

Tension/compression force transducer

With thin film technology up to 100 kN

Models F2301, F23C1, F23S1



WIKA data sheet FO 51.17

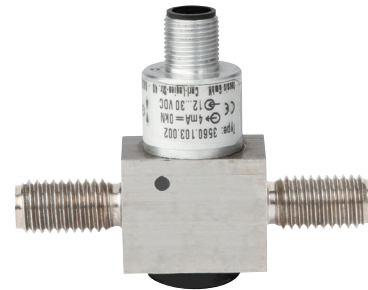


Applications

- Crane systems and hoists
- Industrial weighing technology
- Machine building and plant construction, manufacturing automation
- Theatre and stage construction
- Chemistry and petrochemistry

Special features

- Measuring ranges 0 ... 1 kN up to 0 ... 100 kN
- Corrosion-resistant stainless steel design
- Integrated amplifier
- High long-term stability, high shock and vibration resistance
- Good reproducibility, simple installation



Tension/compression force transducer
Models F2301, F23C1, F23S1

Description

Tension/compression force transducers are designed for static and dynamic measurement tasks in the direct flux of force. They determine the tension and compression forces in a wide scope of applications.

Tension/compression force transducers of this series are often used in hoist and crane systems, as well as for special machine constructions, in laboratories and stage systems. Appropriate technical and regional approvals are available as an option.

These force transducers are made of high-strength, corrosion resistant stainless steel 1.4542, which is particularly suitable for their application areas. The standard active current and voltage outputs are available as output signals (4 ... 20 mA/0 ... 10 V). Redundant output signals are possible.

These force transducers are part of our certified product ELMS1 overload protection (DIN EN ISO 13849-1 with PL d/Kat. 3 and DIN EN 62061 with SIL 2).

Technical data in accordance with VDI/VDE/DKD 2638

| Models | F2301 | F23S1 |
|--|--|--|
| Rated force F_{nom} kN | 1, 2, 3, 5, 10, 20, 30, 50, 100 | |
| Relative linearity error $d_{lin}^{1)}$ | $\pm 0.2 \% F_{nom}$ | |
| Relative reversibility error v | $< 0.1 \% F_{nom}$ | |
| Relative creep, 30 min. at F_{nom} | $0.1 \% F_{nom}$ | |
| Temperature effect on ■ characteristic value TK_C ■ zero signal TK_0 | $0.2 \% F_{nom}/10\text{ K}$ $0.2 \% F_{nom}/10\text{ K}$ | |
| Force limit F_L | $150 \% F_{nom}$ | |
| Breaking force F_B | $> 300 \% F_{nom}$ | |
| Permissible oscillation stress F_{rb} | $\pm 50 \% F_{nom}$ (in accordance with DIN 50100) | |
| Rated displacement (typ.) s_{nom} ■ $< 10\text{ kN}$ ■ $< 100\text{ kN}$ | $< 0.02\text{ mm}$ $< 0.2\text{ mm}$ | |
| Material of measuring device | Stainless steel corrosion-resistant, ultrasonically tested 3.1 material (optional 3.2) | |
| Rated temperature $B_{T, nom}$ | $-20 \dots +80\text{ }^\circ\text{C}$ | |
| Operating temperature $B_{T, G}$ | $-30 \dots +80\text{ }^\circ\text{C}$ (optional $-40 \dots +80\text{ }^\circ\text{C}$) | $-30 \dots +80\text{ }^\circ\text{C}$ |
| Storage temperature $B_{T, S}$ | $-40 \dots +85\text{ }^\circ\text{C}$ | |
| Electrical connection | Circular connector M 12x1, 4-pin, CANopen® 5-pin | 2-circular connector M 12x1, 4-pin |
| Output signal (rated output) C_{nom} | 4 ... 20 mA, 2-wire, 4 ... 20 mA, 3-wire or DC 0 ... 10 V, 3-wire (Optional redundant signal) CANopen® Protocol in accordance with CiA 301, device profile 404, communication services LSS (CiA 305), configuration of the instrument address and baud rate Sync/Async, Node/Lifeguarding, heartbeat; zero and span $\pm 10\text{ }%$ adjustable via entries in the object directory ²⁾ | Redundant, opposing 4 ... 20 mA/20 ... 4 mA versions in accordance with requirements for functional safety per 2006/42/EC Machinery Directive |
| Current consumption | Current output 4 ... 20 mA 2-wire: signal current Current output 4 ... 20 mA, 3-wire: $< 8\text{ mA}$ Voltage output: $< 8\text{ mA}$ CANopen®: $< 1\text{ W}$ | Current output 4 ... 20 mA: signal current |
| Supply voltage | DC 10 ... 30 V for current output DC 14 ... 30 V for voltage output DC 12 ... 30 V for CANopen® | DC 10 ... 30 V for current output |
| Burden | $\leq (UB-10\text{ V})/0.024\text{ A}$ for current output $> 10\text{ k}\Omega$ for voltage output | $\leq (UB-10\text{ V})/0.020\text{ A}$ (channel 1) for current output $\leq (UB-7\text{ V})/0.020\text{ A}$ (channel 2) for current output |
| Response time | $\leq 2\text{ ms}$ (within $10 \dots 90\text{ } \% F_{nom}$) ³⁾ | |
| Protection (acc. to EN/IEC 60529) | IP67 | |
| Electrical protection | Reverse voltage, overvoltage and short-circuit protection | |
| Vibration resistance (acc. to DIN EN 60068-2-6) | 20 g, 100 h, 50...150 Hz | |
| Noise emission | DIN EN 55011 | |
| Noise immunity | In accordance with DIN EN 61326-1/DIN EN 61326-2-3 (optional EMC-strengthened versions) | |
| Optional | Certificates, strength verifications, 3D-CAD files (STEP, IGES) on request | |

1) Relative linearity error acc. to VDI/VDE/DKD 2638 chap. 3.2.6.

2) Protocol acc. to CiA DS-301 V.402. Device profile DS-404 V. 1.2.

3) Other response times are available on request.

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| Models | F23C1 ATEX/IECEX EX ib 1) | F23C1 signal jump |
|--|---|---|
| Rated force F_{nom} kN | 1, 2, 3, 5, 10, 20, 30, 50, 100 | |
| Relative linearity error d_{lin} 2) | $\pm 0.2 \% F_{nom}$ | |
| Relative reversibility error v | $< 0.1 \% F_{nom}$ | |
| Relative creep, 30 min. at F_{nom} | $0.1 \% F_{nom}$ | |
| Temperature effect on ■ characteristic value TK_C ■ zero signal TK_0 | $0.2 \% F_{nom}/10\text{ K}$ $0.2 \% F_{nom}/10\text{ K}$ | |
| Force limit F_L | $150 \% F_{nom}$ | |
| Breaking force F_B | $> 300 \% F_{nom}$ | |
| Permissible oscillation stress F_{rb} | $\pm 50 \% F_{nom}$ (in accordance with DIN 50100) | |
| Rated displacement (typ.) s_{nom} ■ $< 10\text{ kN}$ ■ $< 100\text{ kN}$ | $< 0.02\text{ mm}$ $< 0.2\text{ mm}$ | |
| Material of measuring device | Stainless steel corrosion-resistant, ultrasonically tested 3.1 material (optional 3.2) | |
| Rated temperature $B_{T, nom}$ | $-20 \dots +80\text{ }^\circ\text{C}$ | |
| Operating temperature $B_{T, G}$ | Ex II 2G Ex ib IIC T4 Gb $-25\text{ }^\circ\text{C} < T_{amb} < +85\text{ }^\circ\text{C}$ Ex II 2G Ex ib IIC T3 Gb $-25\text{ }^\circ\text{C} < T_{amb} < +100\text{ }^\circ\text{C}$ Ex I M2 Ex ib I Mb $-25\text{ }^\circ\text{C} < T_{amb} < +85\text{ }^\circ\text{C}$ Ex II 2G Ex ib IIC T4 Gb $-40\text{ }^\circ\text{C} < T_{amb} < +85\text{ }^\circ\text{C}$ Ex I M2 Ex ib I Mb (for cable connection only) | $-30 \dots +80\text{ }^\circ\text{C}$ |
| Storage temperature $B_{T, S}$ | $-40 \dots +85\text{ }^\circ\text{C}$ | |
| Electrical connection | Circular connector M 12x1, 4-pin | |
| Output signal (rated output) C_{nom} | 4 ... 20 mA, 2-wire | 4 ... 16 mA, 2-wire, DC 2 ... 8 V, 3-wire 3) |
| Current consumption | Current output 4 ... 20 mA 2-wire: signal current | Current output 4 ... 20 mA 2-wire: signal current, Current output 4 ... 20 mA 3-wire: $< 8\text{ mA}$, Voltage output: $< 8\text{ mA}$ |
| Supply voltage | DC 10 ... 30 V for current output | DC 10 ... 30 V for current output DC 14 ... 30 V for voltage output |
| Burden | $< (UB-10\text{ V})/0,024\text{ A}$ for current output $> 10\text{ k}\Omega$ for voltage output | |
| Response time | $\leq 2\text{ ms}$ (within 10 ... 90 % F_{nom}) 4) | |
| Protection (acc. to EN/IEC 60529) | IP67 | |
| Electrical protection | Reverse voltage, overvoltage and short-circuit protection | |
| Vibration resistance | 20 g, 100 h, 50...150 Hz acc. to DIN EN 60068-2-6 | |
| Noise emission | DIN EN 55011 | |
| Noise immunity | In accordance with DIN EN 61326-1/DIN EN 61326-2-3 (optional EMC-strengthened versions) | |
| Optional | Certificates, strength verifications, 3D-CAD files (STEP, IGES) on request | |
| Certificates (optional) | ATEX: acc. to EN 60079-0:2012 and EN 60079-11:2012 (Ex ib) IECEX: acc. to IEC 60079-0:2011 (Ed.6) and IEC 60079-11:2011 (Ed. 6) (Ex ib) UL: acc. to UL 61010-1 and CSA C22.2 NO. 61010-1 | |

1) The force transducer with ignition protection type "ib" must only be supplied using galvanically-isolated power supplies. Suitable supply isolators are also optionally available e.g. EZE08X030003.

2) Relative linearity error acc. to VDI/VDE/DKD 2638 chap. 3.2.6.

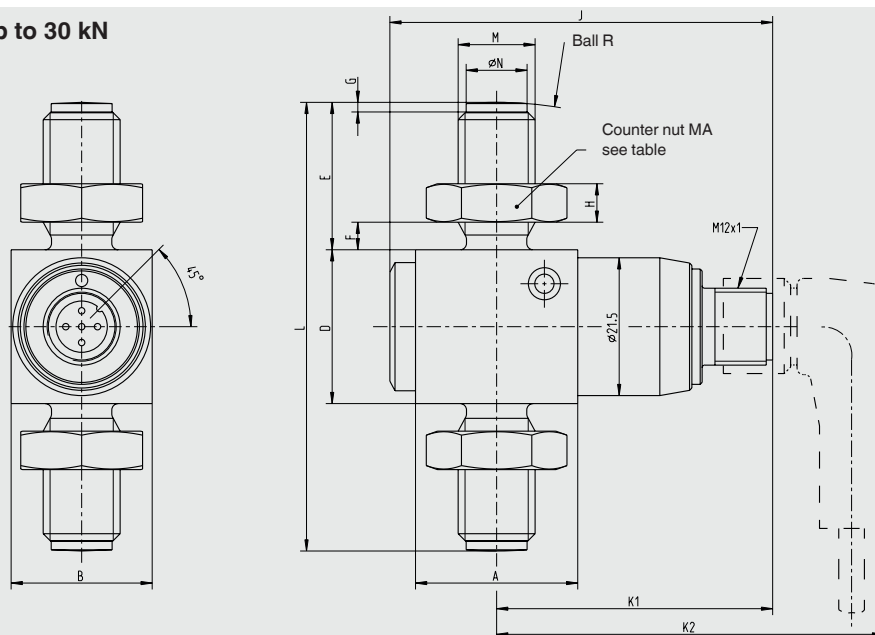
3) Other signal jumps are available on request.

4) Other response times are available on request.

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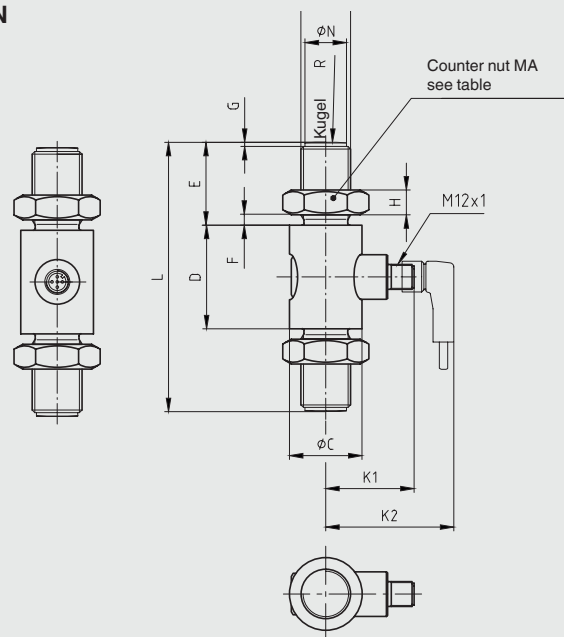
Dimensions in mm

F2301 Versions up to 30 kN



| Rated force in kN | A | B | D | E | F | G | H | J | K1 | K2 | L | M | N -0.1 | Ball R | MA (Nm) | Rated displacement |
|-------------------|------|------|----|----|-----|-----|----|------|----|----|-----|-----------|--------|--------|---------|--------------------|
| 1, 2, 3 | 25.3 | 22 | 24 | 23 | 4.3 | 1.5 | 6 | 59.7 | 43 | 63 | 70 | M12 | 9.5 | 60 | 60 | < 0.02 |
| 5 | 25.3 | 22 | 24 | 23 | 4.3 | 1.5 | 6 | 59.7 | 43 | 63 | 70 | M12 | 9.5 | 60 | 60 | < 0.02 |
| 10 | 25.3 | 22 | 31 | 23 | 4.3 | 1.5 | 6 | 59.7 | 43 | 63 | 77 | M12 | 9.5 | 80 | 60 | < 0.02 |
| 20 | 25.3 | 26 | 33 | 34 | 3.8 | 2 | 10 | 59.7 | 43 | 63 | 101 | M20 x 1.5 | 17 | 100 | 300 | < 0.2 |
| 30 | 27.6 | 27.5 | 40 | 34 | 3.8 | 2 | 10 | 61.5 | 44 | 64 | 108 | M20 x 1.5 | 17 | 120 | 300 | < 0.2 |

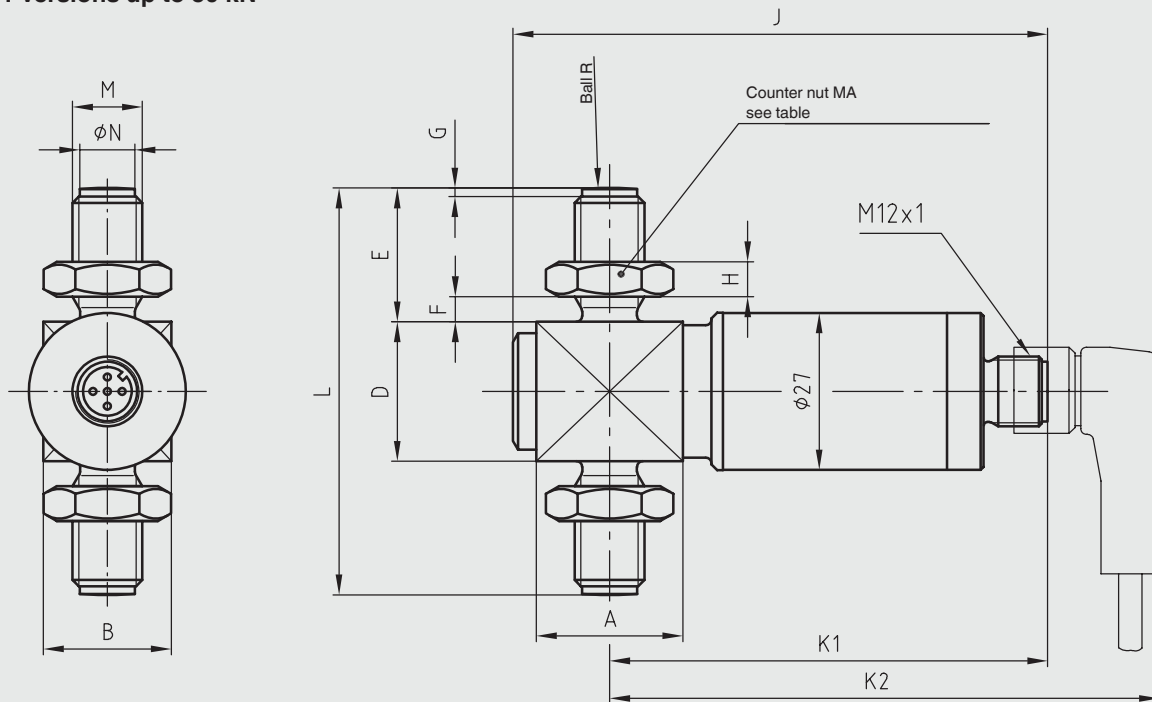
F2301 Versions from 50 kN



| Rated force in kN | C | D | E | F | G | H | K1 | K2 | L | M | N -0.1 | Ball R | MA (Nm) | Rated displacement |
|-------------------|----|----|----|----|---|------|----|----|-----|---------|--------|--------|---------|--------------------|
| 50 | 35 | 50 | 40 | 5 | 2 | 12 | 43 | 62 | 130 | M24 x 2 | 20 | 150 | 500 | < 0.2 |
| 100 | 54 | 54 | 68 | 10 | 3 | 19.5 | 44 | 64 | 190 | M39 x 3 | 34 | 200 | 2,500 | < 0.2 |

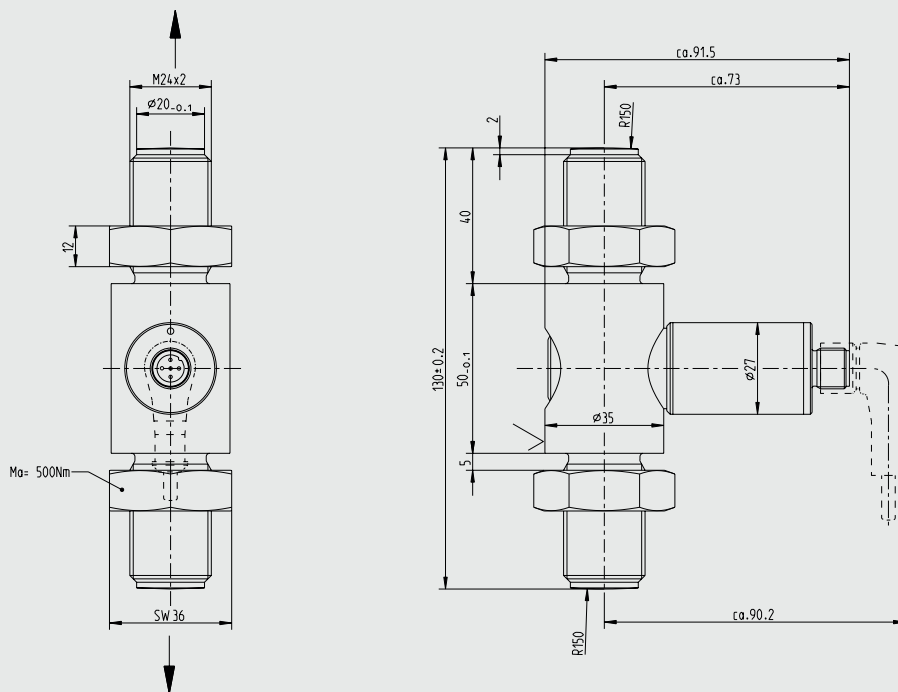
Dimensions in mm

F23C1 Versions up to 30 kN



| Rated force in kN | A | B | D | E | F | G | H | J | K1 | K2 | L | M | N -0.1 | Ball R | MA (Nm) | Rated displacement |
|-------------------|------|------|----|----|-----|-----|----|------|----|----|-----|-----------|-----------|-----------|------------|--------------------|
| 1, 2, 3 | 25.3 | 22 | 24 | 23 | 4.3 | 1.5 | 6 | 59.7 | 43 | 63 | 70 | M12 | 9.5 | 60 | 60 | < 0.02 |
| 5 | 25.3 | 22 | 24 | 23 | 4.3 | 1.5 | 6 | 59.7 | 43 | 63 | 70 | M12 | 9.5 | 60 | 60 | < 0.02 |
| 10 | 25.3 | 22 | 31 | 23 | 4.3 | 1.5 | 6 | 59.7 | 43 | 63 | 77 | M12 | 9.5 | 80 | 60 | < 0.02 |
| 20 | 25.3 | 26 | 33 | 34 | 3.8 | 2 | 10 | 59.7 | 43 | 63 | 101 | M20 x 1.5 | 17 | 100 | 300 | < 0.2 |
| 30 | 27.6 | 27.5 | 40 | 34 | 3.8 | 2 | 10 | 61.5 | 44 | 64 | 108 | M20 x 1.5 | 17 | 120 | 300 | < 0.2 |

Versions from 50 kN

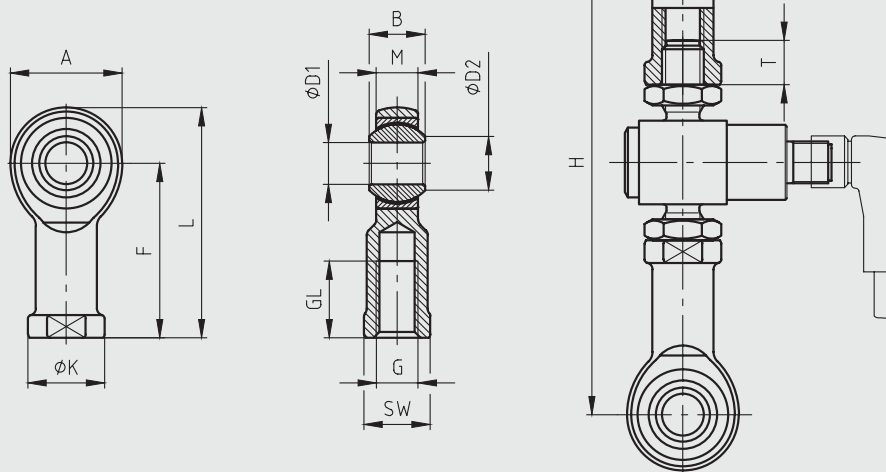


Dimensions in mm

Swivel heads in accordance with DIN ISO 12240-4

Ø -D1 = 12 ... 25 dim. column K

Ø -D2 = 40 ... 80 dim. column E



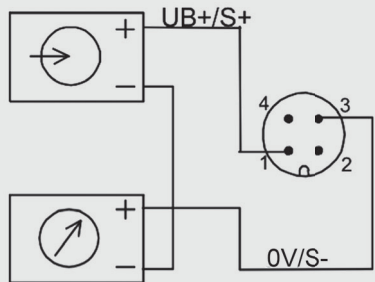
| Rated force in kN | H | Minimum screw-in depth T |
|----------------------|---------|-----------------------------|
| 1, 2, 3, 5 | 148 ± 3 | 9.5 |
| 10 | 155 ± 3 | 9.5 |
| 20 | 219 ± 4 | 16 |
| 30 | 226 ± 4 | 16 |
| 50 | 276 ± 4 | 19.5 |
| 100 | 405 ± 7 | 31 |

| Rated force in kN | Weight in kg | A | B | ØD ₁ | ØD ₂ | F | G | GL | ØK | L | M | SW |
|----------------------|-----------------|----|----|----------------------|-----------------|-----|-----------|----|----|-----|----|----|
| 1, 2, 3, 5, 10 | 0.115 | 32 | 16 | 12 H7 | 15.4 | 50 | M12 | 22 | 22 | 55 | 12 | 19 |
| 20, 30 | 0.415 | 50 | 25 | 20 H7 | 24.3 | 77 | M20 x 1.5 | 33 | 34 | 102 | 18 | 32 |
| 50 | 0.750 | 60 | 31 | 25H7 | 29.6 | 94 | M24 x 2 | 42 | 42 | 124 | 22 | 36 |
| 100 | 2 | 92 | 28 | 40 _{-0.012} | 45 | 142 | M39 x 3 | 65 | 65 | 188 | 23 | 55 |

Pin assignment analogue output

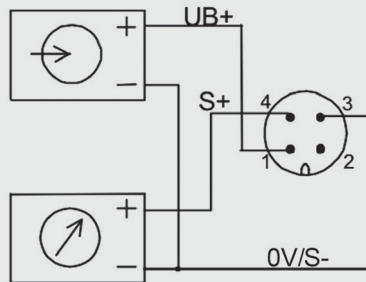
4 ... 20 mA output, 2-wire

Circular connector M12 x 1, 4-pin



0 ... 10 V output, 3-wire

Circular connector M12 x 1, 4-pin



Circular connector M12 x 1, 4-pin

| | 4 ... 20 mA 2-wire | 4 ... 20 mA 3-wire | 0 ... 10 V 3-wire |
|---------------|-----------------------|-----------------------|----------------------|
| Supply UB+ | 1 | 1 | 1 |
| Supply 0V/UB- | 3 | 3 | 3 |
| Signal S+ | 1 | 4 | 4 |
| Signal S- | 3 | 3 | 3 |
| Screen ⊕ | Case | Case | Case |

Cable outlet

| Cable colour | 2-wire | 3-wire |
|--------------|--------|--------|
| Brown | UB+/S+ | UB+ |
| White | - | - |
| Blue | 0V/S- | 0V/S- |
| Black | - | S+ |

Only when using the standard cable, e.g. EZE53X011016

Pin assignment ATEX/IECEx

Circular connector M12 x 1, 4-pin

| | ATEX Ex ib 4...20 mA 2-wire |
|---------------|-----------------------------------|
| Supply UB+ | 1 |
| Supply 0V/UB- | 3 |
| Signal S+ | 1 |
| Signal S- | 3 |
| Screen ⊕ | Case |

Cable outlet

| Cable colour | 2-wire |
|--------------|--------|
| Brown | UB+/S+ |
| White | - |
| Blue | 0V/S- |
| Black | - |

Only when using the standard cable, e.g. EZE53X011016

Pin assignment signal jump version in accordance with EN 62061:2005

Circular connector M12 x 1, 4-pin

| | 4...20 mA 2-wire | 4...20 mA 3-wire | 0...10 V 3-wire |
|---------------|---------------------|---------------------|--------------------|
| Supply UB+ | 1 | 1 | 1 |
| Supply 0V/UB- | 3 | 3 | 3 |
| Relay UR+ | 2 | 2 | 2 |
| Relay UR- | 4 | 3 | 3 |
| Signal S+ | 1 | 4 | 4 |
| Signal S- | 3 | 3 | 3 |
| Screen ⊕ | Case | Case | Case |

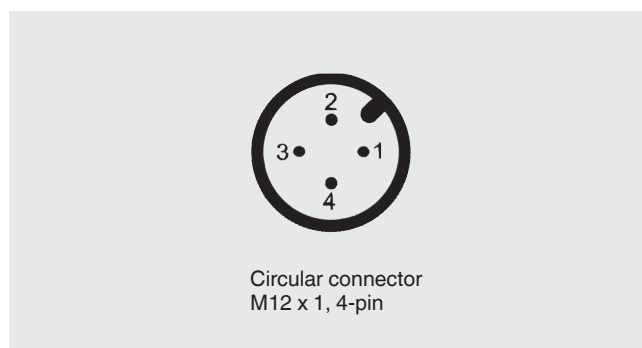
Cable outlet

| Cable colour | 2-wire | 3-wire |
|--------------|--------|-----------|
| Brown | UB+/S+ | UB+ |
| White | UR+ | UR+ |
| Blue | 0V/S- | 0V/S-/UR- |
| Black | UR- | S+ |

Only when using the standard cable, e.g. EZE53X011016

Pin assignment, analogue output, redundant, opposing

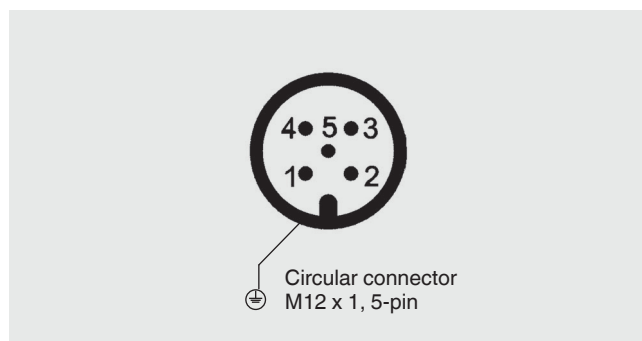
| Circular connector M12 x 1, 4-pin | | |
|-----------------------------------|--|-------------|
| | 4 ... 20 mA / 20 ... 4 mA (redundant) | |
| | Connector 1 | Connector 2 |
| Supply UB+ | 1 | 1 |
| Supply 0V/UB- | 3 | 3 |
| Signal channel1 | 4 | - |
| Signal channel 2 | - | 4 |
| Screen ⊕ | Case | Case |



2-connector variant, for example, in combination with ELMS1 overload protection (F23S1). Version in accordance with requirements for functional safety per 2006/42/EC Machinery Directive.

Pin assignment CANopen®

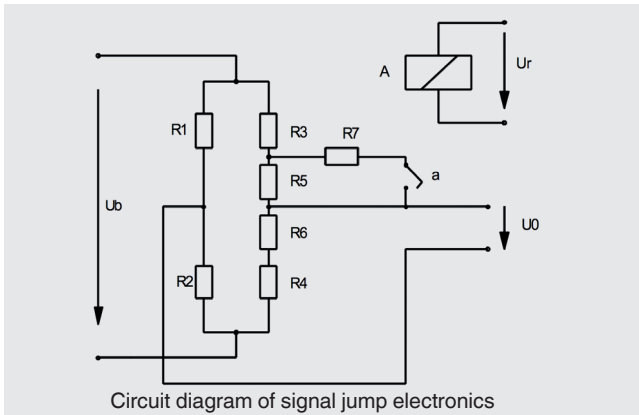
| Circular connector M12 x 1, 5-pin | |
|-----------------------------------|---|
| Screen ⊕ | 1 |
| Supply UB+ (CAN V+) | 2 |
| Supply UB- (CAN GND) | 3 |
| Bus-Signal CAN-High | 4 |
| Bus-Signal CAN-Low | 5 |



Connect the cable shield to the force transducer housing. In the case of accessory cables, the cable shield must be connected with the knurled nut and thus connected to the housing of the force transducer. When extending, only shielded and low capacitance cables should be used. The permitted maximum and minimum lengths of the cable are specified in ISO 11898-2. A high-quality connection of the shielding must also be ensured.

Short description of signal jump electronics

Amplifier electronics 4 ... 20 mA or 0 ... 10 V for signal jump applications with 2-channel PC control



These force transducers are working with four variable resistors (R1 ... R4) connected to a Wheatstone Bridge. Caused by deformation of the body the respective opposite resistors are lengthened or compressed in the same way. This results in an unbalanced bridge and a diagonal voltage U_0 .

This well proven design has been amended by an additional resistor R7 in order to monitor the condition of the amplifier unit and signal path. This resistor is connected as a shunt to resistor R5 by a relay contact (a) as soon as an excitation voltage U_r appears at relay A. The connection of resistor R7 will always result in a defined unbalancing of the zero point (diagonal voltage) of the Wheatstone Bridge.

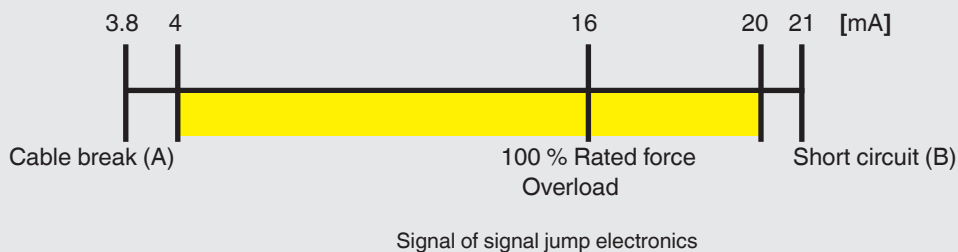
Compliance with functional safety

An external safety controller independently of the force transducer must monitor the safe functioning of the force transducer. The function test with a signal jump of 4 mA / 2 V is generated at a 24-hour interval. The safety controller activates relay A and thus defines the output signal of the force transducer.

If the expected change in the output signal occurs, it can be assumed that the entire signal path of the Wheatstone bridge via the amplifier to the output functions correctly.

If it does not occur, an error in this signal path can be concluded. Furthermore, the measuring signal is to be checked by the safety controller for the Min- (A) and Max- (B) signal values in order to detect a possibly arising line break or short circuit.

The standard adjustment of force transducers with current output 4 ... 20 mA for overload control is e.g.:



With a fixed signal level of, for example, 4 mA, the testing cycle can be triggered in every operating status upon activation of the check relays. The measurement's upper limit

of 20 mA will not be reached. This enables a check of the signal level.

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