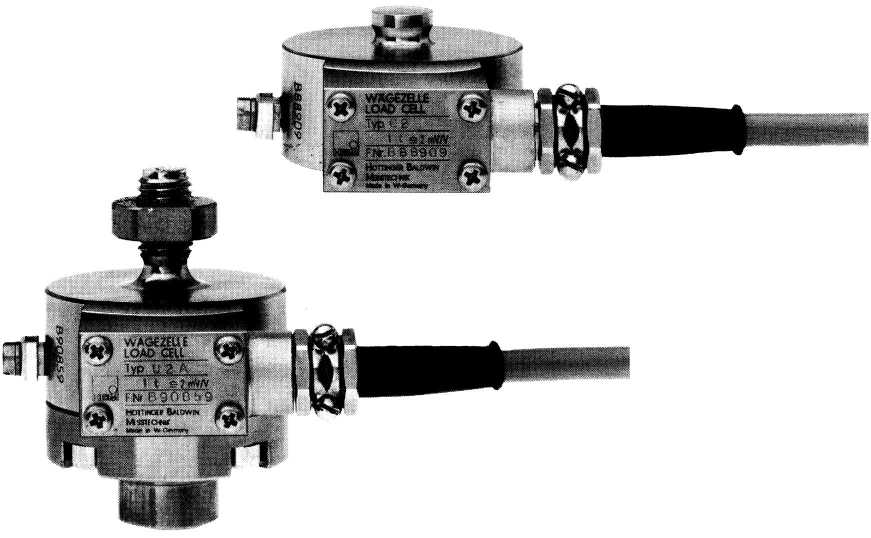
HOTTINGER BALDWIN MESSTECHNIK

HBM

Electrical measurement of mechanical quantities

Mounting instructions



Load cells with strain gauge measuring system

U2A, C2

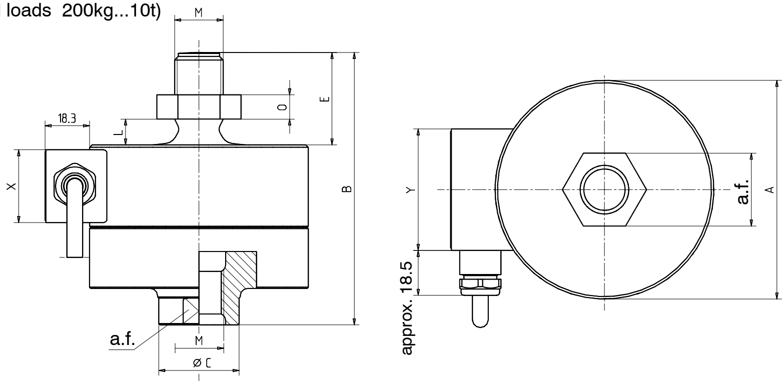
Information sheet for Mounting instructions "Load cells with strain gauge measuring system U2A, C2"

Information

⚠ Attention: Change in dimensions

U2A Dimensions (in mm; 1mm=0.03937 inches)

U2A (Nominal loads 200kg...10t)

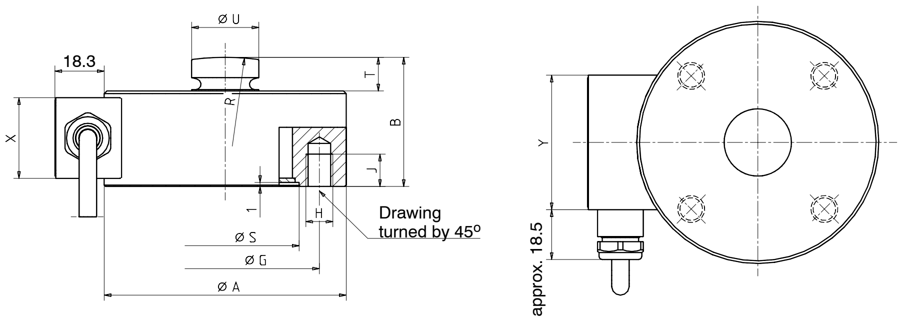


Nom. load in t	$A_{-0.2}$	B	C	E	L_{min}	M	O	a.f.	X	Y
0.2...1	50	72	21	24	5*)	M12	6	19	20	35
2	90	112	33	38	10.6	M20x1.5	10	30	30	50
5	100	141	40	47	13.2	M24x2	12	36	30	50
10	135	197	68	67	19	M39x2	19	60	30	50

*) with U2A/1t: 7.4mm

C2 Dimensions (in mm; 1mm=0.03937 inches)

C2 (Nominal loads 50kg...50t)



Nom. load in t	$\varnothing A_{-0,2}$	B	∅G	H	J	R	$\varnothing S^{H8}$	T	∅U	X	Y
0.05...1	50	30	42	4xM5	7	60	34	7	13	20	35
2 a. 5	90	48	70	4xM10	12	100	55	12.5	25	30	50
10 a. 20	115	60	90	4xM12	16	160	68	12.5	32	30	50
50	155	90	125	4xM16	20	300	97	15.5	44	30	50

Contents

Important Note:

The load cells and force transducers in the U2A, C2 range can be used as machine components (e.g. with container weighing).

Please note in these cases that, in order to provide a high sensitivity, the transducer is not designed with a safety factor (1..20) which is normally applied in machine design.

In particular please take account of the following details given in Chapter 8:
- max. loading limits
- max. longitudinal forces
- max. transverse forces

The technical data on the tansducer is valid only within the permissible loading limits specified in Chapter 8 (Technical Data).

Where a fracture may involve damage to property and injuries to persons, appropriate safety measures (e.g. support against collapse, overload protection) must be taken by the user. Observe the relevant accident prevention regulations. In this respect see Chapter 5, ”Mechanical Installation”.

The electronic system processing the measurement signal should be designed such that no consequential damage occurs as the result of failure of the measurement signal.

1. Introduction

The load cell is approved for use with commercial and course weighing machines ≤ 600 d.
The only difference between load cells and force transducers is the nature of their measurement quantity, according to the intended application in each case:
- Load cells measure loads in the units of weight g, kg or t.
- Force transducers measure forces in the units of force mN, N, kN or MN.

The series discussed in this operating manual are quoted by HBM in the catalogue as load cells, as they are used in particularly large numbers in weighing. They are also obtainable on request as force transducers. The Operating Manual covers both versions.

The local gravitational acceleration in Darmstadt, g = 9.81029 m/s^2, is the basis for calibration of the HBM load cells. The following relationships are applicable for the conversion from kilograms to Newtons and vice versa:

1 N ≙ 0.102 kg
1 kg ≙ 9.81 N

2. Field of application and notes on use

Transducers of the series U 2 A measure tension as well as compression loads in the axial direction and are suitable for dynamic measurements.

Transducers of the series C 2 are intended only for the measurement of compression loads.

Depending on the intended application, the transducers are calibrated as load cells in units of weight, or as force transducers in units of force. The type rating plate indicates the units in which the transducer is calibrated.

HBM load cells and force transducers will sense dynamic loads as exactly as static loads and forces. A special advantage in that respect is their high natural frequency and the low nominal deflection.

Force transducers and load cells made by HBM require no maintenance and may be mounted in places with difficult access. Their electrical measurement outputs can be transmitted to distant control panels or control buildings for display, recording or control purposes.

The force transducers and load cells are precision measuring instruments and must be handled with care. Special attention should be given to this during transport and installation. Impacts, and even simply dropping them, can permanently damage the transducers. Because of the high spring rate of the transducers, sudden loads (e.g. ”free fall” loading) can also lead to unexpected overloading during measurement, with permanent damage. Where such sudden loads cannot be excluded with certainty, they must be suitably absorbed.

One should be most careful to maintain the accurate sealing of the housing, for the protection of the delicate strain gauge application. This mainly applies to the bottom of the housing which is only very thin.

The limits for the permissible mechanical, thermal and electrical stresses are shown in the Technical Data. It is imperative to comply with these. Please take this into account early in the planning stage for the measuring arrangement, during installation and finally during service.

The transducers are completely manufactured from stainlass steel, including the rating plate, etc. Thus theses force transducers and load cells are very suitable for use under aggressive media like e.g. gases or sea water, or in the food industry.

For use in potentially explosive atmospheres the load cells and force transducers are available in ”flameproof enclosure” type of protection and for ”intrinsic safety” [(Ex) i].

3. Structure and mode of operation

3.1 Measuring element

The element is a measuring spring made from stainless steel with 8 strain gauges applied to it. The measuring element at the same time is the upper part of the transducer housing (Fig. 3.1 and 3.2). The strain gauges are arranged in such a way that four of them sense positive strain and the other four negative strain if the spring element is loaded in the measurement direction. Fig. 3.3 shows the strain gauge bridge circuit with all necessary correction and compensation resistors. The latter are used to suppress unwanted influences on the zero output, the sensitivity and the characteristic.

3.2 Housing

The bottom side of the housing which is also the measuring spring, is sealed by a welded thin lid. U 2 A transducers have a threaded bolt on the spring element for the introduction of the load or force (Fig. 3.1). At the lower end of the housing there is a removable adaptor piece for the force introduction by means of knuckle eyes (see 9.2). C 2 transducers have a spherical load button without a thread (Fig. 3.2).

3.3 Measuring procedure, output signal

The force acting in the direction of measurement flexibly deforms the measuring element and hence the strain gauges. The strain gauges vary their ohmic resistance in proportion to their change in length. The Wheatstone bridge is thus detuned. When a bridge excitation voltage is applied, the circuit supplies an output signal proportional to the change in resistance and hence also proportional to the force applied.

An electronic follow-up unit (e.g. amplifier) which is part of a complete measuring system is required for further processing of the measuring signal (see Chapter 4).

3.4 Interference and compensation

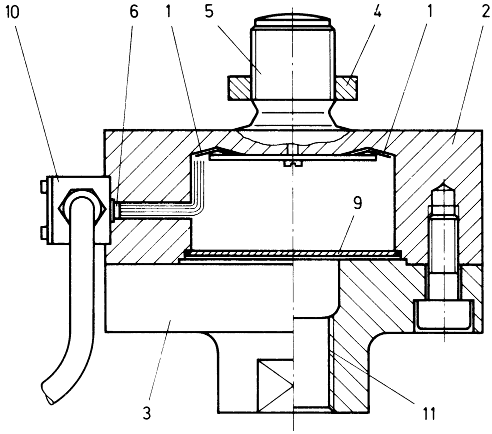
Torsion, bending and sideloads are adverse influences and must be avoided. For that purpose HBM mounting accessories (section 5.3) are available.

Temperature effects on the zero balance (strain gauge bridge and housing) and sensitivity (modulus of elasticity of the spring material) are compensated.

Changes of the ambient pressure act like additional (positive or negative) loads. However, these will be hardly noticeable in the cases of larger nominal loads.

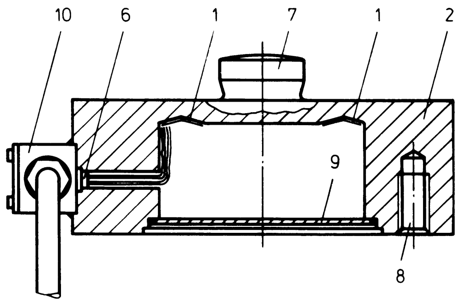
Mechanical schematic diagram

Fig. 3.1: U 2 A



1 = Strain gauges;
2 = Housing measuring spring;
3 = Removable adaptor;
4 = Locking nut;
5 = Threaded bolt for load introduction;
6 = Glass to metal feed through;
7 = Load button;
8 = Set boring;
9 = Welded lid;
10 = Cable box;
11 = Female thread.

Fig. 3.2: C 2



4. Conditions at the site of installation

4.1 Ambient temperature

To achieve optimum measuring results, the nominal temperature range must be respected. Constant or, if necessary, slowly changing temperatures are the best. The temperature coefficients indicated are applicable, in accordance with the VDI/VDE Recommendation 2637, when the temperatures change no faster than 5 K/h. Temperature gradients in the transducer caused by heating (radiant heat) or cooling on one side lead to severe interference. A radiation screen and thermal insulation on all sides give considerable improvements. Naturally, they must not produce any force shunts.

4.2 Humidity

As expected from the classification of protection, humidity and tropical climates do not affect the transducer's operation (DIN 40040, code letter for exposure to humidity: R for IP67 and DIN 40040, code letter for exposure to humidity: A for IP68).

Note: Humidity should not ingress into the free end of the cable.

4.3 Ambient pressure

The ambient pressure for transducers may be between 0 and 5 bar. Please note that pressure changes may shift the zero output signal.

Nominal load	kg t	50	100	200	500	1	2	5	10	20
Change of zero point [% / 10 mbar]		0.141	0.071	0.035	0.014	0.007	0.010	0.005	0.004	0.003

4.4 Chemical influences

The housing of the transducer is made from stainless steel. It is suitable for operation in aggressive atmospheres.

4.5 Deposits

Care should be taken not to allow accumulation of dust, dirt or other particles which would bypass a certain part of the measuring force into the housing and thereby deteriorate the measured value by force shunt.

4.6 Explosion proof models

The weighing cell models U 2-E (100 kg . . . 20 t, for tension load) and C 2-E (100 kg . . . 50 t, for compression load) with flameproof enclosure in explosion proof version (Ex) d 3n G5 can be used in potentially explosive atmospheres of zones 1 and 2 according to VDE 0171. The U 2-E and C 2-E can only be supplied in the IP 67 class of protection.

The transducers conform to the constructional requirements of DIN 50020/VDI/VDE 0170/0171, category "ib", explosion group IIc, temperature class T6. The testing of the transducer to 500 V is depicted by the symbol.

The technical data and the dimensions are the same as for the standard version.

5. Mechanical installation

5.1 Important precautions during mounting

- Handle the transducer carefully.
- Load application surfaces on the transducer as well as on the mounting accessories must be absolutely clean and have proper seating.
- Do not overload the transducers, not even fleetingly, e.g. by unevenly distributed loads.
- Most important, if there are more than three transducers (statically indeterminate bearing) bring the force input points to the same height. For central loading, the output signals of all transducers should be approximately equal.
- Each transducer should be shunted by a stranded copper cable (approx. 50 mm^2) during or immediately after installation. For this purpose, HBM supplies very flexible earthing cable EEK in lengths of 0.4 m, 0.6 m and 0.8 m. The cable is secured above and below the transducer (for example with screws M 10). This prevents any welding or lightning currents flowing through the transducer and welding together the force introduction point.

5.2 General guide lines for installation

Mounting accessories are supplied by HBM for the transducers of series U 2 A in the form of knuckle eyes, for force transducers and load cells of series C 2 in the form of ball bearing supports and pendle bearings as detailed in section 9.2. These mounting accessories avoid that torsional and bending moments as well as side and slanted loads are introduced into the transducer.

The loads on the load cell (forces on the force transducer) must act as closely as possible in the direction of measurement. Torsional and bending moments, offcentre loads and transverse loading or lateral forces are interference variables, that is, causes of errors in measurement, and if the permitted limits are exceeded they can damage the transducer. Transverse loading and lateral forces also include the relevant components of any measurement quantities which are introduced obliquely.

The effects of wind, acceleration, conveyor belt friction etc. perpendicular to the transducer axis must be absorbed by suitable supports. These can be for example counter-guide links or guide rollers, which at the same time stabilise the structure and secure the weighing container or similar laterally, or limit its mobility. The supports must no absorb any load or force components in the measuring direction, that is, act as a shunt.

Thermal expansions between a number of bearing points, when the transducers are rigidly installed, can cause transverse stressing. This can be avoided by using mounting accessories from HBM (see section 9.2).

5.3 Mounting for tension loads

The transducer has a threaded bolt at the upper side of the housing and on the adaptor piece a female thread for the introduction of tension loads.

The knuckle eyes can be used for quasistatic loads (load cycle ≦ 10 Hz). Flexible tensile bars should be used for dynamic loads with higher frequency.

One can remove the adaptor (3) after unscrewing the screws (5). It will then be possible to mount the transducer upside down (Fig. 5.2). In that case the seating surface for the transducer must be absolutely even and smooth. The screws (5) (minimum Quality A 2-70) shall be tightened with the torque M_A (5) specified in the table next page.

The screwed connections on the threaded bolt and the female thread shall be suitably prestressed for the measurement of dynamic forces. This is achieved on the unloaded transducer at the fastening torque M_A (4). All fastening torque values are listed in the table below for all U 2 A types. Exceeding of these torque values by max. 10 % is permitted but no torque should be applied to the transducer body.

5.4 Mounting for tension and compression loads

The transducers are designed to measure axial loads both in tension and compression mode. They are suitable for alternating loads. For this purpose the transducer must be mounted without play in axial direction.

For permanent dynamic loads it is necessary to prestress the connecting threads by means of counter nuts above the load maximum. This is best achieved by adjusting the nuts under nominal tension load. By countering directly at the threaded holes of the transducer the wrench torque is kept off the measuring element.

5.5 Mounting for compression loads

On the C 2 transducer which is a special transducer for compression forces the load button is without the thread. Mounting the transducer with pendle bearing support EPO 3 or with multiple ball bearing support EVK will protect the transducer against side load effects. If no pendle bearing assembly EPO 3 is used, one should envisage pressure plates which have to be hardened (HR_C 41 . . . 45) and grounded even and which should be sufficiently rigid and fluck.

Fig. 5.1
Standard mounting of the U 2 A

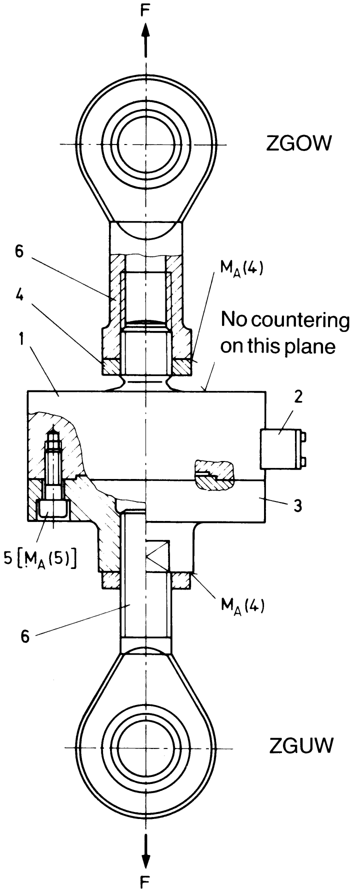
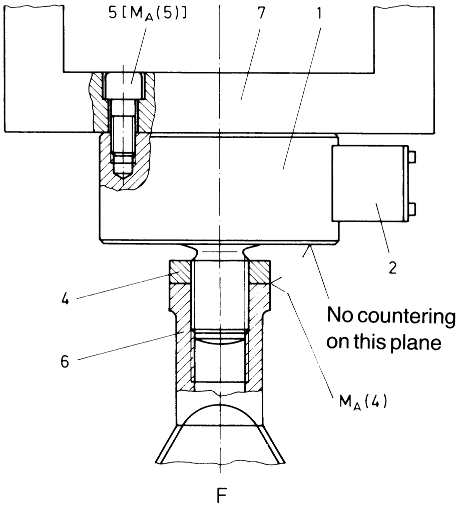


Fig. 5.2
Upside down mounting of the U 2 A



1 = transducer
2 = cable box
3 = adaptor
4 = countering nut
5 = mounting screws
6 = knuckle eye
7 = mounting plate

U 2 A with nominal load	Weight approx.	fastening torque values M_A (4)	M_A (5)
50 kg to 1 t	0.8 kg	60 Nm	5 Nm
2 t	2.9 kg	300 Nm	35 Nm
5 t	4.3 kg	500 Nm	60 Nm
10 t	10.7 kg	2500 Nm	60 Nm
20 t	15.9 kg	4500 Nm	150 Nm

The self-aligning pendle bearing ZPL permits an inclination of max. 3° related to the transducer axis. With side loads a restoring force will occur which tries to return the system to its initial position. The Pendle bearing is self-lateral stay rods which could lead to force shunts are not required. Lateral stops should only be provided for safety reasons if high side forces do occur.

6. Measurement equipment

A complete measuring system is required in order be able to take measurements using the transducer. This system consists of:

- transducer
- amplifier
- wiring cable
- recording device (optional)

An amplifier is required to provide the transducer with the bridge excitation voltage and to amplify the measurement signal. Both carrier frequency and DC amplifiers can be used.

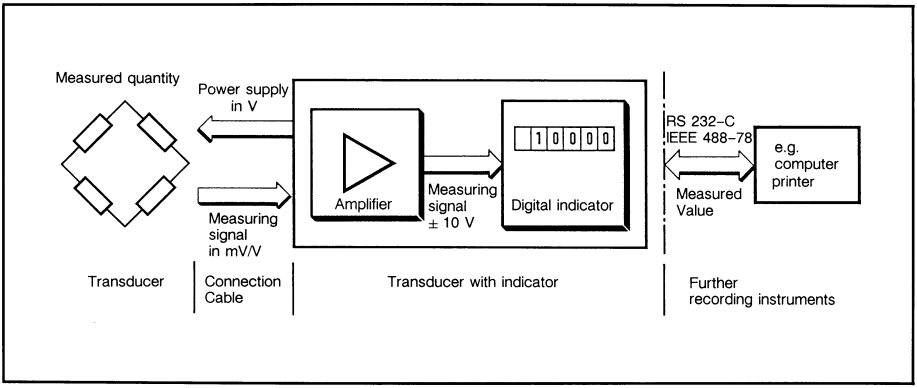


Fig. 6.1: Basic diagram of a measuring system

7. Electrical connection

7.1 Notes on wiring

Electrical and magnetic fields often cause the introduction of disturbing voltages into the measuring circuit. These disturbances are chiefly caused by heavy current conductors installed parallel to the measuring lines, but they can also be produced by contactors or electric motors in the vicinity. Also interference voltages can be occur along the electrical path, in particular through earthing the measuring system at a number of points, causing differences in potential.

Please note following hints:

- Use only screened, low capacitance measuring cable (cable from HBM fullfills these requirements).
- Do not lay the measuring cable parallel to power and control lines. If this is not possible (e.g. in cable ducts), the measuring cable can be protected, e.g. by steel conduit and a minimum distance of 50 cm is maintained to the other cables. Power cables and control lines should be of the twisted type (15 twists per meter).
- The stray fields of transformers, motors and contactors must be avoided.
- Do not wire the transducer, amplifier and display device to multiple earths. All equipment in the measuring system should be connected to the same earth conducter.
- Connect the screens of the cables to the operating voltage zero on the amplifier – not to the earth of the housing.

7.2 Allocation of the cable cores

The connection lead of the transducer has colour-coded free core ends. You can connect transducers with soldering or terminal type connections directly. For transducers with connection sockets, you must first solder a plug onto the cable. The allocation of connections for HBM amlifiers is given in the following table:

The cable screen (yel) should not be connected to the transducer ground, but must be connected to the operating voltage zero (contact 12, E) on the measuring amplifier.

		Electronic unit with	
Core colour	Function	Terminal or soldered connection	7-terminal connection plug
2' Grey (GY)	Sensing conductor	16	G
2 Black (BK)	Bridge excitation voltage	21	B
3 Blue (BU)	Bridge excitation voltage	20	C
3' Green (GN)	Sensing conductor	17	F
1 White (WH)	Measuring signal	22	A
4 Red (RD)	Measuring signal	19	D
5 Yellow (YE)	Cable screen	12	E

If the transducer is connected according to the information given in the table, the output voltage from the amplifier is positive for a compression load on the transducer.

7.3 Methods of connection

The transducers are equipped with a six-core connection cable. This is a prerequisite for operating the measuring system in the six-wire mode, which alone can ensure the greatest accuracy of measurement.

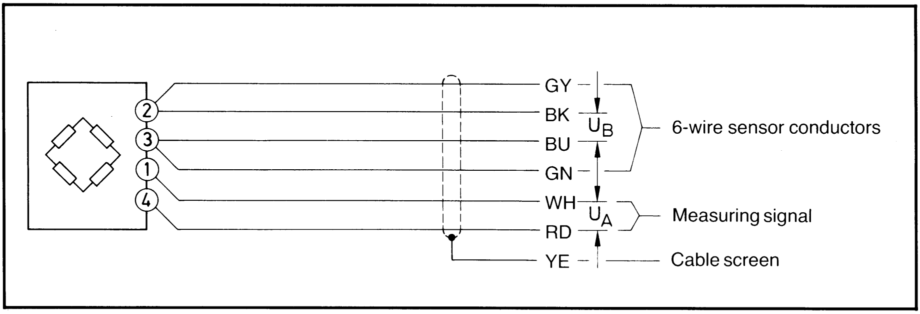


Fig. 7.1: Transducer with six-core cable

Six-wire technique

The extra cores (green and greay) in addition to the traditional four-wire connection pick up the actual value of the bridge excitation voltage at the transducer and feed it back to a suitable electronic measuring unit. The electronic unit now regulates the excitation voltage so that the value adjusted is available at the transducer free from losses. Any changes is resistance of the cable caused by the effects of temperature are thus constantly eliminated, even during measurement. A cable extension is possible without any problems.

Four-wire technique

The transducers are calibrated at the factory so that when the bridge exitation voltage is applied and the nominal load is present, the nominal output signal (nominal sensitivity) is available at the end of the cable. The cable is thus included in the calibration. If the length of the cable changes, this leads to changes in sensitivity. The effects of temperature on the cable are not compensated.

For many requirements in metrology, the four-wire technique is entirely sufficient today. Not all measuring amplifiers are yet suitable for the six-wire technique.

Identification of the transducers:

Transducer calibrated in the six-wire technique:	Yellow cable sleeve' The letter "K" is stamped into the type plate
Transducer calibrated in the four-wire technique:	Black cable sleeve Grey-black and blue-green cable cores are soldered together.

Connect the transducer using the technique for which it was calibrated at the factory.

Connecting a four-wire transducer by the six-wire technique and vice versa leads to changes in sensitivity and the effect of temperature on sensitivity.

7.4 Transducer connected in the four-wire technique

The sensor conductors for six-wire operation are soldered together with the conductors for the bridge excitation voltage. Do not separate the blue-green and black-grey conductors which have been soldered together. Also, do not shorten the cable.

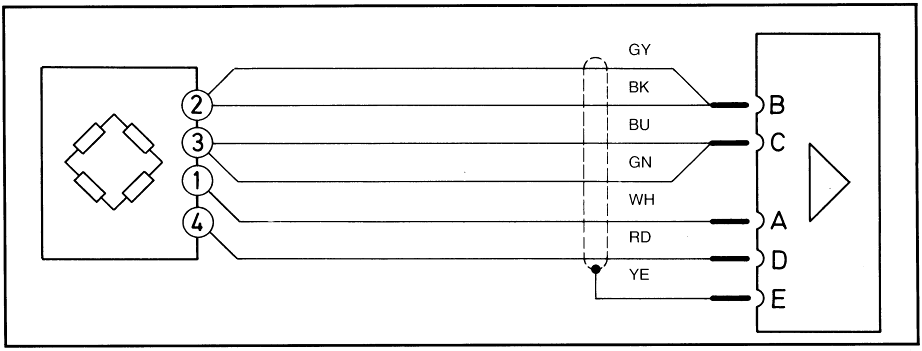


Fig. 7.2: Transducer using the four-wire technique, amplifier using the four-wire technique

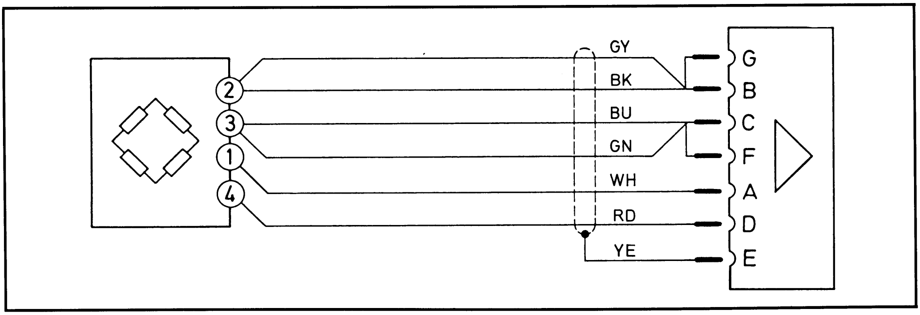


Fig. 7.3: Transducer using four-wire technique, amplifier using six-wire technique

7.5 Connection in the six-core technique

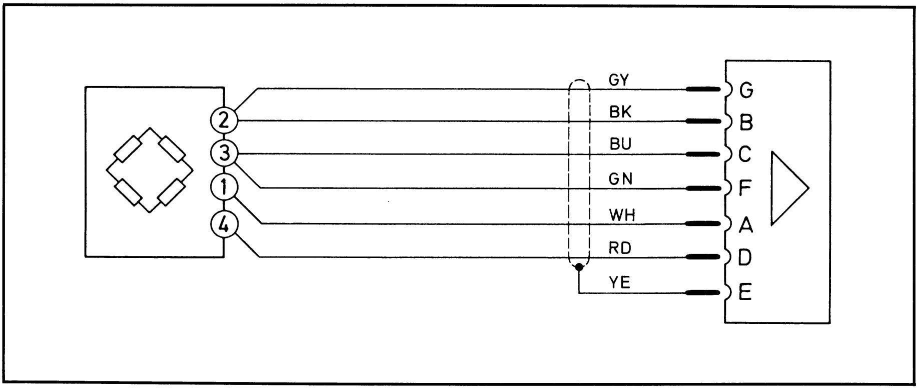


Fig. 7.4: Transducer using six-wire technique, amplifier using six-wire technique

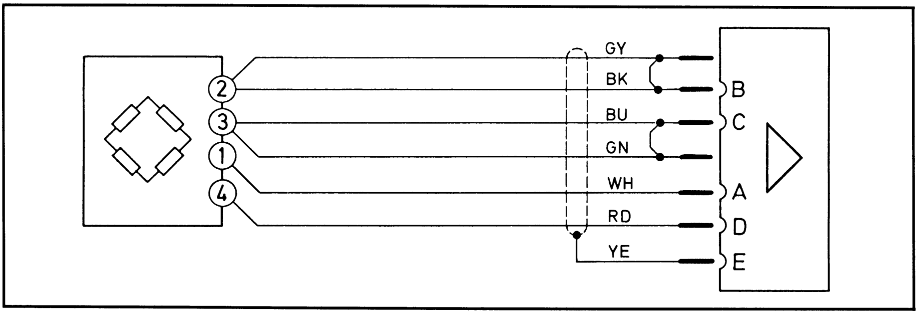


Fig. 7.5: Transducer using six-wire technique, amplifier using four-wire technique

When connecting to the amplifier using the four-wire technique, join together the blue and green cores, and the black and grey cores. The following deviations from the sensitivity and temperature coefficient of the sensitivity occur:

Weighing cell/Force transducer	U2A, C2
Sensitivity	– 0.066 %
TK_C	– 0.00257 %/10 K

7.6 Cable extension

Extension cables must be screened and of the low capacitance type. We recommend the use of HBM cables which fulfil these requirements.

For cable extensions, care must be taken to ensure a satisfactory connection with the lowest possible transfer resistance and good insulation. The plug connectors from HBM fulfil these requirements. If special humidity protection required, the KVM cable connection sleeves, for example, (connections soldered and potted) or the VKK cable connection box (screwed connection in a cast housing) can be used.

If the transducer has already been equipped with a long cable at the factory, this is included in the calibration.

When placing the order you can also state whether, when compensating for the effects of temperature on sensitivity, the same temperature should be assumed for the transducer, the entire cable or only part of it.

With long cables the effects of the temperature dependence of the resistance should be compensated. The six-wire circuit should therefore be used and this is possible with a number of HBM amplifiers.

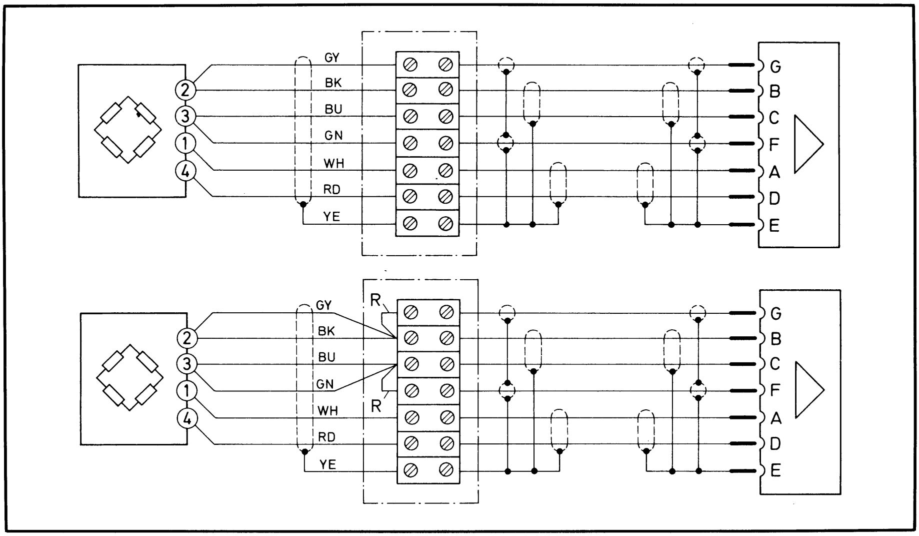


Fig. 7.6: Connection in Six-core (Four-core) technique with extension

The complete measurement system should be recalibrated if a four-core cable is extended and connected to a measuring amplifier. The effects of temperature on the extension cable are not compensated.

Attention: The effects of temperature are balanced out only for the extension cable, not for the standard cable.
The standard cable should be loosely wound round the transducer so that it is subject as far as possible to the same temperature.

7.7 Parallel connection of more than one strain gauge transducers

If more than one tranducers with the same nominal load are connected in parallel, they can, if the load is evenly distributed, bear a total load corresponding to the sum of the individual nominal loads. The parallel connection of strain gauge transducers then gives the output signal 2 mV/V for loading with the total load.

An overload of individual load cells cannot be detected from the output signal. Therefore appropriate safety precautions should be taken (mechanical overload stops).

The transducers are connected in parallel electrically by joining together the core ends of the transducer connection cables having the same colour (figure 7.7). The VKK terminal boxes from the HBM range are suitable for this connection. The cables between the transducers and terminal boxes must be equal in length.

If you would like comprehensive information on the parallel connection of strain gauge transducers, we recommend the HBM special publication "Parallel connection of strain gauge transducers", which you can obtain from your HBM representative.

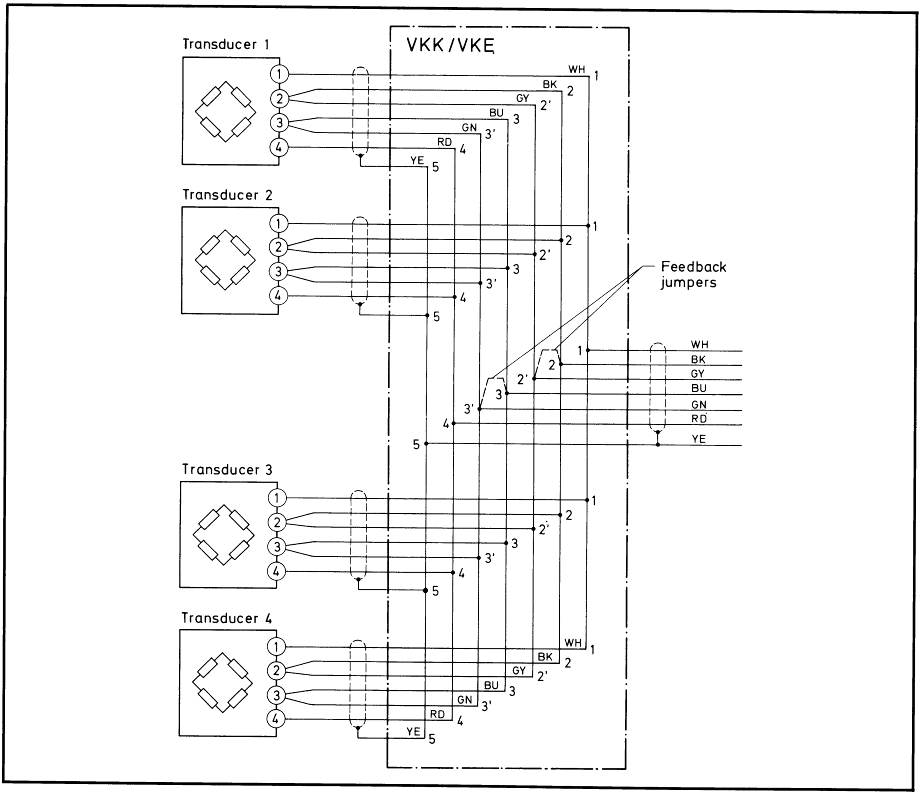


Fig. 7.7: Load cells wired in parallel

8. Electrical balancing of the measuring system

The amplifier is adjusted in accordance with the operating manual of the amplifier used, after connection of the transducer. Proceed as follows:

- Bridge excitation voltage ——————> for strain gauge transducers we recommend $U_B = 5$ V
- Measuring bridge ——————> strain gauge full bridge
- Carry out zero-point balancing
- Calibration

8.1 Zero balancing

By zero balancing, you ensure that when the transducer is not loaded the amplifier output signal is ZERO. In this way any signal that is present on the unloaded transducer (e.g. through the weight of the installation fittings) is electrically balanced.

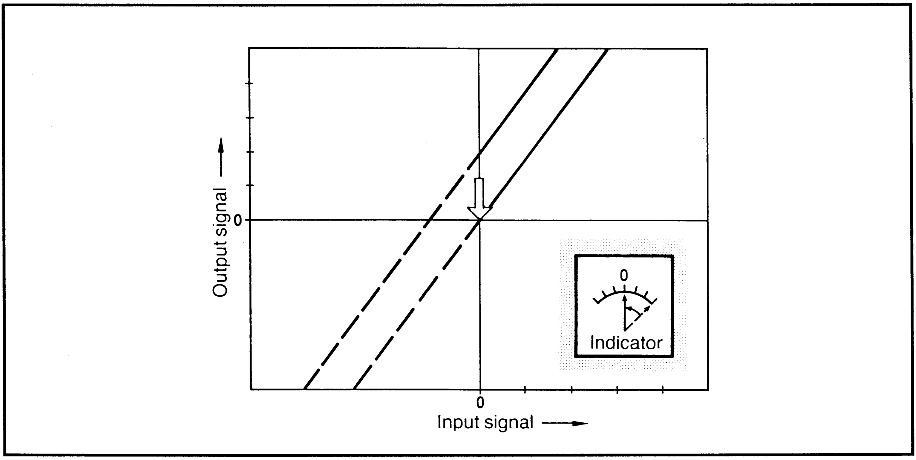


Fig. 8.1: Effect of adjusting the zero point

The zero balancing of the bridge is carried out with no load on the transducer. With carrier frequency amplifiers, zero balancing according to magnitude (R balance) and phase (C balance) is carried out. Please see the operating manual of the amplifier concerned for further information.

8.2 Calibration

By calibration, we mean the clear indication of the mechanical quantity to be measured from the electrical output signal of the electronic measuring unit.

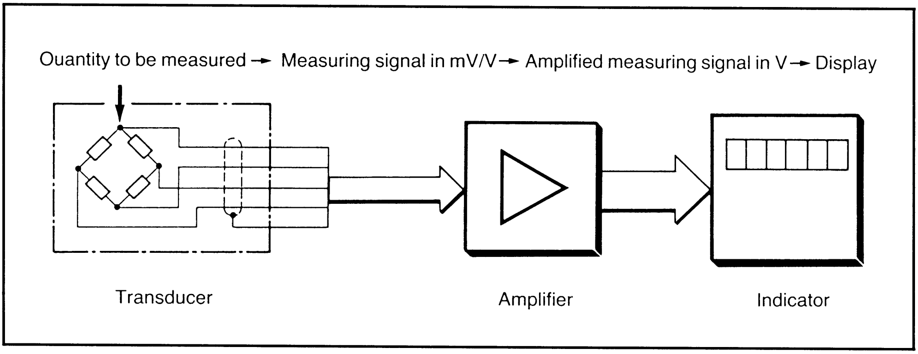


Fig.8.2: Signal flow diagram of a measuring system

The transducers are supplied with calibrated sensitivity, that is, the type plate indicates accurately what output signal arises at nominal load (maximum value of the measuring range). The standard cable (or on request an extension) is included in this value.

8.2.1 Amplifiers with permanently set measurement range

For amplifiers with a calibrated measuring range, the ratio of output signal to input signal is permanently preset. The mechanical quantity sought can be determined by calculation using this equation:

$$\frac{\text{Cal. measuring range (mV/V)}}{\text{Nominal sensitivity (mV/V)}} \cdot \frac{\text{Indicated Digits}}{\text{Full load indication (Digits)}} \cdot \text{Nom. load} = \text{mechanical quantity}$$

Example:

Transducer: nominal load 500 kg
nominal sensitivity 2,00 mV/V

Amplifier: measurement range 2 mV/V
With digit display including adjustable matching*

The nominal output signal of the transducer is 10 V, that is, an input signal of 2 mV/V is amplified to 10 V.

If the indicator at the amplifier displays 6800 Digits, for example, the mechanical quality is calculated as follows:

$$\frac{2\ \text{mV/V}}{2.00\ \text{mV/V}} \cdot \frac{6800\ \text{Digits}}{10000\ \text{Digits}} \cdot 500\ \text{kg} = 340\ \text{kg}$$

* see cap. 8.2.3

8.2.2 Amplifier with adjustable measuring range

With amplifiers with adjustable measuring range the ratio of the output to the input voltage can be separately set. To do this, the following is required:

1. application of a defined signal to the amplifier input.
2. adjustment of the amplifier output voltage with its measuring range adjustment ("MEASURING range fine") to the desired value (changing the gain).

The ratio of the voltages at the amplifier can be represented by a characteristic. Figure 8.4 shows as an example two characteristics when the gain is adjusted differently.

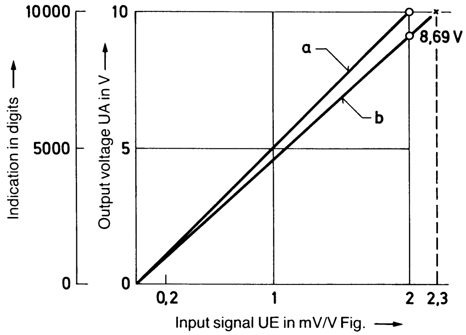


Fig. 8.3: Amplifier characteristics with different gain

Depending on the measurement task, the accuracy requirements and the justifiable expenditure, you can produce a defined input signal by:

- **direct mechanical loading**
- **a calibration signal within the amplifier**
- **a calibration unit**

- **Calibration with the calibration signal inside the amplifier**

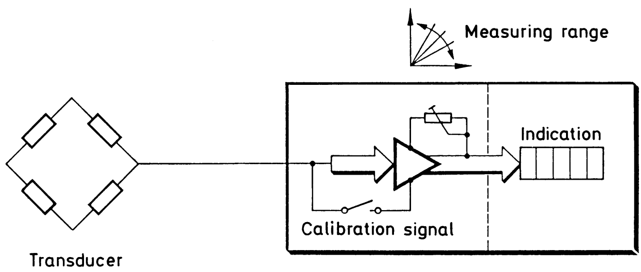


Fig. 8.4: Calibration with the calibration signal inside the amplifier

Many HBM amplifier have an internal calibration signal which is applied to the input of the amplifier in place of the measuring signal. You can set the required output signal with the amplifier's measurement range adjustment.

Advantage: Easy to apply and free from problems.

Disadvantage: The calibration does not include the entire measuring system. The components from the amplifier input to the transducer are not taken into consideration. In particular, when the measuring cables are long and there is a fourwire circuit, inaccuracies can be expected here.

Example:

Calibration with the calibration signal inside the amplifier. Direct reading indication with the correct decimal position (for digital indicators only).

- Transducer: nominal load 500 kg
  nominal sensitivity 2.0 mV/V
- Amplifier: With digital display including adjustable matching*
  internal calibration signal: 1mV/V

You would like the indicator to show the value 5000 when the transducer is fully loaded.

> Connect the Transducer

> Set the 'MEASURING range coarse' multiple-step switch to 2 mV/V

> Adjust the 'Indicator matching' selector switch to 5000

> Calculate the setting of the display for a 1 mV/V calibration signal

Indication = Calibration signal/Nominal sensitivity × desired indication

1 mV/V/2.0 mV/V × 5000 digits = 2500

> Call up the calibration signal, hold the button pressed and

Adjust the indication of 2500 with the **'MEASURING range fine'** adjustment

When loaded at the nominal load of 500 kg, the indicator now shows 5000, the value with the correct figures. If you can also select the position of the decimal point at the indicator, a display with the correct decimal position can also be obtained (250 for the calibration signal; 500 for nominal load).

* see cap. 8.2.3

- Calibration with a calibration unit

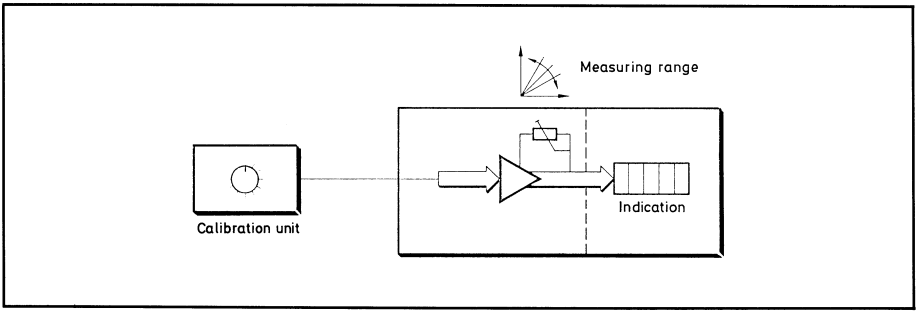


Fig. 8.5 Calibration with a calibration unit

A calibration unit is connected into the measuring system in place of the transducer. You can set different calibration signals in steps on the calibration unit, e.g. K3607. These signals are then present on the amplifier input.

Advantage: The complete measuring system is calibrated, because the cable is included in the calibration process.

Disadvantage: Calibration unit must have the same bridge resistance as the transducer

Example: Calibration with the calibration unit

The display should show a correctly formatted figure when the transducer is loaded with the nominal load.

- Transducer: nominal load 500 kg
  nominal sensitivity 2.0 mV/V
- Amplifier: With digital display including adjustable matching*
- Calibration unit: K 3607

> Adjust the **'MEASURING range coarse'** multiple step switch to 2 mV/V

> Adjust the 'Indicator matching' selector switch to 5000

> Adjust the calibration value at the calibration unit to 2.0 mV/V

> Adjust the output signal to 5000 Digits with **'MEASURING range fine'**

> Connect the transducer into the measuring system in place of the calibration unit

When loaded at the nominal load of 500 kg, the indicator now shows 5000, the value with the correct figures. If you can also select the position of the decimal point at the indicator, a display with the correct decimal position can also be obtained (250 for the calibration signal; 500 for nominal load).

* see cap. 8.2.3

● Calibration with direct mechanical load

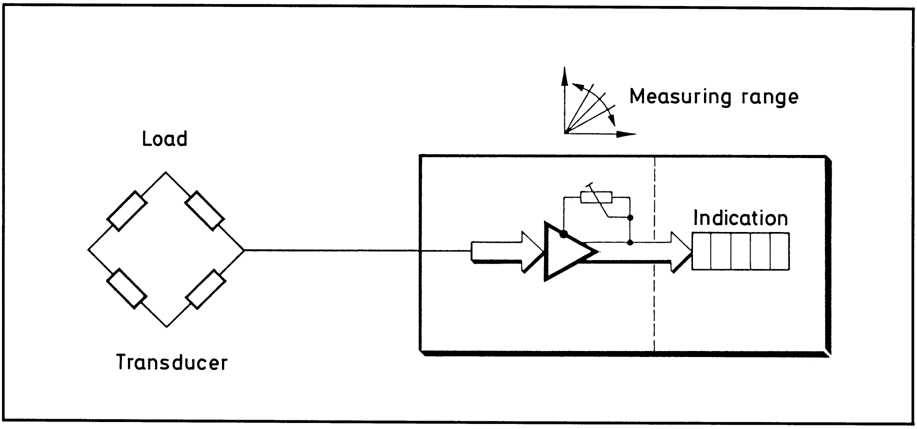


Fig.8.6: Calibration with direct mechanical loading

The amplifier is loaded with a defined mechanical load (e.g. with calibrated weights). You can than set the required measurement display with the measurement range adjustment on the amplifier.

Advantage: Most accurate method, because calibration is made using the accuracy of the calibrated weights; cable effects are taken into account.

Disadvantage: Often associated with disproportionately high expenditure.

Example: Calibration by direct mechanical loading of the transducer

- Transducer: nominal load 100 kg
  nominal sensitivity 2.0 mV/V
- Amplifier: With digital display including adjustable matching*

> Set the 'MEASURING range coarse' multiple-step switch to 2 mV/V

> Adjust the 'Indicator matching' selector switch to 10000

> Apply a known load to the transducer, ideally the nominal load.

> Set the display to the value of the applied load with MEASUREMENT range fine.

The display shows the correct significant figures. If you can also select the position of the decimal point at the indicator, a display with the correct decimal position can also be obtained.

* see cap. 8.2.3

8.2.3 Calibration with amplifiers without display matching

Please note the following when using an amplifier without a selector switch for display matching:

This item is no longer valid:

> Adjust the 'Indicator matching' selector switch to . . .

Without a selector switch you must set the required display with the switch, MEASUREMENT RANGE.

The sensitify is increased by reducing the measurement range is however restricted. Please take into account the range tolerances of your amplifier (see the technical description of the relevant amplifier plug-in module).

9. Technical Data

Series		U2A		C2	
Accuracy class		**0.2**	**0.1**	**0.2**	**0.1**
Nominal load	kg t	50	100; 200; 500; 1; 2; 5; 10; 20	50	100; 200; 500; 1; 2; 5; 10; 20; 50;
Sensitivity (output at nominal load)	mV/V	2		2	
Sensitivity tolerance (Calibration tolerance of the output signal at nominal load and g = 9.81029 m/s²)					
for tension	%	< ± 0.2	< ± 0.2	< ± 0.2	
for compression	%	< ± 1.5	< ± 0.5		
Temp. coefficient of sensitivity per 10 K					
in the nominal temperature range	%	< ± 0.1		< ± 0.1	
in the service temperature range	%	< ± 0.1		< ± 0.1	
Temp. coefficient of the zero point per 10 K					
in the nominal temperature range	%	< ± 0.05		< ± 0.05	
in the service temperature range	%	< ± 0.1		< ± 0.1	
Combined error for tension	%	< ± 0.2	< ± 0.1	< ± 0.2	< ± 0.1
Combined error for compression	%	< ± 0.2	< ± 0.1		
Variability (repeatability)	%	< ± 0.03		< ± 0.03	
Creep over 30 min. by nominal load and reference temperature	%	< ± 0.06		< ± 0.06	
Input resistance at reference temperature	Ω	350 ± 2		350 ± 2	
Output resistance at reference temperature	Ω	356 ± 0.2		356 ± 0.2	
Insulation resistance	GΩ	> 5		> 5	
Nominal range of supply voltage	V	0.5 ... 10	0.5 ... 12	0.5 ... 10	0.5 ... 12
Maximum supply voltage	V	12	18	12	18
Protection class (DIN 40050)		IP 67	IP 68	IP 67	IP 68
Reference temperature	°C	+ 23		+ 23	
Nominal temperature range	°C	− 10 ... + 70		− 10 ... + 70	
Service temperature range	°C	− 30 ... + 85	− 30 ... + 70	− 30 ... + 85	− 30 ... + 70
Storage temperature range	°C	− 50 ... + 85	− 50 ... + 70	− 50 ... + 85	− 50 ... + 70
Climatic application class (DIN 40040)		Rel. influence of humidity: R	Rel. influence of humidity: A	Rel. influence of humidity: R	Rel. influence of humidity: A

Mechanical Data

Nominal load	Service load	Limit load	Breaking load	Permissible dynamic loading* (Amplitude of oscillation DIN 50100)		Relative static limit transverse load at nominal load in %		Measuring displacement in mm		Natural frequency in kHz ± 15 %	
				U 2 A	C 2	U 2 A	C 2	U 2 A	C 2	U 2 A	C 2
50 kg	65 kg	65 kg	< 150 kg	50 kg	50 kg	25	50	< 0.1	<0.1	4	4.4
100 kg	150 kg	150 kg	< 300 kg	160 kg	100 kg	25	50	< 0.1	< 0.1	6	8.7
200 kg	300 kg	300 kg	< 600 kg	320 kg	200 kg	25	50	< 0.1	< 0.1	8.7	9.7
500 kg	750 kg	750 kg	< 1.5 t	800 kg	500 kg	25	50	< 0.1	< 0.1	14	18.5
1 t	1.5 t	1.5 t	< 3 t	1.6 t	1 t	25	50	< 0.1	< 0.1	17.5	19.3
2 t	3 t	3 t	< 6 t	3.2 t	2 t	25	50	< 0.07	< 0.06	8	13
5 t	7.5 t	7.5 t	< 15 t	5 t	5 t	25	50	< 0.07	< 0.06	8.5	14
10 t	15 t	15 t	< 30 t	16 t	10 t	25	50	< 0.09	< 0.06	6	13
20 t	30 t	30 t	< 60 t	32 t	20 t	25	50	< 0.09	< 0.06	5.6	14
50 t	75 t	75 t	< 150 t	–	50 t	–	50	–	< 0.1	–	10.5

* The max. load peak must not exceed the nominal load. U 2 A, permissible continuous fatigue rating; C 2, permissible continuous pulsating loading; sine-shaped load in each case.

Nominal load	Weight in kg	
	U 2 A	C 2
50 kg	0.8	0.4
100 kg	0.8	0.4
200 kg	0.8	0.4
500 kg	0.8	0.4
1 t	0.8	0.4
2 t	2.9	1.8
5 t	4.3	1.8
10 t	10.7	3.0
20 t	15.9	3.0
50 t	–	8.6

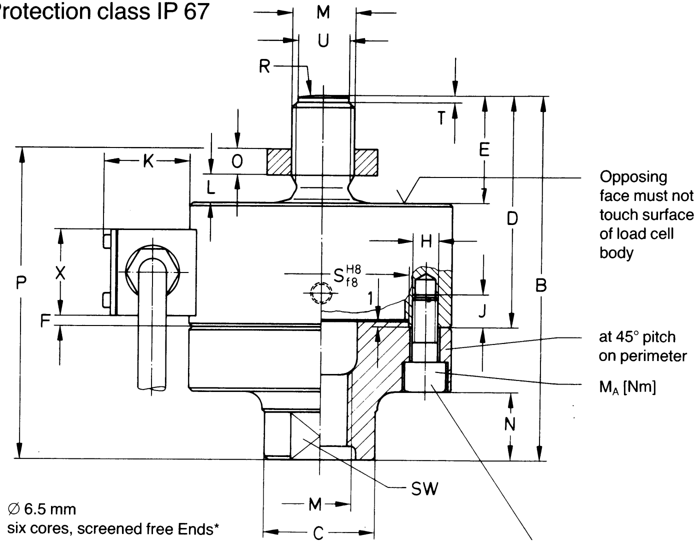
ATTENTION: CHANGE IN DIMENSIONS (see information sheet on page 2)

10. Dimensions (Dimensions with medium tolerance to DIN 7168)

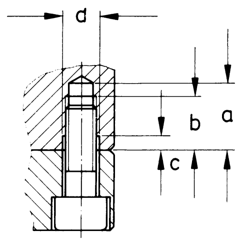
10.1 Transducer

U 2 A, U 2-E
for nominal loads from 50 kg to 20 t
(for nominal forces from 500 N to 200 kN)

Protection class IP 67



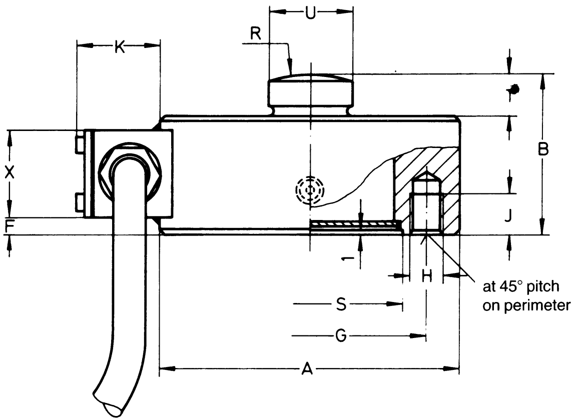
∅ 6.5 mm
six cores, screened free Ends*



only for
U 2 A / 50 kg – 1 t
and U 2 A / 2 t

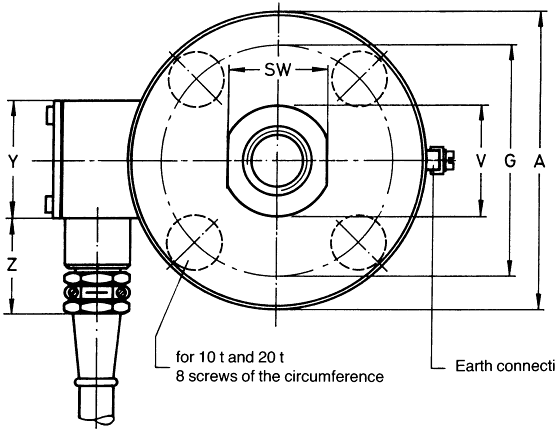
C 2, C 2-E
for nominal loads from 50 kg to 50 t
(for nominal forces from 500 N to 500 kN)

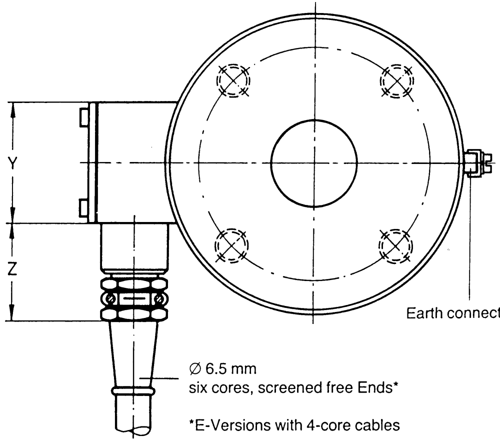
Protection class IP 67



	a	b	c	∅ d
50 kg — 1 t	15	12	4	5,5
2 t	20,5	16,5	4,5	11

ATTENTION: CHANGE IN DIMENSIONS (see Information sheet on page 2)





Type U2A	Dimensions in mm																								M_A [Nm]
	∅ $A_{-0.2}$	B	∅ C	D	E	F	∅ G	H	J	K	$L_{min.}$	M	N	O	P	R	∅ S	SW	T	∅ U	V	X	Y	Z	
50 kg – 1 t	50	72	21	47	24	2	42	4 x M5	6	22	5/7.4	M12	13	7	59.2/62.6*	60	34	19	1.6	9.5	22	20	32	26	5
2 t	90	112	33	72	38	5	70	4 x M10	12	25	10.6	M20 x 1.5	15	10	94.8	100	55	30	1.6	17	34	26	36	34	35
5 t	100	141	40	86	47	5	78	4 x M12	17	25	13.2	M24 x 2	19	12	119.2	100	61	36	2	20	40	26	36	34	60
10 t	135	197	68	122	67	10	105	8 x M12	16	26	19	M39 x 2	29	19	168	160	79	60	2	36	65	26	36	34	60
20 t	155	232	82	142	85	10	125	8 x M16	20	26.5	24.2	M48 x 2	32	22	193.2	160	97	70	2.2	43	82	26	36	34	150

*) nur bei U 2 A/1 t

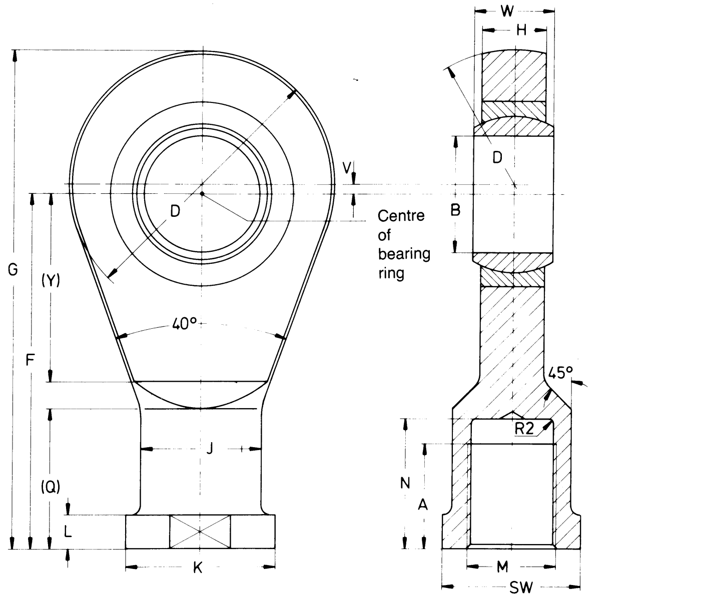
Type	Dimensions in mm												
	∅ $A_{-0.2}$	B	F	∅ G	H	J	K	R	∅ S	T	∅ U	X	Y	Z
C 2/50 kg . . . /1 t	50	30	2	42	4 x M5	6	25	60	34^{H8}	7	$13_{-0.1}$	20	32	25
C 2/2 t and 5 t	90	48	5	70	4 x M10	12	27	100	55^{H8}	12.5	$25_{-0.1}$	26	36	34
C 2/10 t and 20 t	115	60	10	90	4 x M12	16	27	160	68^{H8}	12.5	$32_{-0.1}$	26	36	34
C 2/50 t	155	90	10	125	4 x M16	20	28	300	97^{H8}	15.5	$44_{-0.1}$	26	36	34

10.2 Mounting accessories

Knuckle eyer for U 2 A

Knuckle eye ZGOW for above

for nominal loads from 50 kg to 20 t
(for nominal forces from 500 N to 200 kN)



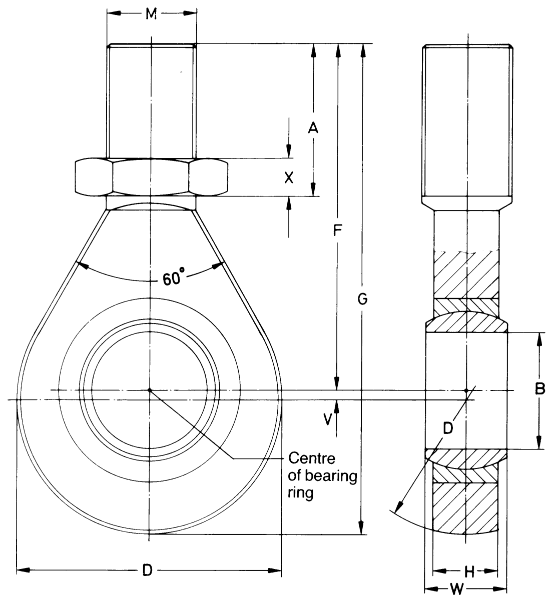
Attention: In cranes, or for the transport of suspended loads or in other uses where a breakage by overloading might lead to injuring persons it is not permitted to use knuckle eyes without **additional safeguard** against crashing!

Narrow tolerance according to DIN 7168 – medium

for transducers	Type	Weight (in kg)	Dimensions (mm) A	∅B	F	∅D	N	G	H	∅J	∅K	L	M	(Q)	SW	V	W	(Y)	Surface	Material
U 2 A/50 kg . . . t	U 2/1 t/ZGOW	0.2	22	12^{H7}	50	32	—	66	12	17.5	22	6.5	M 12	—	19	–	16	15	Zinc passivated to DIN 50961	25 Cr Mo 4
U 2 A/2 t	U 2/2 t/ZGOW	0.5	33	20^{H7}	77	50	—	102	18	27.5	34	10	M 20x1.5	—	32	–	25	24		25 Cr Mo 4
U 2 A/5 t	U 2/5 t/ZGOW	0.8	42	25^{H7}	94	60	—	124	22	33.5	42	12	M 24x2	—	36	–	31	29		25 Cr Mo 4
U 2 A/10 t	U 2/10 t/ZGOW	3.2	50	$50^{+0.002}_{-0.014}$	151	115	56	212.5	28	52	65	15	M 39x2	60	60	4	35	78		C 45 (heat treated)
U 2 A/20 t	U 2/20 t/ZGOW	4.8	60	$60^{+0.003}_{-0.018}$	167	126	66	235	36	65	82	15	M 48x2	77	70	5	44	72		C 45 (heat treated)

Knuckle eye ZGUW for below

for nominal loads from 50 kg to 20 t
(for nominal forces from 500 N to 200 kN)



Narrow tolerance according to DIN 7168 – medium

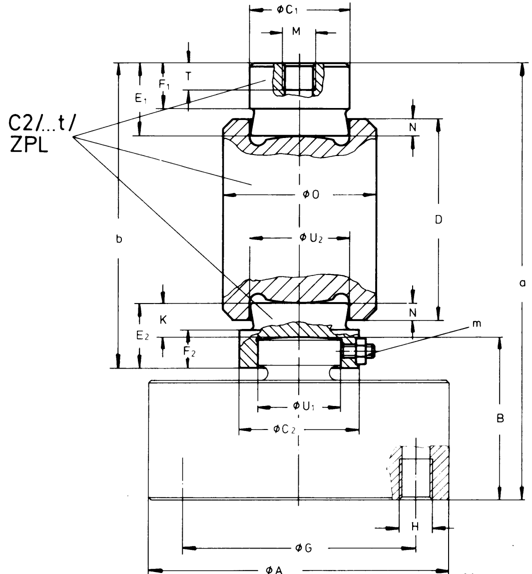
for transd. U 2 A	Type	Weight (in kg)	Dimensions (mm)										Surface	Material
			A	∅B	∅D	F	G	H	M	V	W	X		
50 kg . . . 1 t	U 2/1 t/ZGUW	0.1	33	12^{H7}	32	54	70	12	M 12	—	16	7	Zinc passivated to DIN 50 961	25 Cr Mo 4
2 t	U 2/2 t/ZGUW	0.2	47	20^{H7}	50	78	103	18	M 20 x 1.5	—	25	9		25 Cr Mo 4
5 t	U 2/5 t/ZGUW	0.4	57	25^{H7}	60	94	124	22	M 24 x 2	—	31	10		25 Cr Mo 4
10 t	U 2/10 t/ZGUW	1.1	65.5	$50^{+0.002}_{-0.014}$	115	148.5	210	28	M 39 x 2	4	35	16		C 45 (heat treated)
20 t	U 2/20 t/ZGUW	3.2	80	$60^{+0.003}_{-0.018}$	126	168	236	36	M 48 x 2	5	44	18		C 45 (heat treated)

Self-aligning pendle bearing

C 2/...t/ZPL
stainless steel

for nominal loads from 50 kg up to 50 t
(for nominal forces from 500 N up to 500 kN)

maximum inclination related
to the transducer axis 3°



Narrow tolerance according to DIN 7168 – medium

for transducers	Type	Weight (in kg)	Dimensions (mm) ∅A -0.2	B	∅C_1 -0.1	∅C_2	D	E_1	E_2	F_1	F_2	∅G	H	K	M	N	∅O	T	∅U -0.1	∅U_{2h9}^{D10}	a	b	Screw and countering nut m
C2/50 kg...1 t	C2/ 1 t/ZPL	0.7	50	30	20	22	45	17	13	9	6	42	M 5	8	M 8	5	30	6.5	13	20	90	65	M3
C2/2t	C2/ 2t/ZPL	0.9	90	48	30	36	60	22	19	14	11	70	M10	10	M10	5	46	8	25	30	130	91	M4
C2/5t	C2/ 5t/ZPL	1.5	90	48	41.1	36	73	26	19	16	11	70	M10	10	M10	5	46	8	25	30	147	108	M4
C2/10t	C2/10t/ZPL	2.7	115	60	50.8	46	82	32	22	21	12	90	M12	13	M12	6	56	10	32	• 40	175	124	M4
C2/20t	C2/20t/ZPL	3.5	115	60	50.8	46	102	32	22	21	12	90	M12	13	M12	6	56	10	32	40	195	144	M4
C2/50t	C2/50t/ZPL	6.1	155	90	65	58	141	45	31	32	20	125	M16	20	M16	8	75	14	44	52	280	201	M4

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