# Tension/compression force transducer
# With thin-film technology and swivel head to 45 kN [10,116 lbf]
# Model F2303



## Applications

- Machine building and plant construction
- Manufacturing automation
- Presses, lifting cylinders, welding guns, drives
- Chemistry and petrochemistry

## Special features

- Measuring ranges 0 ... 10 kN to 0 ... 45 kN [0 ... 2,248 lbf to 0 ... 10,116 lbf]
- Corrosion-resistant stainless steel design
- Integrated amplifier
- High long-term stability, high shock and vibration resistance
- Good reproducibility, simple installation

**Tension/compression force transducer, model F2303**

## 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.

Force transducers of this series are used for measuring axial forces on electric spindle presses, for monitoring overload protection in lifting cylinders and for measuring force on punches, presses and welding guns. 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 and CAN protocols are possible.





Data sheets showing similar products:
Tension/compression force transd. with thin-film technology; model F2301, F23C1, F23S1; see data sheet FO 51.17
Tension/compression force transd. with thin-film technology to 200 kN; model F2304; see data sheet FO 51.47

## Specifications in accordance with VDI/VDE/DKD 2638

| Model | F2303 |
|---|---|
| **Rated force $F_{nom}$ kN** | 10, 18, 20, 34, 45 |
| **Rated force $F_{nom}$ lbf** | 2,248; 4,047; 4,496; 7,644; 10,116 |
| **Relative linearity error $d_{lin}$** [1] | 0.5 % $F_{nom}$ |
| **Relative reversibility error** | < 0.1 % $F_{nom}$ |
| **Relative creep, 30 min. at $F_{nom}$** | 0.1 % $F_{nom}$ |
| **Temperature effect on** | |
| Zero signal TK0 | 0.4 % $F_{nom}$ / 10 K |
| Characteristic value $TK_C$ | 0.4 % $F_{nom}$ / 10 K |
| **Limit force $F_L$** | 150 % $F_{nom}$ |
| **Breaking force $F_B$** | 300 % $F_{nom}$ |
| **Permissible vibration loading $F_{rb}$** | ±50 % $F_{nom}$ (in accordance with DIN 50100) |
| **Rated displacement (typical) $s_{nom}$** | < 0.1 mm [< 0.004 in] |
| **Material of the measuring body** | Corrosion-resistant stainless steel 1.4542, ultrasound-tested 3,1 material (optionally 3,2) |
| **Rated temperature range $B_{T, nom}$** | -20 … +80 °C [-4 ... +176 °F] |
| **Service temperature range $B_{T, G}$** | -30 … +80 °C [-22 ... +176 °F] |
| **Storage temperature range $B_{T, S}$** | -40 … +85 °C [-40 ... +185 °F] |
| **Electrical connection** | Circular connector M12 x 1, 4-pin |
| **Output signal (Rated characteristic value) $C_{nom}$** | ■ 4 … 20 mA 2-wire<br>■ 4 … 20 mA 3-wire<br>■ DC 0 … 10 V 3-wire<br>■ Optional redundant signal<br>■ CANopen®<br>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 ±10 % adjustable via entries in the object directory [2] |
| **Current/power consumption** | Current output: 4 … 20 mA<br>Signal current: 2-wire |
| **Supply voltage UB** | DC 10 ... 30 V for current output |
| **Load** | ≤ (UB − 10 V)/0.024 A for current output |
| **Response time** | < 1 ms (within 10 % to 90 % $F_{nom}$) [3] |
| **Ingress protection (per EN/IEC 60529)** | IP67 |
| **Electrical protection** | Reverse polarity protection, overvoltage and short-circuit resistance |
| **Vibration resistance (per DIN EN 60068-2-6)** | 20 g, 100 h, 50 ... 150 Hz |
| **Immunity** | Per DIN EN 61326-1/DIN EN 61326-2-3 (optionally EMC-protected versions) |
| **Options** | Certificates, strength verifications, 3D/CAD files (STEP, IGES) on request |

1) Relative linearity error is specified in accordance with Directive VDI/VDE/DKD 2638 Chap. 3.2.6.
2) Protocol in accordance with CiA 301, device profile 404, communication service LSS (CiA 305) / 3) Other response times possible upon request.
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## Approvals

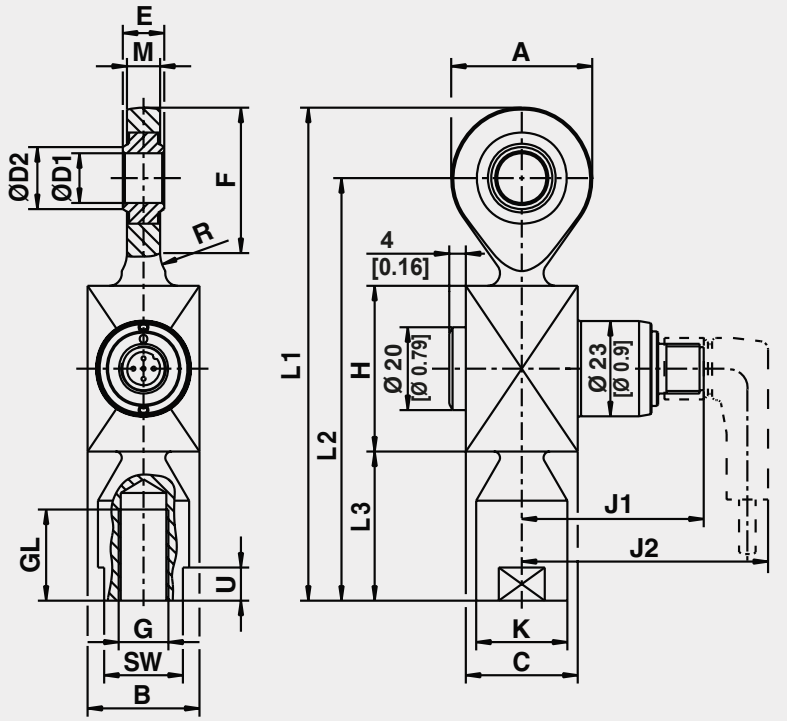
| Logo | Description | Region |
|---|---|---|
| CE | **EU declaration of conformity**<br>EMC directive | European Union |
| UKCA | **UKCA**<br>EMC directive | United Kingdom |

### Optional approvals

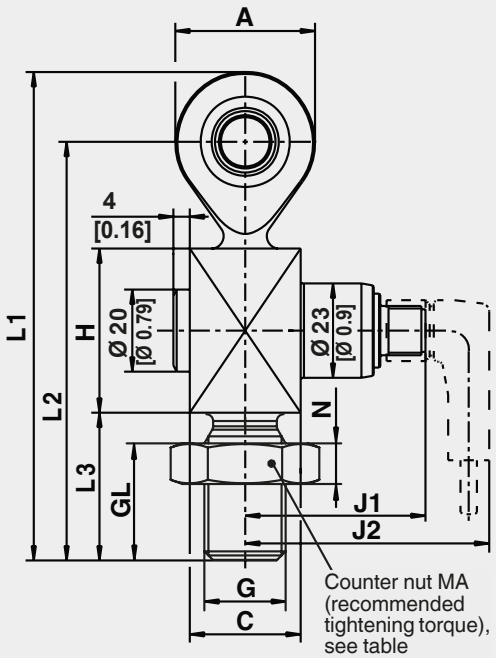
| Logo | Description | Region |
|---|---|---|
| EAC | **EAC** | Eurasian Economic Community |

## Dimensions in mm [in]

**F2303 version from 10 kN [2.248 lbf], female thread**




**F2303 version from 10 kN [2,248 lbf] male thread**

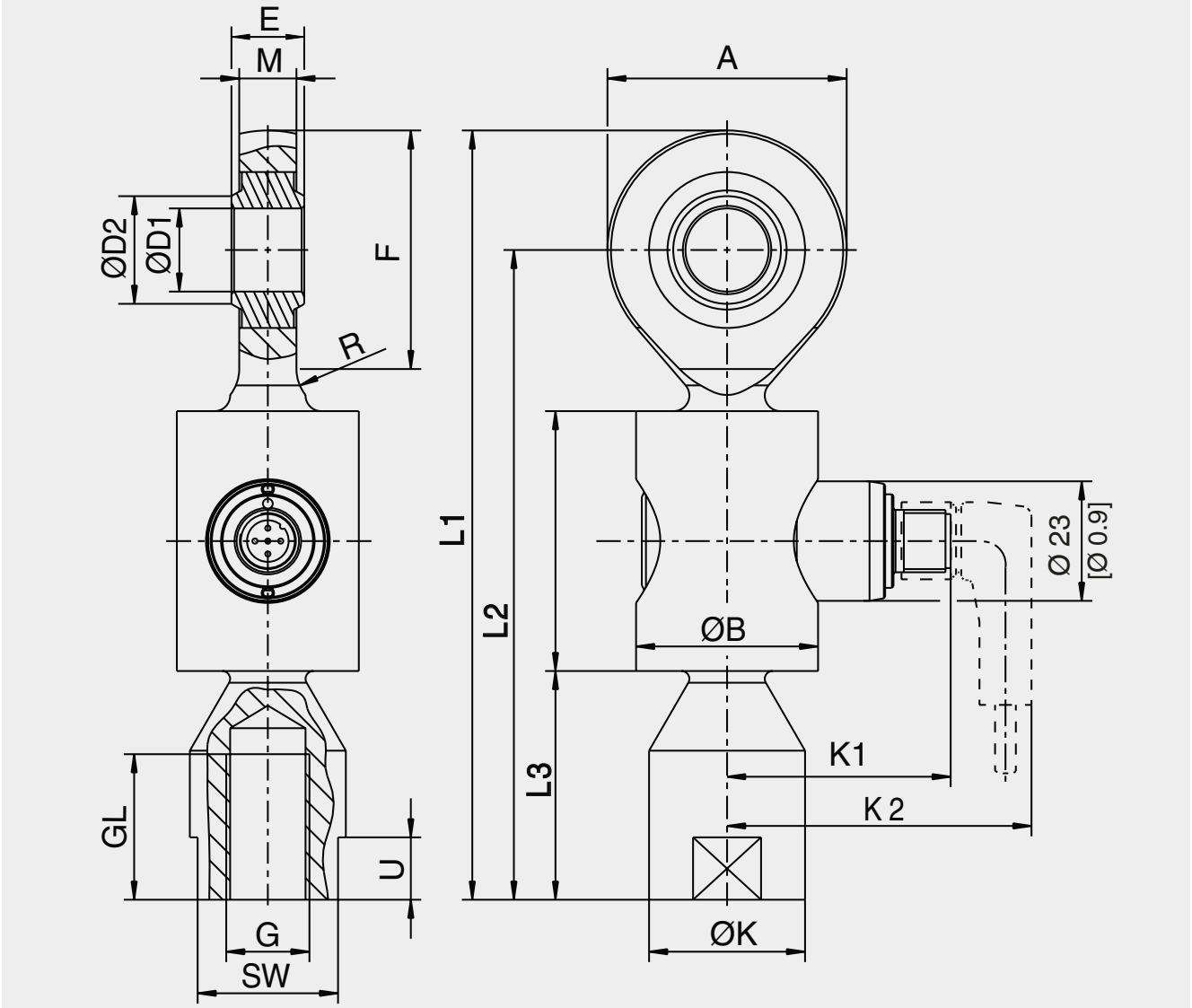



| Rated force in kN [lbf] | Thread version | Dimensions in mm [in] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | ØD1 -0.008 | ØD2 | E | F | G | GL | H |
| **10 [2.248]** | female | 34 [1.34] | 27 [1.06] | 27 [1.06] | 12 [0.5] | 15 [0.6] | 10 [0.4] | 35.1 [1.38] | M10 x 1.25 | 21 [0.83] | 40 [1.57] |
| **10 [2.248]** | male | 34 [1.34] | 28 [1] | 28.7 [1.13] | 20 [0.79] | 35 [1.37] | 19 [0.75] | 46 [1.8] | M20 x 1.5 | 24.5 [0.96] | 33 [1.3] |
| **18 [4.047]** | female | 34 [1.34] | 27 [1.06] | 27 [1.06] | 12 [0.5] | 15 [0.6] | 10 [0.4] | 35 [1.37] | M12 x 1.25 | 22 [0.87] | 40 [1.57] |
| **18 [4.047]** | male | 34 [1.34] | 27 [1.06] | 27 [1.06] | 12 [0.5] | 15 [0.6] | 10 [0.4] | 35 [1.37] | M20 x 1.25 | 22 [0.87] | 40 [1.57] |
| **20 [4.496]** | male | 34 [1.34] | 28 [1] | 28.7 [1.13] | 20 [0.79] | 35 [1.37] | 19 [0.75] | 46 [1.8] | M20 x 1.25 | 24.5 [0.96] | 33 [1.3] |

| Rated force in kN [lbf] | Thread version | Dimensions in mm [in] | | | | | | | | | MA [Nm] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | J1 | J2 | ØK | L1 | L2 | L3 | M | SW | U | N | |
| **10 [2,248]** | female | 44 [1.73] | 63 [2.48] | 22 [0.87] | 119 [4.68] | 102 [4] | 36 [1.42] | 8 [0.31] | 19 [0.75] | 8 [0.31] | - | - |
| **10 [2,248]** | male | 44 [1.73] | 63 [2.48] | - | 117.5 [4.63] | 92.5 [3.64] | 30.5 [1.2] | 14 [0.55] | 19 [0.75] | - | 10 [0.4] | 60 |
| **18 [4,047]** | female | 44 [1.73] | 63 [2.48] | 22 [0.87] | 119 [4.68] | 102 [4] | 36 [1.42] | 8 [0.31] | 19 [0.75] | 8 [0.31] | - | - |
| **18 [4,047]** | male | 44 [1.73] | 63 [2.48] | - | 119 [4.68] | 102 [4] | 36 [1.42] | 8 [0.31] | 19 [0.75] | - | 10 [0.4] | 60 |
| **20 [4,496]** | male | 44 [1.73] | 63 [2.48] | - | 117.5 [4.63] | 92.5 [3.64] | 30.5 [1.2] | 14 [0.55] | 19 [0.75] | - | 10 [0.4] | 60 |

## Dimensions in mm [in]

**F2303 versions from 34 kN [7,644 lbf]**

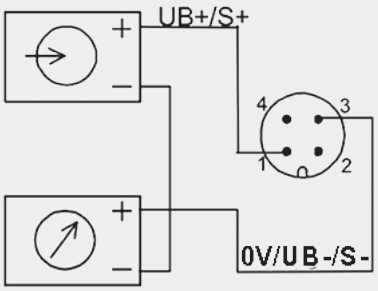



| Rated force in kN [lbf] | Thread version | Dimensions in mm [in] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | ØB | ØD1 $_{-0.008}$ | ØD2 | E | F | G | GL | H |
| **34 [7,644]** | female | 46 [1.81] | 35 [1.38] | 17 [0.67] | 20.7 [0.82] | 14 [0.55] | 46 [1.81] | M16 x 1.5 | 28 [1.1] | 50 [1.97] |
| **45 [10,116]** | female | 53 [2.09] | 54 [2.16] | 20 [0.79] | 24.2 [0.95] | 16 [0.63] | 54 [2.16] | M20 x 1.5 | 33 [1.3] | 54 [2.16] |

| Rated force in kN [lbf] | Thread version | Dimensions in mm [in] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | J1 | J2 | ØK | L1 | L2 | L3 | M | SW | U |
| **34 [7,644]** | female | 43 [1.7] | 62 [2.44] | 30 [1.18] | 148 [5.83] | 125 [4.92] | 44 [1.73] | 11 [0.43] | 27 [1.06] | 12 [0.47] |
| **45 [10,116]** | female | 44 [1.73] | 63 [2.48] | 35 [1.38] | 171 [6.73] | 144.5 [5.69] | 54 [2.16] | 13 [0.51] | 32 [1.26] | 13 [0.51] |

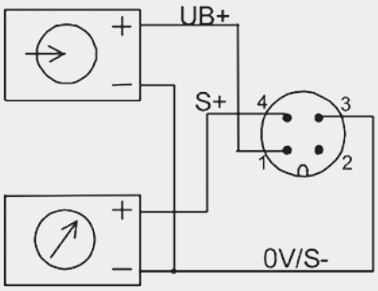
## Pin assignment of analogue output

**Output signal 4 ... 20 mA, 2-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 |
| **Shield** ⏚ | Case | Case | Case |

**Output signal 0 ... 10 V, 4 ... 20 mA, 3-wire**
Circular connector M12 x 1, 4-pin




| Cable assignment in combination with circular connector M12 x 1, 4-pin | | |
|---|---|---|
| **Cable colour** | **2-wire** | **3-wire** |
| **Brown** | UB+/S+ | UB+ |
| **White** | - | - |
| **Blue** | 0V/S- | 0V/S- |
| **Black** | - | S+ |

Only when using standard cable, e.g. item number 14259454

## Pin assignment with signal jump

| 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 |
| **Shield** ⏚ | Case | Case | Case |

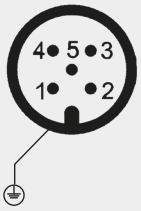
| Cable assignment in combination with circular connector M12 x 1, 4-pin | | |
|---|---|---|
| **Cable colour** | **2-wire** | **3-wire** |
| **Brown** | UB+/S+ | UB+ |
| **White** | UR+ | UR+ |
| **Blue** | 0V/S- | 0V/S-/UR- |
| **Black** | UR- | S+ |

Only when using standard cable, e.g. item number 14259454

## Pin assignment for CANopen®

| Circular connector M12 x 1, 5-pin | |
|---|---|
| **Shield** ⏚ | 1 |
| **Supply UB+ (CAN V+)** | 2 |
| **Supply UB- (CAN GND)** | 3 |
| **Bus signal, CAN-High** | 4 |
| **Bus signal, CAN-Low** | 5 |

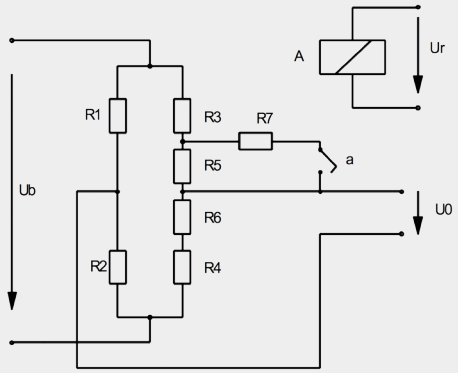
Circular connector M12 x 1, 5-pin




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.




Circuit diagram of signal jump electronics

With these force transducers, four variable resistors (R1 ... R4) are connected together to form a Wheatstone bridge. When the measuring body deforms, the opposing resistors are stretched or compressed in the same way. This leads to a detuning of the bridge and a diagonal voltage U0.

The test resistor R7 is now important in connection with checking the subsequent amplifier circuit and the subsequent signal paths. This is switched parallel to the resistor R5 via the relay contact (a) as soon as the excitation voltage Ur of the relay A is present. The connection of the resistor R7 causes a defined, always constant, detuning of the zero point (diagonal voltage) of the Wheatstone bridge.

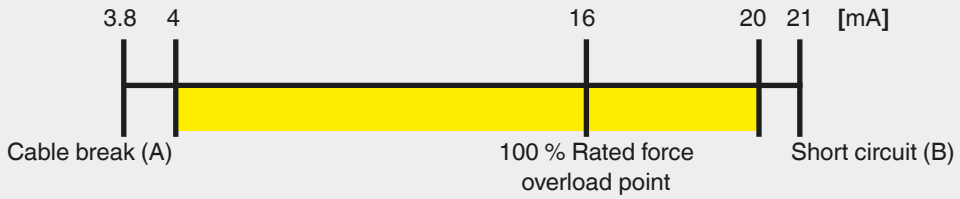
### Compliance with functional safety

An external safety control system independent of the force transducer must monitor the safe functioning of the force transducer. The functional test with a signal jump of 4 mA / 2 V is executed at an interval of 24 hours. The safety control system activates the relay A, thus changing the output signal of the force transducer in a defined manner.

If the expected change in the output signal occurs, it can be assumed that the entire signal path from the Wheatstone bridge via the amplifier through to the output is functioning correctly. If this does not occur, then it can be concluded that there is a error in the signal path.

Moreover, the measuring signal should be checked by the safety control for the min. (A) and max. (B) signal value to ensure that any cable break or short-circuit that has occurred is detected.

The default setting of the force transducer with current output 4 ... 20 mA for overload detection is, for example:




Signal of signal jump electronics

With a fixed signal jump of, for example, 4 mA, the test cycle can then be triggered, in any operating state, by activating the test relay. The upper measuring range limit of 20 mA will never be reached and thus the checking of the signal jump is enabled.