Mounting Instructions

Inductive displacement transducer

WA..

B 25.WA.40 en

Contents **Page**

Safety instructions

Use in accordance with the regulations

Displacement transducers of the WA type series are suitable for all situations where there are strict ruggedness and accuracy requirements, such as in research, development and industrial applications. Use for any additional purpose shall be deemed to be **not** in accordance with the regulations.

In the interests of safety, the transducer should only be operated as described in the Mounting Instructions. It is also essential to observe the appropriate legal and safety regulations for the application concerned during use. The same applies to the use of accessories.

The transducer is not a safety element within the meaning of its use as intended. Proper and safe operation of this transducer requires proper transportation, correct storage, assembly and mounting and careful operation and maintenance.

General dangers due to non-observance of the safety instructions

The WA displacement transducer corresponds to the state of the art and is fail-safe.

The transducers can give rise to residual dangers if they are inappropriately installed and operated by untrained personnel.

Everyone involved with the installation, commissioning, maintenance or repair of a displacement transducer must have read and understood the Mounting Instructions and in particular the technical safety instructions.

Residual dangers

The scope of supply and performance of the transducer covers only a small area of displacement measurement technique. In addition, equipment planners, installers and operators should plan, implement and respond to the safety engineering considerations of displacement measurement technique in such a way as to minimize residual dangers. Prevailing regulations must be complied with at all times. There must be reference to the residual dangers connected with displacement measurement technique.

In these mounting instructions residual dangers are pointed out using the following symbols:

Symbol:  **DANGER**

Meaning: **Highest level of danger**

Warns of a **directly** dangerous situation in which failure to comply with safety requirements **will** lead to death or serious physical injury.

Symbol:  **WARNING**

Meaning: **Dangerous situation**

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

Symbol:  **CAUTION**

Meaning: **Possibly dangerous situation**

Warns of a potentially dangerous situation in which failure to comply with safety requirements **could** lead to damage to property, slight or moderate physical injury.

Symbol:  **NOTE**

Refers to the fact that important information is being given about the product or its use.

Symbol: CE

Meaning: CE mark

The CE mark indicates a guarantee from the manufacturer that the product meets the requirements of the relevant EC directives (see Declaration of conformity on page 25).

Conversions and modifications

The transducer must not be modified from the design or safety engineering point of view except with our express agreement. Any modification shall exclude all liability on our part for any damage resulting therefrom.

Qualified personnel

This instrument is only to be installed by qualified personnel strictly in accordance with the technical data and with the safety rules and regulations which follow. It is also essential to observe the appropriate legal and safety regulations for the application concerned. The same applies to the use of accessories.

Qualified personnel means persons entrusted with the installation, fitting, commissioning and operation of the product who possess the appropriate qualifications for their function.

Accident prevention

The relevant accident prevention regulations of the trade safety associations must be taken into account.

1 Introduction

HBM's WA displacement transducers are particularly well suited for use with all applications requiring a high degree of durability and precision, such as research, development and industry.

To provide documentary evidence of quality, a separate test report containing the test data is included in the list of components supplied with the product.

2 Electrical structure and connection

The principle of measurement is based on an active quarter bridge (in the case of the WA2, on an active half bridge), that is expanded to a full bridge connection. The displacement transducer can be used in full-bridge and half-bridge mode. The transducer is designed with integral sensor circuits to operate in a six wire circuit.

When operating with a six wire amplifier, the cable can be shortened or lengthened (to a maximum of 300m) without effect, as the additional sensor circuits, gray and green, tap the voltage at the feeders in the sensor and carry it back to the six wire amplifier. This regulates the voltage so that it reaches the transducer loss-free.

2.1 Electrical connection WA electronics

The transducer is fitted with an integrated evaluation circuit for operating at direct voltage (15 – 30 volts). The integrated evaluation circuit is designed for operation with a separated extra-low voltage (SELV circuit). The WA electronics are not designed to be connected to a direct voltage network in accordance with EN 61010–1. The output signal is available as a standardized voltage value. The lower range value of the transducer corresponds to 0.5 V (live zero), the upper range value of the transducer corresponds to 10V. The cable connecting the WA electronics to follower electronics can be shortened or lengthened as required (max. 50m).

NOTE

For versions with a plug connection between the transducer and the electronics module, please note the following: **Transducer and electronics are assigned to each other and must not be interchanged.**

With cable extensions, use shielded cable (see Section 2.1 Pin assignment).

2.2 Pin assignment

Transducer	Wire colour	Amplifier	
WA	Cable	15-pin Sub-D connector	7-pin MS-connector
Measurement signal (+)	WH = white	8	A
Measurement signal (−)	RD = red [1]	15	D
Excitation voltage (+)	BU = blue	6	C
Excitation voltage (−)	BK = black	5	B
Sensor circuit (+)	GN = green	13	F
Sensor circuit (−)	GY = gray [2]	12	g
Shield		Enclosure	Enclosure

1) with full bridge only

2) for the high temperature version: violet

2.3 Pin assignment WA electronics

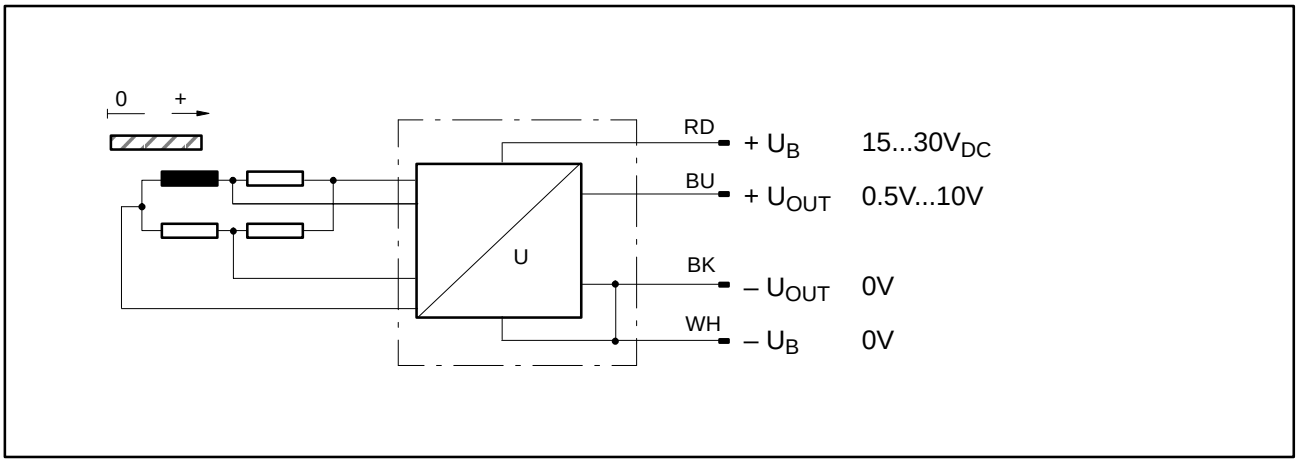


Fig. 2.1: Electrical block diagram WA electronics

Special notes on operating WA transducers:

CAUTION

With amplifiers, you must connect zero operating voltage to the protection circuit (terminals):

in the case of system devices with a sliding switch (e.g. MGC), by connecting terminal 2 (zero operating voltage) to the protection circuit in the case of the MVD2555 amplifier.

Connecting to terminals:

1. The shield can be accessed through a notch in the cable sheath (see Fig. 2.2).
2. Place the shield flat on the body of the casing.

Fitting to a connector:

Place the cable shield flat on the connector housing (see chap. 6.1).

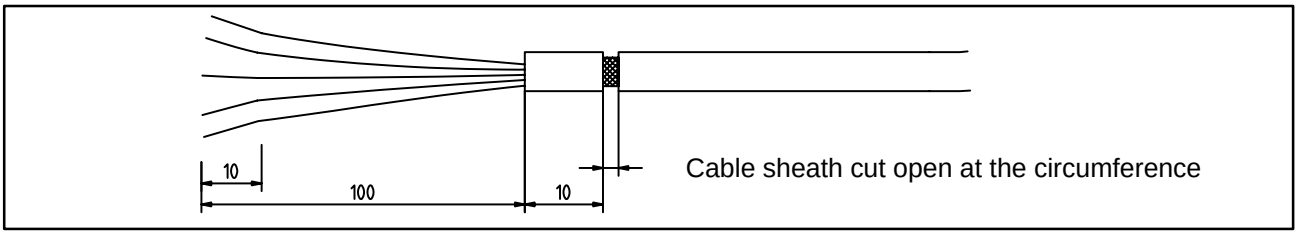


Fig. 2.2: Notched cable sheath

2.4 Principle of measurement, wiring assignment: WA2

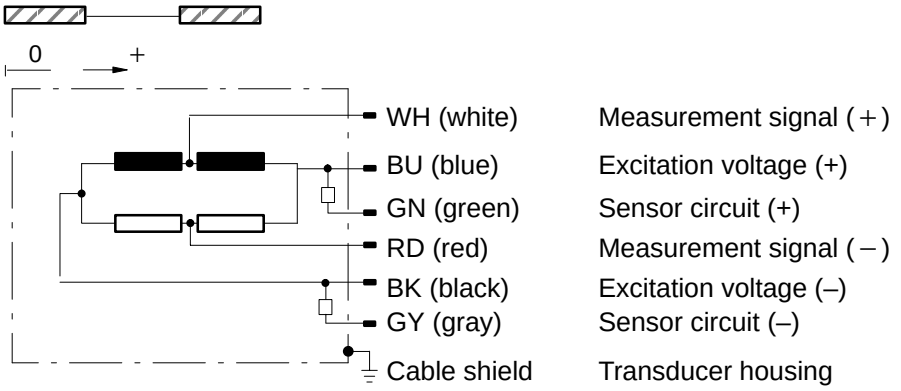
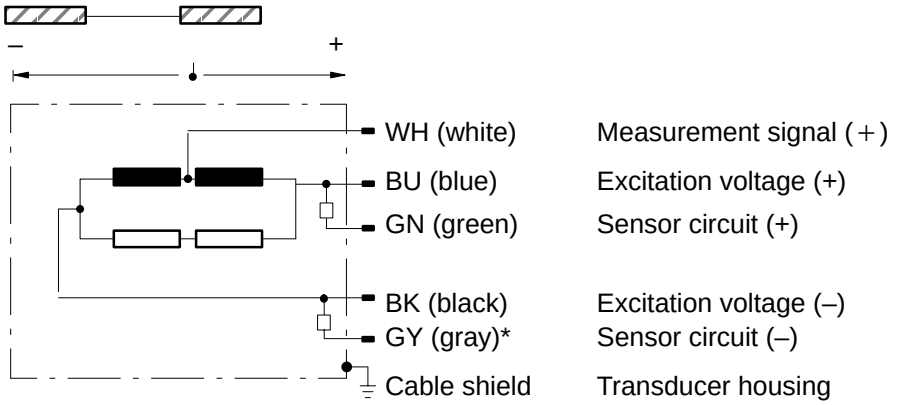


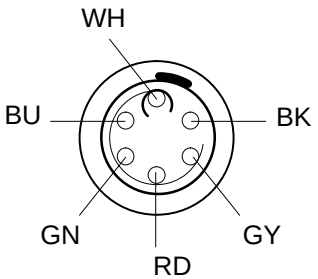
Fig. 2.3: General electrical wiring-diagram, full bridge with 80mV/V



* for the high temperature version: violet

Fig. 2.4: General electrical wiring-diagram, half bridge with 40mV/V

For information on using other transducer connection types, refer to the operating manual for the chosen amplifier (connection diagram WA, see types of connection).



80mV/V, 6-pin

Fig. 2.5: Lemosa connector pin assignment (solder side of male cable connector)

2.5 Principle of meas., wiring assignment: WA10...WA500

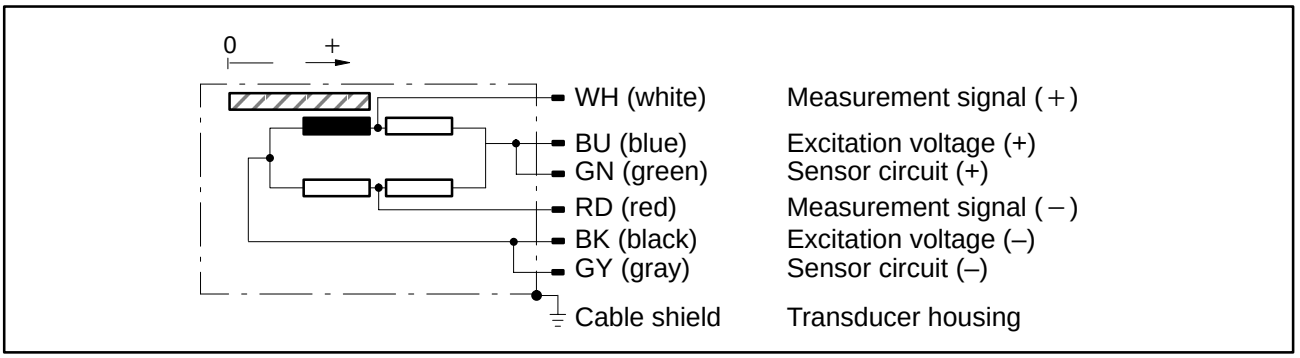


Fig. 2.6: General electrical wiring-diagram, full bridge with 80mV/V

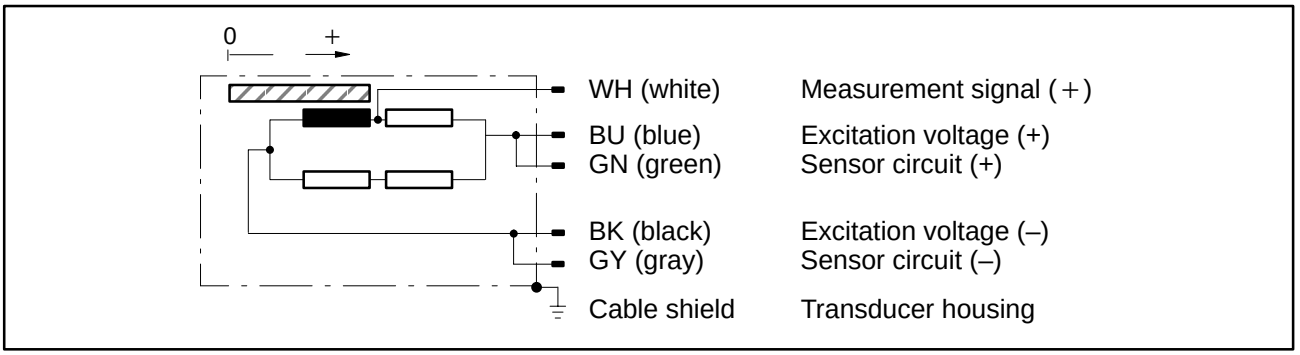


Fig. 2.7: General electrical wiring-diagram, half bridge with 80mV/V

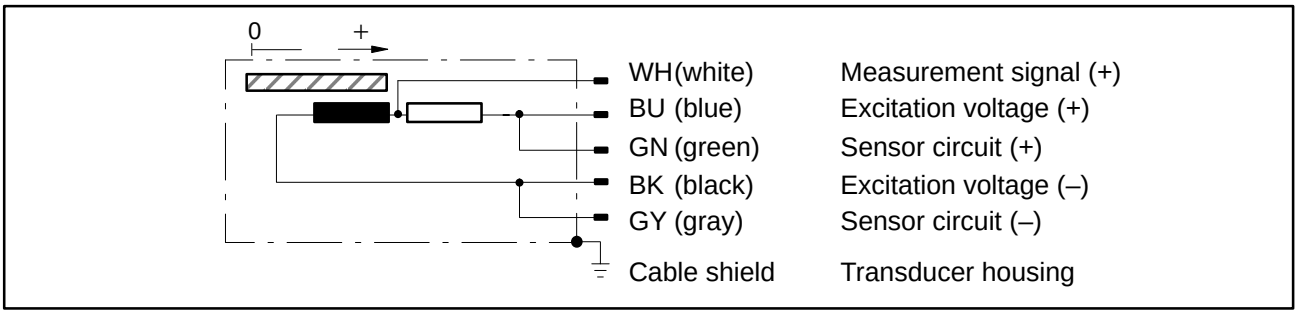


Fig. 2.8: General electrical wiring-diagram, half bridge with 10mV/V (optional)

For information on using other transducer connection types, refer to the operating manual for the chosen amplifier (connection diagram WA, see types of connection).

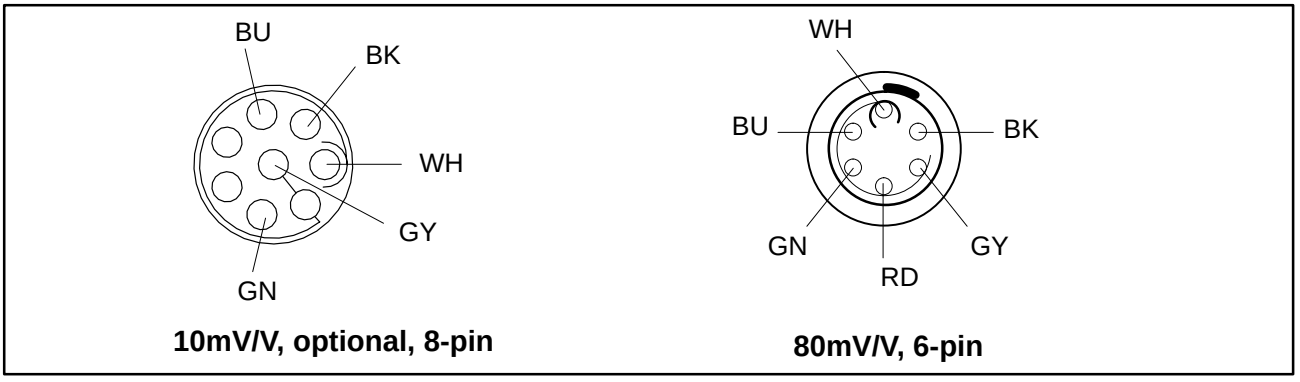


Fig. 2.9: Lemosa connector pin assignment (solder side of male cable connector)

3 Balancing

3.1 Zero balance

Plunger (WA/...–L)

The plunger has a threaded piece for connecting it to the measurement object.

- Insert the plunger into the transducer as far as the first marking ring (the projecting part of the plunger corresponds to size C, see page 18 “Dimensions”).
- for the WA2: push in the core until the 0 (±1mV/V) display
- for WA electronics: push in the core until the output voltage is 0.5V

CAUTION

The transducer and plunger must not be transposed.

The transducer and plunger are arranged by Ident. No. to prevent transposition. Plungers and coil systems that have not been balanced with one another can give rise to measurement errors in excess of 1%.

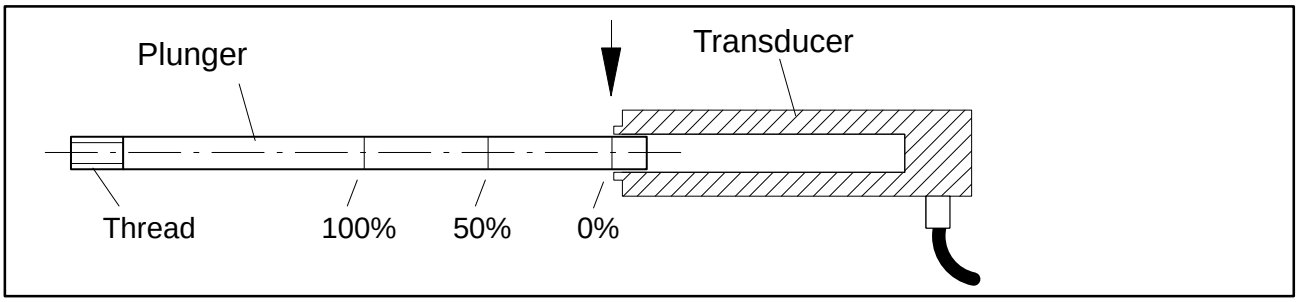


Fig.3.1: Plunger with markings (zero balance)

Probe (WA/...–T)

The mechanical zero position of the displacement probe (size E, see page 18 ”Dimensions”) is derived for neutral position with probe tip extended. With *WA electronics* , the output voltage here is 0.5 ±0.05V.
Movement of the probe tip in the measurement direction by an initial stroke of up to 0.5mm has no effect on the technical data of the displacement probe.
Having chosen the position, any output signal still present should be reset to zero on the amplifier.
Initial stroke for the WA2 probe until 0±1mV/V is reached on the amplifier.
Initial stroke for *WA electronics* until 0.5±0.05 V is reached on the amplifier.

3.2 Calibration

3.2.1 Coarse adjustment using marking rings on the plunger

By using the marking rings on the plunger, you can calibrate at an accuracy of ±1mm (not to be recommended for measurement **“längen”** ≤10mm). The nominal displacement is derived by inserting the plunger as far as the last marking ring (100%) before the plunger thread (the projecting part of the plunger corresponds to size C minus size A, see ”Dimensions” on page 18).

With the plunger in this position, the output signal from the displacement transducer (nominal sensitivity 80mV/V ±1%) has to be assigned to a display or to an output signal from the amplifier.

With WA electronics the output signal of the displacement transducer in this end position is 10V ±0.05V.

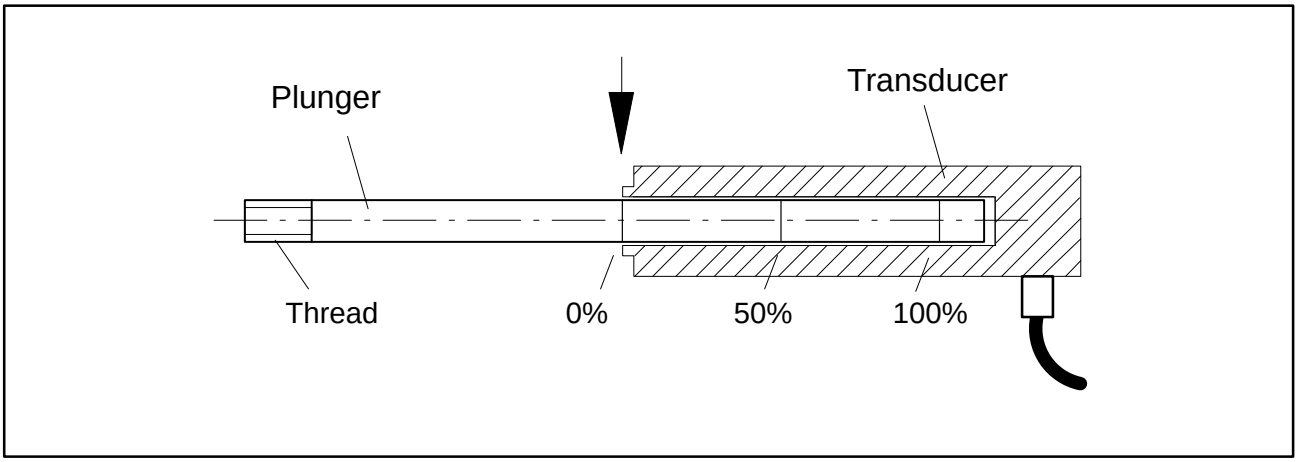


Fig.3.2: Plunger with markings (sensitivity balancing)

3.2.2 Direct calibration

If a high degree of precision is required, we recommend direct calibration using gauge blocks with dimensions corresponding to the displacement, movement or change in length that you wish to measure. Use commercially available gauge blocks or templates for this purpose.

This ensures that the effect on tolerances of zero point, sensitivity, cable effects and amplifier sensitivity are compensated. This calibration must take the whole measurement chain into account.

For instance, when the position of the probe tip or plunger corresponds to the gauge block, the output signal from the displacement transducer (nominal sensitivity 80mV/V ±1%) has to be assigned to a display or to an output signal from the amplifier.

3.2.3 Calibration with input of characteristics

The sensitivity of WA transducers using 80mV/V has a characteristic tolerance of ±1% and can be input directly when using the conveniently designed amplifiers in the MGCplus, MVD2555 or PME series.

NOTE

Please ensure that the sensitivity at an excitation voltage of 2.5V_{rms} has been ascertained.

4 Hydraulic version

4.1 Instructions for mounting a piston

1. Bore out the piston from the cylinder.
2. Screw the plunger into the piston head and secure it with a lock-nut or adhesive.

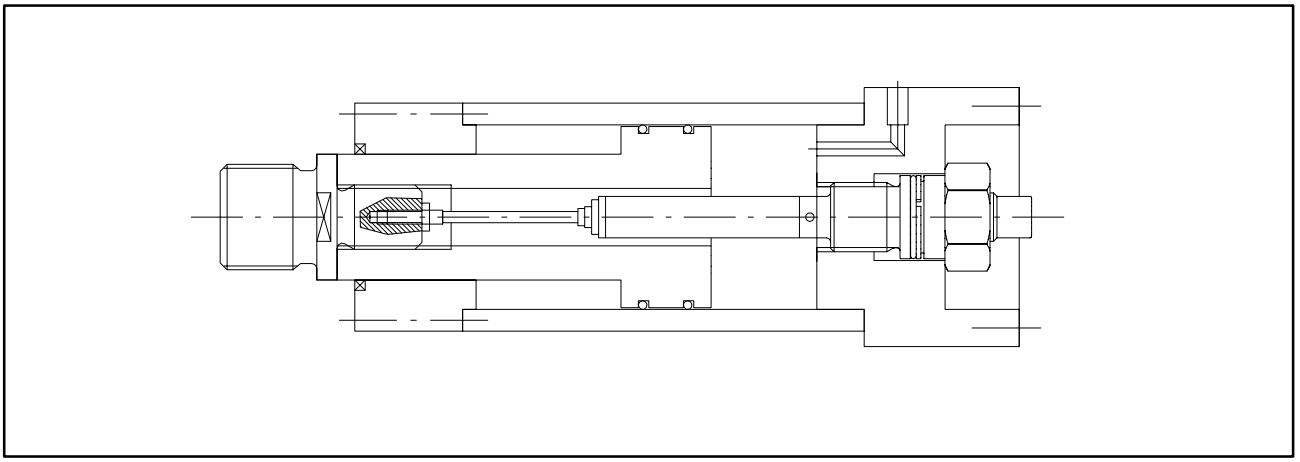


Fig. 4.1: Piston (typical mounting)

4.2 Commissioning with HBM amplifiers

1. Draw out the transducer or the core until the zero position of the displacement transducer is reached (see dimension G, Page 18; differing for the WA2: ±1mV/V)
2. Carry out a zero balance.
3. Insert the transducer or the core until the nominal displacement of the transducer is reached
4. Balance the output signal to nominal displacement.

More notes on commissioning can be found in the appropriate operating manual for the selected amplifier.

5 Dynamic measurements

5.1 Frequency and acceleration limits

The measurement frequency range of the measurement chain has to be determined electrically from the upper cut-off frequency of the amplifier. You can find the appropriate data in the operating manual for your amplifier.

Maximum permissible acceleration has a decisive effect on the mechanical characteristics of the displacement transducer. This information can be found in the appendix to the Technical Data.

In the case of displacement probes, care must be taken that the probe pin does not withdraw from the measurement object due to inertia.

To a first approximation, many tasks may generally be regarded as sinusoidal. For maximum permitted acceleration a_{max} with given displacement amplitude s the mechanical cut-off frequency f_{max} is:

$$f_{zul} = \frac{1}{2\pi} \cdot \sqrt{\left(\frac{a_{zul}}{s}\right)}$$

6 Interference effects

Carrier frequency transmission is in principle highly insensitive to electrical interference. Even so, high-intensity interference can falsify measurements.

Interference can be injected into a measuring circuit from a source which is:

– electromagnetic,

– inductive

– galvanic

– mechanical.

Interference is most commonly caused by:

– high-power transmission lines running parallel to the measurement circuit,

– a nearby protection relay,

– electric motors,

– potential differences in the earth system or polyphase earthing of the measurement chain,

– potential differences caused by capacitive influences

– vibration,

– with amplifiers, you must connect zero operating voltage to the protection circuit (terminals).

6.1 Shielding design

The Greenline HBM shielding design ensures that the entire measurement chain is completely enclosed in a Faraday cage, due to the special way the cable shield is arranged (see also reprint G36.35.0, Greenline shielding design).

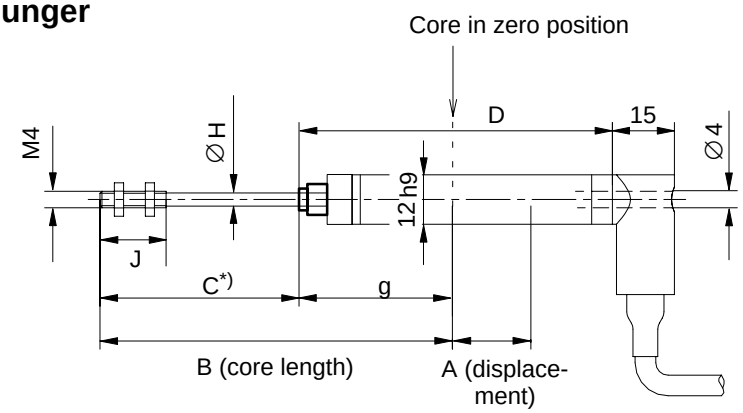
6.2 Signal ground

All devices – transducers, amplifiers and display devices – are located on an earth potential (if necessary wire to a potential equalization line). If this is not possible, the transducer should be fitted earth-isolated.

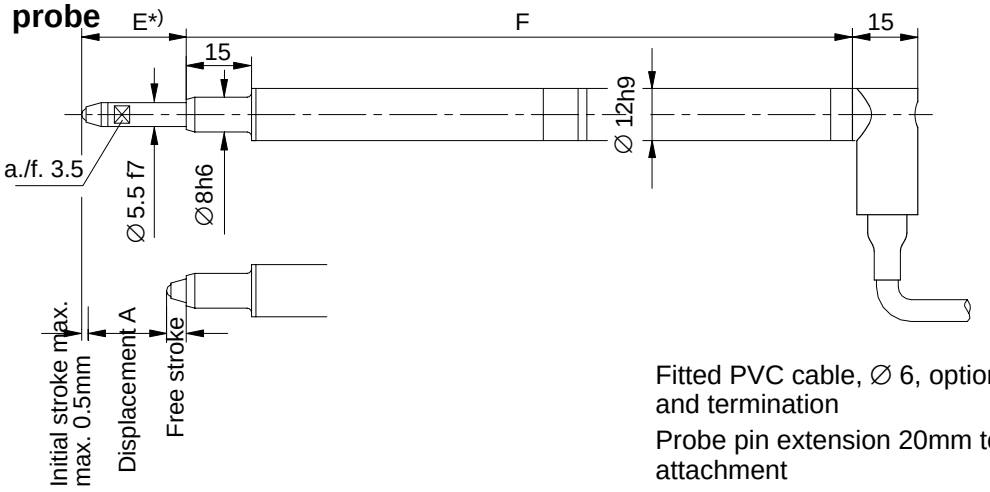
7 Dimensions

Dimensional variation to DIN 7168-coarse

Plunger



**Displace-
ment
probe**



Fitted PVC cable, ∅ 6, optional length and termination

Probe pin extension 20mm to optional attachment

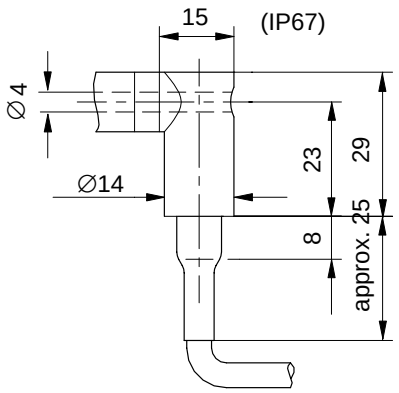
Initial stroke for the WA2 probe until 0 ± 1mV/V is reached at the amplifier

*) in zero position (plunger, displacement probe extended)

	Plunger							Displacement probe		
Measuring range	**A**	**B**	**C**	**D**	**g**	**∅H**	**J**	**A**	**E**	**F**
0...2mm	2	75.5	40	69	35.5	1.2	15	2	14	130
0...10mm	10	66	40	69	26 ± 0.5	3.7	16	10	14	130
0...20mm	20	87	55	84	32 ± 0.5	3.7	16	20	24	170
0...50mm	50	117	85	114	32 ± 0.5	3.7	16	50	54	230
0...100mm	100	180	134	181.6	46 ± 10	3.7	16	100	104	372.6
0...200mm	200	280	234	281.6	46 ± 10	3.7	16			
0...300mm	300	380	334	381.6	46 ± 10	3.7	16			
0...500mm	500	580	534	581.6	46 ± 10	3.7	16			

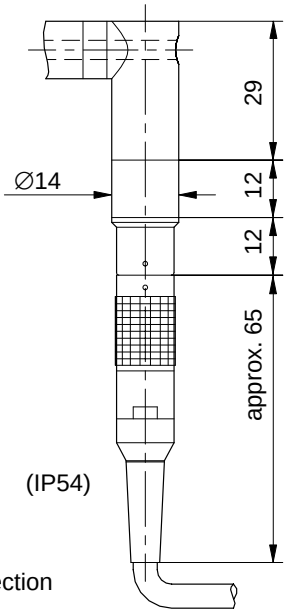
8 Types of connection (mechanical)

Standard version



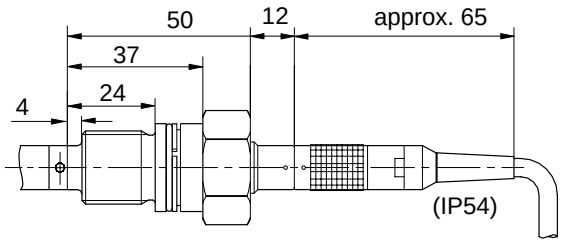
Type of connection **32K**

Optional versions

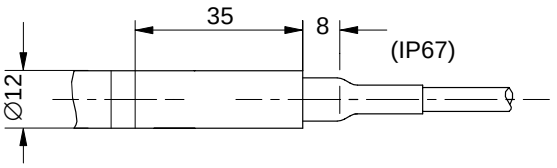


Type of connection **32S**

Optional version, pressure-resistant for hydraulic cylinders



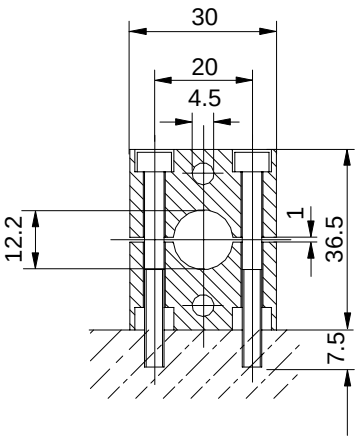
Type of connection **31S**



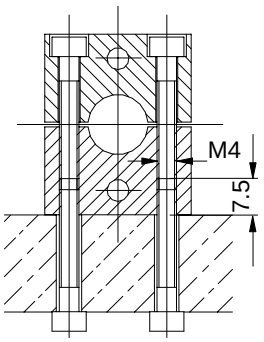
Type of connection **33K**

9 Mounting set

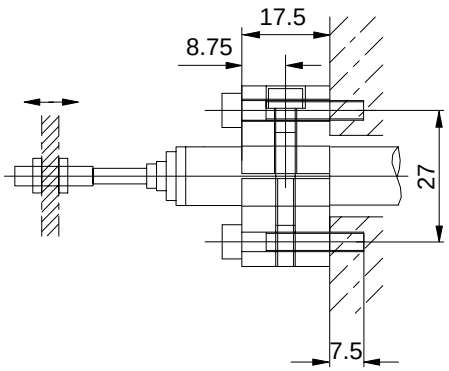
1. Fitting suggestion



2. Fitting suggestion



3. Fitting suggestion

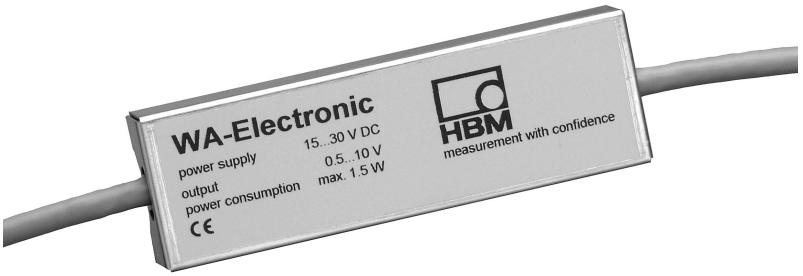


WS/ZB12

2 mounting blocks with countersink Km4 DIN 74
1 mounting block with thread M4
4 fillister-head screws M4x25, DIN 912
2 fillister-head screws M4x40, DIN 912
1 hexagonal-head bolt spanner a.f. 3

Operating temperature range from
–40°C ... +80°C

10 Dimensions WA electronics



Length: 102mm
Width: 32mm
Depth: 13,5mm

11 Specifications

Type		WA2	WA10	WA20	WA50	WA100	WA200	WA300	WA500
Nominal displacement	mm	0...2	0...10	0...20	0...50	0...100	0...200	0...300	0...500
Nominal sensitivity Nominal output signal at nominal displacement with output unloaded	mV/V	80							
Characteristic tolerance Deviation of sensitivity from nominal sensitivity	%	±1							
Zero point tolerance with core in zero position	mV/V	±1	±8						
Linearity deviation Greatest deviation between start and end point (including hysteresis by reference to nominal sensitivity)	%	≤ ±0.2 or ≤ ±0.1							
Nominal temperature range	°C	−20...+80							
Operating temperature range Standard Variant for high temp.	°C °C	−30...+80 –40...+150							
Effect of temperature on zero signal in nominal temperature range per 10K, by reference to nominal sensitivity	%	< ±0.1							
Effect of temperature on output signal in nominal temperature range per 10K, by reference to actual value	%	< ±0.1							
Input resistance	Ω	100 ± 10%	350 ± 10%						
Output resistance	Ω	570 ± 10%	680 ± 10%						

Type		WA2	WA10	WA20	WA50	WA100	WA200	WA300	WA500
Nominal excitation voltage	V_{rms}	2.5							
Operating range of the excitation voltage	V_{rms}	0.5...10							
Carrier frequency,									
Nominal range	kHz	4.8 ± 1%							
Operating range	kHz	4.8 ± 8%							
Weight									
of transducer body	g	54	56	57	68	104	147	190	276
of plunger	g	4	6	7	9	13	20	28	42
Surface materials	–	rust-resistant							
Impact resistance, test severity level to DIN IEC68, Part 2-27; IEC 68-2-27-1987									
Number of impacts (per direction)	–	1000							
Impact acceleration	m/s^2	650							
Impact duration	ms	3							
Impact form	–	Half sine wave							
Vibration resistance, test severity level to DIN IEC 68, Part 2-6, IEC 68-2–6-1982									
Frequency range	Hz	5 to 65							
Vibration acceleration	m/s^2	150							
Stress duration (per direction)	h	0.5							
Max. number of stress cycles		10 million					–		
Spring constant	N/mm	0.116				0.063	–		
Spring force in zero position (for 1mm initial stroke) approx.	N	2.4				2	–		
Spring force in final position (=nominal displacement) approx.	N	2.7	3.6	4.7	8.2	8.3	–		
Max. permissible probe tip acceleration approx.	m/s^2	170		140	95	45	–		
Max. permissible plunger acceleration	m/s^2	2500							
Probe tip cut-off frequency for 1mm stroke approx.	Hz	60		55	45	30	–		

Type		WA2	WA10	WA20	WA50	WA100	WA200	WA300	WA500
Probe tip cut-off frequency at nominal displacement approx.	Hz	18		10	5	3	–		
Degree of protection acc. to EN 60 529 for transducer duct and core channel	–	IP67 (depending on connection piece)							
Max. permissible pressure (increasing load)	bar	350							
Overload limit (to VDI/VDE 2600, Sheet 4)	bar	450							
Destructive range (to VDI/VDE 2600, Sheet 4)	bar	> 500							

11.1 Specifications WA electronics

Type		WA 10	WA 20	WA 50	WA 100	WA 200	WA 300	WA 500
Nominal displacement	mm	10	20	50	100	200	300	500
Nominal output span	V	9.5 (0.5...10)						
Output span tolerance	%	0.5						
Linearity deviation Greatest deviation between start and end point (including hysteresis by reference to nominal sensitivity)	%	± 0.2						
Nominal temperature range	°C	–20...+60						
Operating temperature range	°C	–20...+70						
Effect of temperature on zero signal in nominal temperature range per 10K, by reference to nominal sensitivity	%	≤ ± 0.2; typically < ± 0.15						
Effect of temperature on output signal in nominal temperature range per 10K, by reference to actual value	%	≤ ± 0.15; typically < ± 0.1						
Supply voltage	V	15...30						
Dependence on supply voltage, typically	%	0.03						
Burden in the output	kΩ	≥ 10						
Current consumption	mA	45 (typically 26)						
Power yield max.	W	1.5						
Cut-off frequency	Hz	520 filter 4th order, Butterworth						
Dimensions of the electronics module	mm	102 x 32 x 13.5						
Cable length betw. transducer and electronics	m	3...20						
Cable length betw. electronics and evaluator	m	3...50						

12 Replacement parts, accessories

- PVC cable as cable type S1, 3m, with Lemosa connector (2–9268.0675 for 80mV/V / 2–9268.0580 for 10mV/V)
- PVC cable as cable type S2, length as required (max. 300m, 2–9268.0676 for 80mV/V / max. 20m, 2-9268.0588 for 10mV/V)
- PTFE cable as cable type S3, 3m; with Lemosa connector (2–9268.0766 for 80mV/V; 2–9268.0768 for 10mV/V)
- PTFE cable as cable type S4, length as required; max. 20m (2–9268.0767 for 80mV/V; 2–9268.0769 for 10mV/V)
- Lemosa connector, detachable (6-pin, 3-3312.0126 for 80mV/V / 8-pin, 3-3312.0139 for 10mV/V)
- Lemosa jack, detachable (6-pin, 3-3312.0235 for 80mV/V / 8-pin, 3-3312.0140 for 10mV/V)
- Measurement insert with carbide ball (3-6061.0003)
- Mounting set WS/ZB12

13 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: ***098/09.1997***

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

Induktiver Wegaufnehmer der Typenreihe WA

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).

Darmstadt, 15.09.1997

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Seite 2 zu	Page 2 of	Page 2 du
	Document: ***098/09.1997***	

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:

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

QV1051A1.03

Notes on the CE mark

In addition to the information specified in this Operating Manual, the following points must be observed when commissioning the transducer:

- Transducers with unterminated cables are to be fitted with connectors to CE standard. In this event the shielding must be laid evenly over the whole area. If a different connection technique is used for the same transducers (such as to amplifiers) then a good EMC shield is to be provided in the wiring loom, the shielding again being laid over the full area.

- In the case of a Series K-WA with the 31L type of connection, the connecting section of the stranded wires must be shielded in accordance with CE requirements.

- In the case of a Series K-WA with 31S or 32S types of connection in linearity class 0.1%, the linearity deviation of 0.1% may be exceeded under the influence of electromagnetic fields.

Modifications reserved.
All details describe our products in general form only.They are not to be understood as express warranty and do not constitute any liability whatsoever.

Hottinger Baldwin Messtechnik GmbH

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