			
Material							
– internal surface (threaded section/ pressure connector/housing)		1.4301, 1.4542		1.4542			
– external surface (threaded section/pressure connector/housing)		1.4542, 1.4301, nickel-plated brass, rubber, silicone					
Output characteristics							
Output signal span	mV/V	2 ± 0.15%					1.5 ± 0.15%
Linearity variation incl. Hysteresis	%	± 0.15		± 0.1		± 0.2	
Repeatability in accordance with DIN 1319	%	±0.05					
Temperature effect per 10K in the nominal range of the excitation voltage on the sensitivity, related to the actual value							
in the nominal temperature range	%	± 0.1					
in the service temperature range	%	± 0.2					
Temperature effect per 10K in the nominal range of the excitation voltage on the zero signal, related to the actual value							
in the nominal temperature range	%	± 0.1					
in the service temperature range	%	± 0.15					
Nominal range of the excitation voltage (Effective value)	V	0.5...12					
Input resistance for reference temperature	Ω	350 ± 2.5					
Output resistance for reference temperature	Ω	350 ± 1.5					

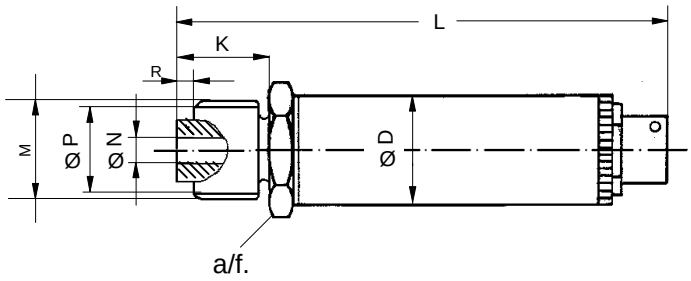
Ambient conditions		
Reference temperature	°C	23
Nominal temperature range	°C	–10...+80
Limiting temperature range	°C	–40...+100 (...120°C up to 24 hours)
Storage temperature range	°C	–50...+100
Degree of protection (in accordance with DIN 40050, IEC 529)		IP67
Mechanical specifications		
Pressure connection 1-P3MB		M12x1.5
Electrical connection 1-P3MB 1-P3MBP		 Cable, 3m, unterminated Device connector HS6P
Weight without cable, approx.	g	200

9 Dimensions (in mm)

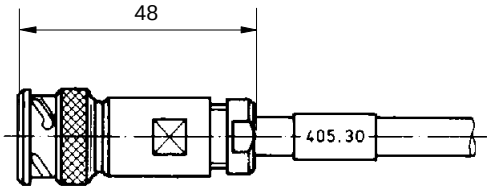
Version with cable connection



Version with plug connection



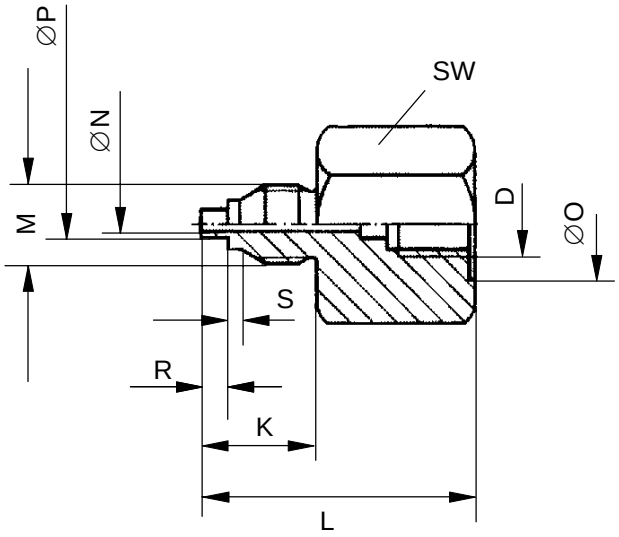
Cable socket HKS6



P3MB		D	K	L	M	N	O	P	SW	R
with cable connection	**1bar...5bar**	25	12	101	M12x1.5	5	6.5	–	22	–
	10bar...2000bar	25	12	112	M12x1.5	5	6.5	–	27	–
	3000bar	25	20	129	M20x1.5	5	6.5	17.5	27	3
with plug connection	**1bar...5bar**	25	12	85	M12x1.5	5	–	–	22	–
	10bar...2000bar	25	12	97	M12x1.5	5	–	–	27	–
	3000bar	25	20	105	M20x1.5	5	–	17.5	27	3

To be ordered separately:

Connecting branch for measuring ranges up to 500bar;
material: 1.4305 stainless steel



Connecting branch, type	D	K	L	M	N	O	P	R	S	SW
1-P3M/500/M20	M12x1.5	25	50	M20x1.5	4	20.2	5	5	3	32
1-P3M/500/R1/2	M12x1.5	20	50	G1/2	4	20.2	5	5	3	32

10 Options

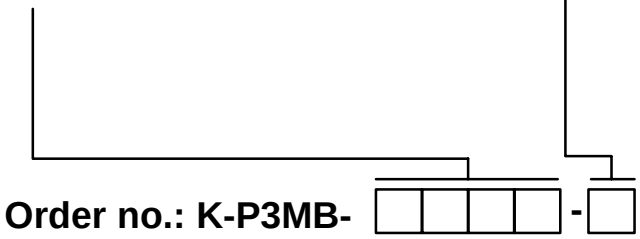
Option1:

Code	Measuring range
01AM	1bar
01RM	1bar
05AM	5bar
05RM	5bar
010B	10bar
020B	20bar
050B	50bar
100B	100bar
200B	200bar
500B	500bar
01KB	1000bar
02KB	2000bar
03KB	3000bar

Option2:

Code	Electrical connection
Y	with cable, ≤20m, unterminated[1)]
M	with cable, 3m, MS-connector
D	with cable, 3m, D15-connector
N	with cable, ≤20m, MS-connector[1)]
F	with cable, ≤20m, D15-connector[1)]
E	with cable, 3m unterminated [Ex(i)], for ≥10bar
X	with cable, ≤20m unterminated [Ex(i)][1)], for ≥10bar
Q	with HS6P[2)] connector [Ex(i)]

[1)] Please state length of cable required



Ordering example for 10bar with HS6P connector [(Ex)i]:

Order no.: K-P3MB-010B-Q

Standard version with 3m-long unterminated cable:

Order no.: 1-P3MB/10BAR...1-P3MB/3000bar

11 Copy of Declaration of Conformity

HOTTINGER BALDWIN MESSTECHNIK

HOTTINGER BALDWIN MESSTECHNIK GMBH
Im Tiefen See 45 - D-64293 Darmstadt
Tel. ++49/6151/803-0, Fax. ++49/6151/894896

Konformitätserklärung ***Declaration of Conformity*** ***Déclaration de Conformité***

Document: ***071/05.1996***

Wir,	We,	Nous,
	Hottinger Baldwin Messtechnik GmbH, Darmstadt	
erklären in alleiniger Verantwortung, daß das Produkt	declare under our sole responsibility that the product	déclarons sous notre seule responsabilité que le produit
	Absolutdruckaufnehmer der Typenreihe P3MB (P6A, P31AP)	
auf das sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder normativen Dokument(en) übereinstimmt (siehe Seite 2) gemäß den Bestimmungen der Richtlinie(n)	to which this declaration relates is in conformity with the following standard(s) or other normative document(s) (see page 2) following the provisions of Directive(s)	auquel se réfère cette déclaration est conforme à la (aux) norme(s) ou autre(s) document(s) normatif(s) (voir page 2) conformément aux dispositions de(s) Directive(s)

89/336/EWG - Richtlinie des Rates vom 3. Mai 1989 zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit, geändert durch 91/263/EWG, 92/31/EWG und 93/68/EWG

Die Absicherung aller produktspezifischen Qualitätsmerkmale erfolgt auf Basis eines von der DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) seit 1986 zertifizierten Qualitätsmanagementsystems nach DIN ISO 9001 (Reg.Nr. DQS-10001). Die Überprüfung der sicherheitsrelevanten Merkmale (Elektromagnetische Verträglichkeit, Sicherheit elektrischer Betriebsmittel) führt ein von der DATech erstmals 1991 akkreditiertes Prüflaboratorium (Reg.Nr. DAT-P-006 und DAT-P-012) unabhängig im Hause HBM durch.	All product-related features are secured by a quality system in accordance with DIN ISO 9001, certified by DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) since 1986 (Reg. No. DQS-10001). The safety-relevant features (electromagnetic compatibility, safety of electrical apparatus) are verified at HBM by an independent testing laboratory which has been accredited by DATech in 1991 for the first time (Reg. Nos. DAT-P-006 and DAT-P-012).	Chez HBM, la détermination de tous les critères de qualité relatifs à un produit spécifique est faite sur la base d´un protocole DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) certifiant, depuis 1986, notre système d´assurance qualité selon DIN ISO 9001 (Reg.Nr. DQS-10001). De même, tous les critères de protection électrique et de compatibilité électromagnétique sont certifiés par un laboratoire d´essais indépendant et accrédité depuis 1991 (Reg.Nr. DAT-P-006 et DAT-P-012).

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Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften. Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.	This declaration certifies conformity with the Directives listed above, but is no asseveration of characteristics. Safety directions of the delivered product documentation have to be followed.	Cette déclaration atteste la conformité avec les directives citées mais n´assure pas un certain charactère. S.v.p. observez les indications de sécurité de la documentation du produit ajoutée.
Folgende Normen werden zum Nachweis der Übereinstimmung mit den Vorschriften der Richtlinie(n) eingehalten:	The following standards are fulfilled as proof of conformity with the provisions of the Directive(s):	Pour la démonstration de la conformité aux disposition de(s) Directive(s) le produit satisfait les normes:

prEN 50082-2 : 1992 ***Elektromagnetische Verträglichkeit (EMV); Fachgrundnorm Störfestigkeit;*** Teil 2: Industriebereich; Deutsche Fassung

EN 50082-2 : 1995 ***Elektromagnetische Verträglichkeit (EMV); Fachgrundnorm Störfestigkeit;*** Teil 2: Industriebereich; Deutsche Fassung

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