Tension/compression force transducer
With thin-film technology to 200 kN [44,962 lbf]
Model F2304

Applications

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

Special features

- Measuring ranges 0 ... 1 kN to 0 ... 200 kN [0 ... 225 lbf to 0 ... 44,962 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 F2304

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 and swivel head; model F2303; see data sheet FO 51.46

Specifications in accordance with VDI/VDE/DKD 2638

Model	F2304
Rated force F_{nom} kN	1; 2; 3; 5; 10; 20; 30; 50; 100; 200
Rated force F_{nom} lbf	225; 450; 674; 1,124; 2,248; 4,496; 6,744; 11,240; 22,481; 44,962
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	0.2 % F_{nom} / 10 K
characteristic value TK_C	0.2 % 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 ■ 4 … 20 mA 3-wire ■ 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 ±10 % adjustable via entries in the object directory [2)]
Current/power consumption	Current output: 4 … 20 mA Signal current: 2-wire
Supply voltage UB	■ DC 9 ... 36 V for current output ■ DC 13 ... 36 V for voltage output ■ DC 9 ... 36 V for CANopen®
Load	≤ (UB − 10 V)/0.024 A for current output
Response time	< 1 ms (within 10 % to 90 % F_{nom}) [3)]
Ingress protection (per IEC/EN 60529)	
Unplugged state	IP66, IP67
Plugged-in state	IP68, IP69, IP69K
Electrical protection	Reverse polarity protection, overvoltage and short-circuit resistance
Vibration resistance	20 g, 100 h, 50 ... 150 Hz (to DIN EN 60068-2-6)
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

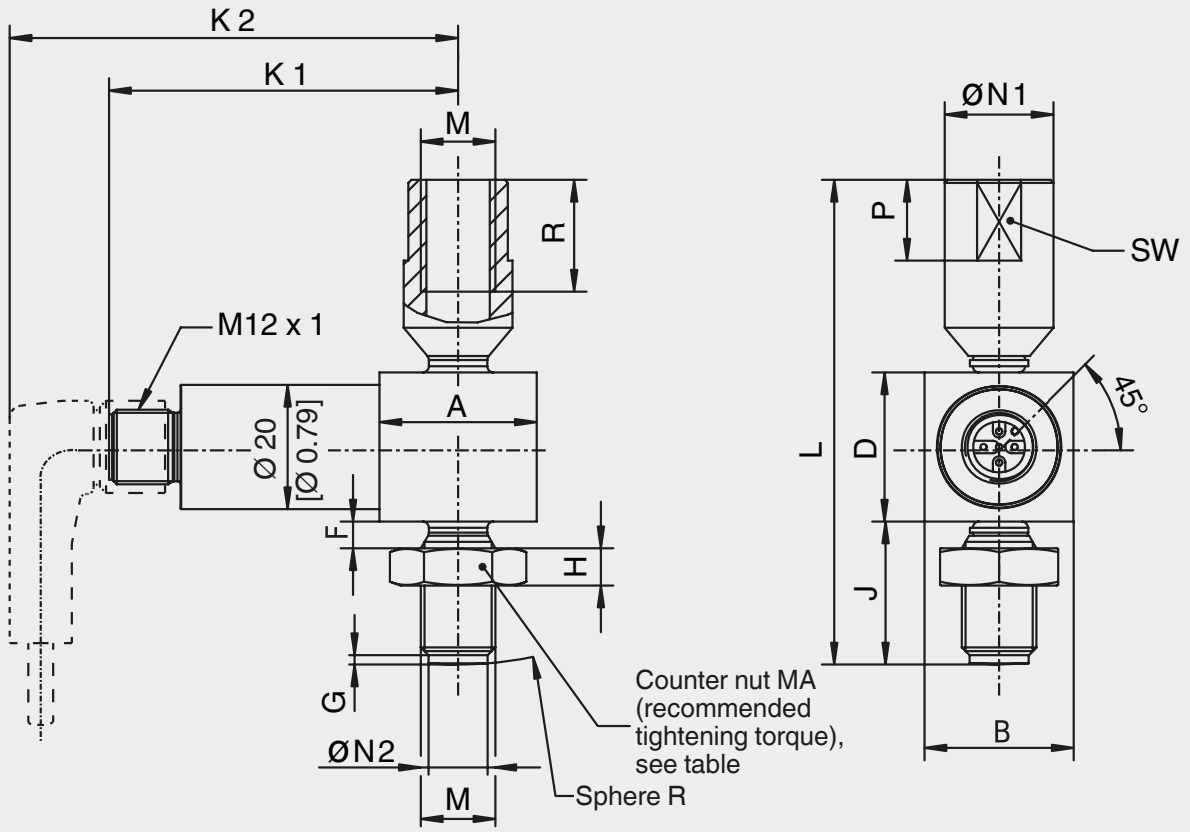
Logo	Description	Region
CE	**EU declaration of conformity** EMC directive	European Union
UKCA	**UKCA** EMC directive	United Kingdom

Optional approvals

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

Dimensions in mm [in]

Version to 30 kN [6,744 lbf]

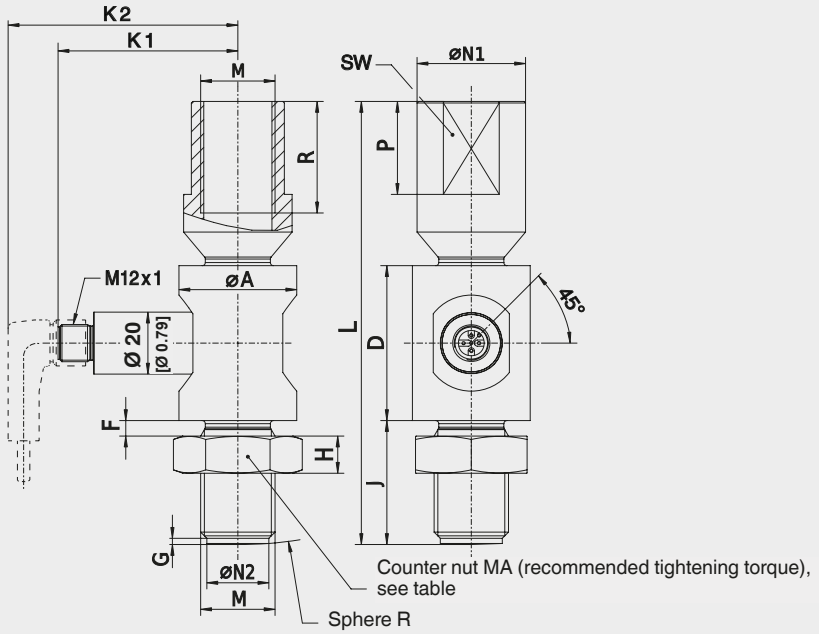


Rated force in kN [lbf]	Dimensions in mm [in]									
	A	B	D	F	G	H	J	K1	K2	L
1 [225], 2 [450], 3 [674]	25.3 [0.99]	24 [0.94]	24 [0.94]	4.3 [0.17]	1.5 [0.06]	6 [0.24]	23 [0.9]	56 [2.2]	76 [2.99]	78 [3.07]
5 [1,124]	25.3 [0.99]	24 [0.94]	24 [0.94]	4.3 [0.17]	1.5 [0.06]	6 [0.24]	23 [0.9]	56 [2.2]	76 [2.99]	78 [3.07]
10 [2,248]	25.3 [0.99]	24 [0.94]	31 [1.22]	4.3 [0.17]	1.5 [0.06]	6 [0.24]	23 [0.9]	56 [2.2]	76 [2.99]	85 [3.35]
20 [4,496]	25.3 [0.99]	26 [1.02]	35 [1.38]	3.8 [0.15]	2 [0.08]	10 [0.4]	34 [1.34]	56 [2.2]	76 [2.99]	113 [3.35]
30 [7,644]	26 [1.02]	27 [1.06]	40 [1.57]	3.8 [0.15]	2 [0.08]	10 [0.4]	34 [1.34]	56.5 [2.22]	76.5 [3.01]	118 [4.64]

Rated force in kN [lbf]	Dimensions in mm [in]								MA [Nm]
	M	P	R	SW	ØN1	ØN2$_{-0.1}$	Sphere R	Rated displacement	
1 [225], 2 [450], 3 [674]	M12	13 [0.51]	18 [0.71]	16 [0.63]	17.5 [0.29]	9.5 [0.37]	60 [2.36]	< 0.5 [< 0.02]	15
5 [1,124]	M12	13 [0.51]	18 [0.71]	16 [0.63]	17.5 [0.29]	9.5 [0.37]	60 [2.36]	< 0.5 [< 0.02]	15
10 [2,248]	M12	13 [0.51]	18 [0.71]	16 [0.63]	17.5 [0.29]	9.5 [0.37]	80 [3.15]	< 0.5 [< 0.02]	15
20 [4,496]	M20x1.5	20 [0.79]	30 [1.18]	26 [1.02]	31 [1.22]	17 [0.67]	100 [3.94]	< 0.5 [< 0.02]	60
30 [7,644]	M20x1.5	20 [0.79]	30 [1.18]	26 [1.02]	31 [1.22]	17 [0.67]	120 [4.72]	< 0.5 [< 0.02]	60

Dimensions in mm [in]

Version from 50 kN [11,240 lbf]

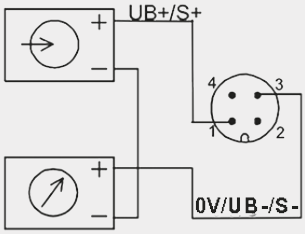


Rated force in kN [lbf]	Dimensions in mm [in]								
	ØA	D	F	G	H	J	K1	K2	L
50 [11,240]	38 [1.5]	50 [1.97]	5 [0.2]	2 [0.08]	12 [0.47]	40 [1.57]	58 [2.28]	68 [2.68]	143 [5.63]
100 [22,481]	46 [1.81]	54 [2.16]	7.5 [0.3]	3 [0.12]	19.5 [0.76]	71 [2.8]	62.5 [2.46]	82.5 [3.25]	209.5 [8.25]
200 [44,962]	67 [2.64]	67 [2.64]	7.5 [0.3]	3 [0.12]	22.5 [0.88]	82 [3.23]	73 [2.87]	93 [3.66]	243 [9.57]

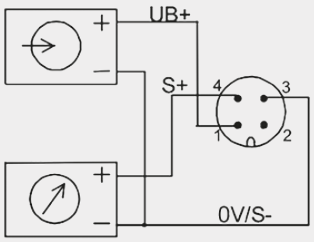
Rated force in kN [lbf]	Dimensions in mm [in]								MA [Nm]
	M	R	SW	P	ØN1	$ØN2_{-0.1}$	Sphere R	Rated displacement	
50 [11,240]	M24 x 2	36 [1.42]	30 [1.18]	30 [1.18]	35 [1.38]	20 [0.79]	150 [5.9]	< 0.5 [< 0.02]	110
100 [22,481]	M39 x 3	58.5 [2.3]	50 [1.97]	50 [1.97]	56 [2.2]	34 [1.34]	200 [7.87]	< 0.5 [< 0.02]	390
200 [44,962]	M45 x 3	67.5 [2.66]	55 [2.16]	56 [2.2]	65 [2.56]	40 [1.57]	250 [9.84]	< 0.5 [< 0.02]	495

Pin assignment of analogue output

Output signal 4 ... 20 mA, 2-wire
Circular connector M12 x 1, 4-pin



Output signal 0 ... 10 V, 4 ... 20 mA, 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
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	-	-
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 of analogue output, redundant

Circular connector M12 x 1, 5-pin	
	4 ... 20 mA, 2-wire
UB1+/S1+	1
UB2+/S2+	2
UB1-/S1-	3
UB2-/S2-	4
Shield ⏚	Case

Circular connector M12 x 1, 5-pin		
	4 ... 20 mA, 3-wire	0 … 10 V, 3-wire
Supply UB+	1	1
Supply 0V/S-	3	3
Signal S1+	4	4
Signal S2+	2	2
Shield ⏚	Case	Case

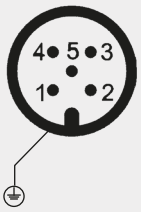
Cable assignment in combination with circular connector M12 x 1, 5-pin		
Cable colour	**2-wire**	**3-wire**
Brown	UB+/S+	UB+
White	-	-
Blue	0V/S-	0V/S-
Black	-	S+

Only when using standard cable, e.g. 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

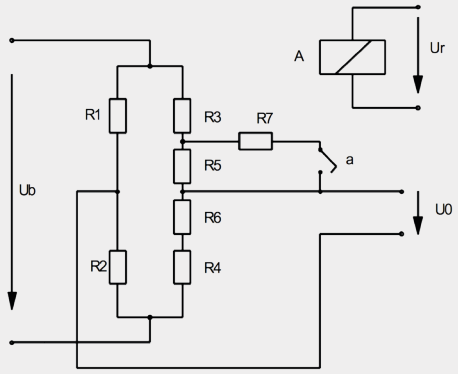
Circular connector M12 x 1, 5-pin



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.

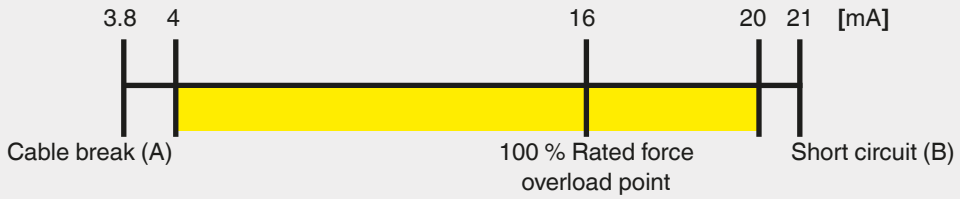
Compliance with functional safety

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.

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