

Tension/compression force transducer

With thin-film technology up to 500 kN

Models F2301, F23C1, F23S1

WIKA data sheet FO 51.17



Applications

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

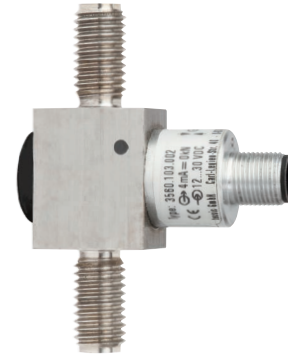
Special features

- Measuring ranges 0 ... 1 kN up to 0 ... 500 kN
- Corrosion-resistant stainless steel design
- Integrated amplifier
- High long-term stability, high shock and vibration resistance
- Good reproducibility, simple installation

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.

These tension/compression force transducers are often used in linear drives, as well as for special machine constructions, in laboratories and stage systems. The force transducers are also perfectly suitable for hoists and crane systems. Appropriate technical and regional approvals are available as an option.



Tension/compression force transducer, models F2301, F23C1, F23S1

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.

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

Specifications in accordance with VDI/VDE/DKD 2638

Model	F2301	F23S1
Rated force F_{nom} kN	1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500	3, 5, 10, 20, 30, 50, 100
Relative linearity error d_{lin} ¹⁾	$\pm 0.5 \% F_{nom}$	
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	$0.4 \% F_{nom}/10 \text{ K}$	
zero signal TK_0	$0.4 \% F_{nom}/10 \text{ K}$	
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}		
$< 10 \text{ kN}$	$< 0.02 \text{ mm}$	
$< 100 \text{ kN}$	$< 0.2 \text{ mm}$	
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 $\pm 10 \%$ 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
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.

CANopen[®] and CiA[®] are registered community trade marks of CAN in Automation e.V.

Model	F23C1 ATEX/IECEX EX ib ¹⁾	F2301 signal jump
Rated force F_{nom} kN	1, 2, 3, 5, 10, 20, 30, 50, 100	
Relative linearity error d_{lin} ²⁾	$\pm 0.5 \% F_{nom}$	
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	$0.4 \% F_{nom}/10 \text{ K}$	
zero signal TK_0	$0.4 \% F_{nom}/10 \text{ K}$	
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 kN	< 0.02 mm	
<100 kN	< 0.2 mm	
Material of measuring device	Stainless steel corrosion-resistant, ultrasonically tested 3.1 material (optional 3.2)	
Rated temperature $B_{T, nom}$	-20 ... +80 °C	
Operating temperature $B_{T, G}$	Ex II 2G Ex ib IIC T4 Gb -25 °C < T_{amb} < +85 °C Ex II 2G Ex ib IIC T3 Gb -25 °C < T_{amb} < +100 °C Ex I M2 Ex ib I Mb -25 °C < T_{amb} < +85 °C Ex II 2G Ex ib IIC T4 Gb -40 °C < T_{amb} < +85 °C Ex I M2 Ex ib I Mb (for cable connection only)	-30 ... +80 °C
Storage temperature $B_{T, S}$	-40 ... +85 °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 mA, Voltage output: < 8 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 k Ω for voltage output	
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	






1) The force transducer with ignition protection type "ib" must only be supplied using galvanically-isolated power supplies.

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

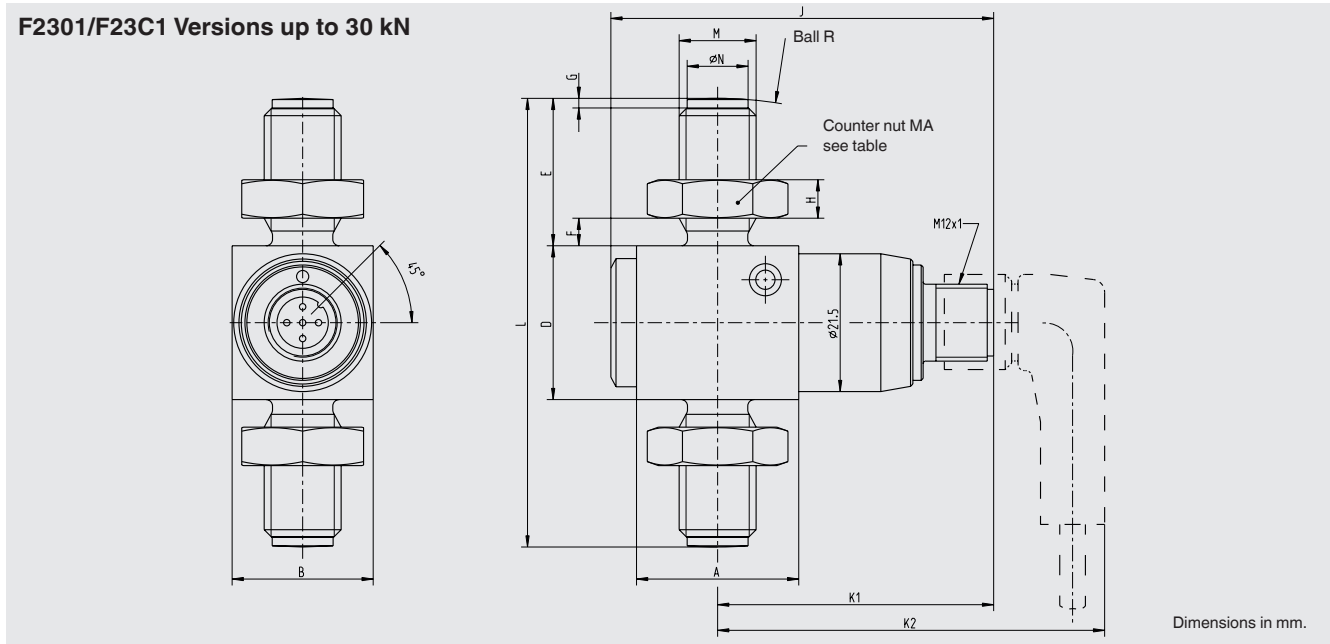
3) Other signal jumps are available on request.

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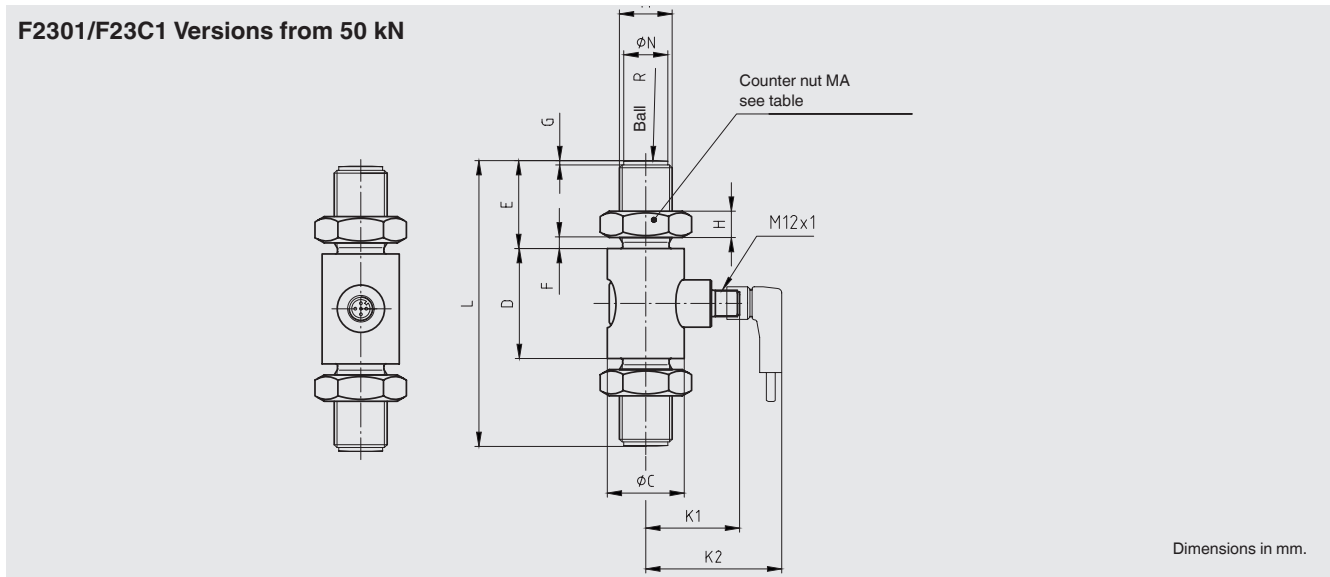
Approvals

Logo	Description	Country
	EU declaration of conformity <ul style="list-style-type: none"> ■ EMC directive ■ RoHS directive 	European Union
	ATEX directive (Option) Hazardous areas Ex ib Ex II 2G Ex ib IIC T4 Gb $-25\text{ °C} < T_{\text{amb}} < +85\text{ °C}$ Ex II 2G Ex ib IIC T3 Gb $-25\text{ °C} < T_{\text{amb}} < +100\text{ °C}$ Ex I M2 Ex ib I Mb $-25\text{ °C} < T_{\text{amb}} < +85\text{ °C}$ Ex II 2G Ex ib IIC T4 Gb $-40\text{ °C} < T_{\text{amb}} < +85\text{ °C}$ I M2 Ex ib I Mb (only with cable connection available)	European Union
	IECEx (Option) Hazardous areas Ex ib Ex ib IIC T4/T3 Gb $-25\text{ °C} < T_{\text{amb}} < +85\text{ °C}$ Ex ib IIC T4 Gb $-25\text{ °C} < T_{\text{amb}} < +100\text{ °C}$ Ex ib I Mb $-25\text{ °C} < T_{\text{amb}} < +85\text{ °C}$ Ex ib IIC T4 Gb $-40\text{ °C} < T_{\text{amb}} < +85\text{ °C}$	International
	UL (Option) Approvals for components	USA and Kanada
	EAC (Option) <ul style="list-style-type: none"> ■ EMC directive 	Eurasian Economic Community

Dimensions

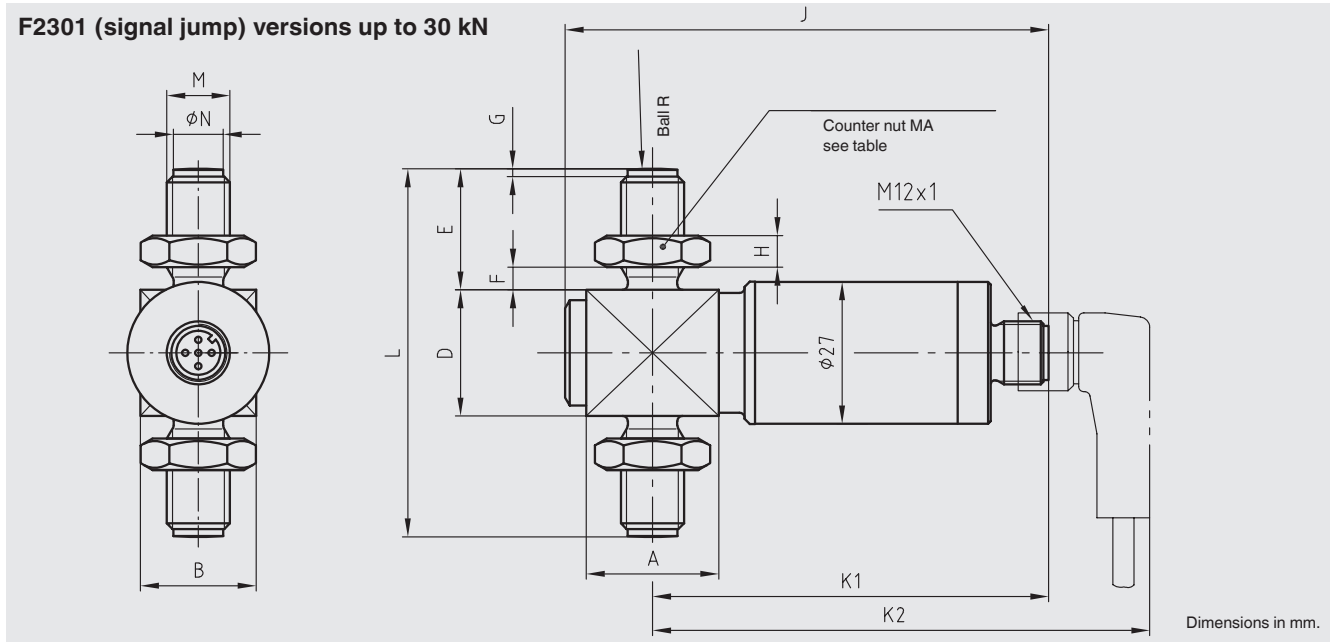


Rated force in kN	A	B	D	E	F	G	H	J	K1	K2	L	M	N -0.1	Ball R	MA (Nm)	Rated displacement
1, 2, 3	25.3	22	24	23	4.3	1.5	6	59.7	43	63	70	M12	9.5	60	60	< 0.02
5	25.3	22	24	23	4.3	1.5	6	59.7	43	63	70	M12	9.5	60	60	< 0.02
10	25.3	22	31	23	4.3	1.5	6	59.7	43	63	77	M12	9.5	80	60	< 0.02
20	25.3	26	33	34	3.8	2	10	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

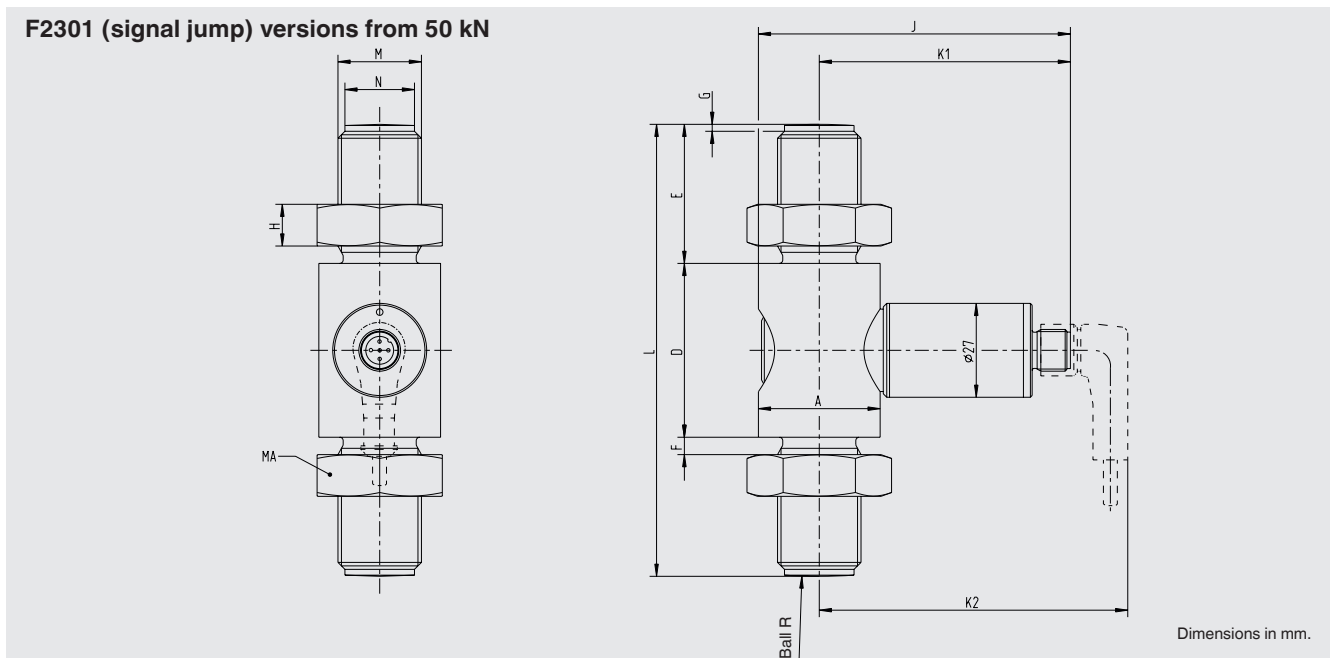


Rated force in kN	C	D	E	F	G	H	K1	K2	L	M	N -0.1	Ball R	MA (Nm)	Rated displacement
50	35	50	40	5	2	12	43	62	130	M24 x 2	20	150	500	< 0.2
100	54	54	68	10	3	19.5	44	64	190	M39 x 3	34	200	2,500	< 0.2
200	67	67	82	12	3	22.5	45	65	231	M45 x 3	40	250	4,000	< 0.2
300	73	73	98	14	3	28	49	69	269	M56 x 4	50	300	6,000	< 0.2
500	94	94	113	17	3	32	59	79	320	M64 x 4	58	400	9,000	< 0.2

Dimensions



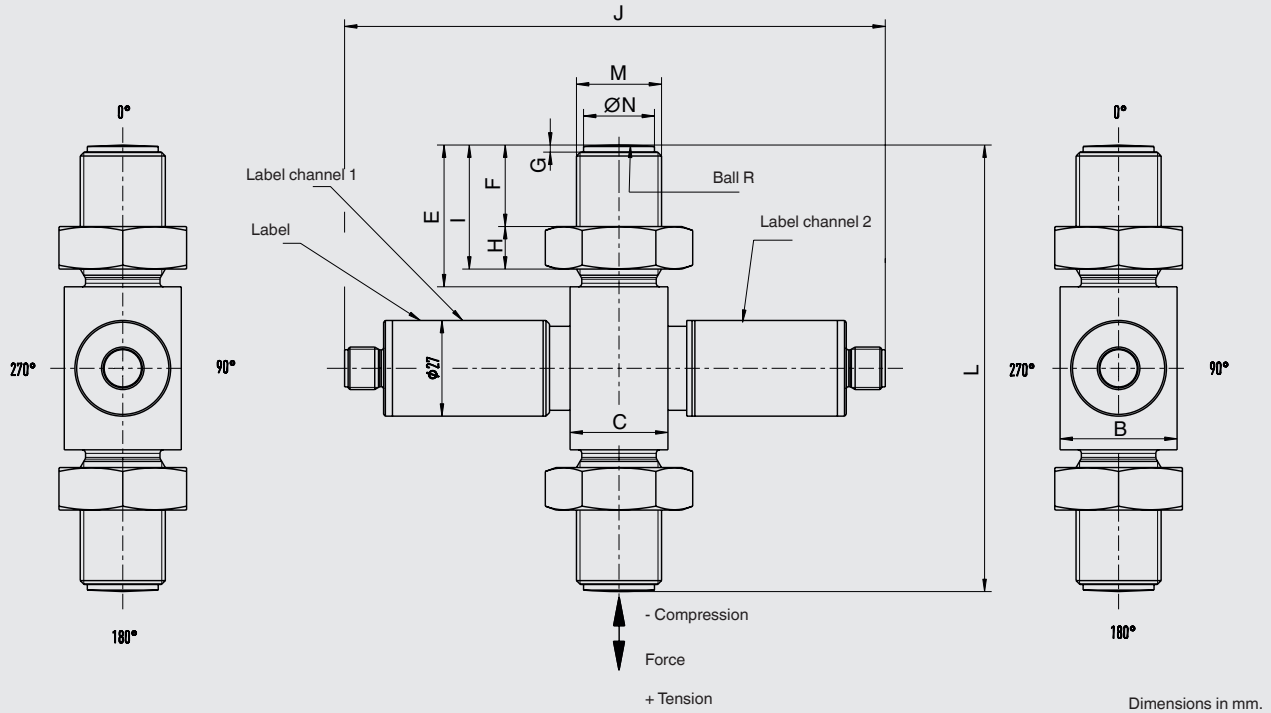
Rated force in kN	A	B	D	E	F	G	H	J	K1	K2	L	M	N -0.1	Ball R	MA (Nm)	Rated displacement
1, 2, 3	25.3	22	24	23	4.3	1.5	6	59.7	43	63	70	M12	9.5	60	60	< 0.02
5	25.3	22	24	23	4.3	1.5	6	59.7	43	63	70	M12	9.5	60	60	< 0.02
10	25.3	22	31	23	4.3	1.5	6	59.7	43	63	77	M12	9.5	80	60	< 0.02
20	25.3	26	33	34	3.8	2	10	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



Rated force in kN	∅A	D	E	F	G	H	J	K1	K2	L	M	N -0,1	Ball R	MA (Nm)	Rated displacement
50	35	50	40	5	2	12	91.5	73	90.2	130	M24 x 2	20	150	500	< 0.2
100	54	54	68	10	3.7	19.5	91.5	71	91	197	M39 x 3	34	200	2,500	< 0.2

Dimensions

F23S1 Versions from 3 kN



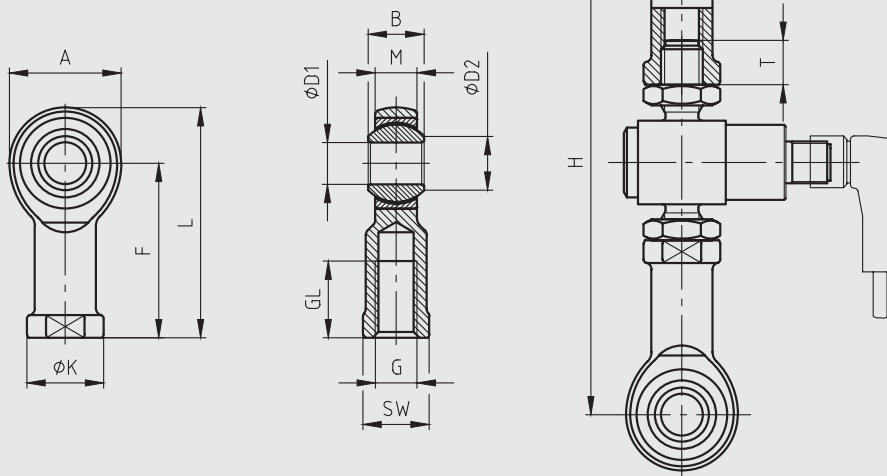
Rated force in kN	B	C	E	F	G	H	I	J	L	M	ØN -0.1	Ball R
3-7	22	25.3	23	12.7	1.5	6	18.7	152.5	75	M12	9,5	60
6-13	25.3	25.3	26	13.5	1.5	8	21.5	152.5	85	M16 x 1.5	13	80
12-26	27.5	27.6	34	20.2	2	10	30.2	152.5	108	M20 x 1.5	17	120
18-40	33	27.6	40	23	2	12	35	152.5	126	M24 x 2	20	120
31-70	40	40	48	25	2	15	40	157.4	154	M30 x 2	26	150
67-151	60	60	78	47.8	3	19.7	67.5	177.4	223	M42 x 2	38	250

Dimensions

Swivel heads in accordance with DIN ISO 12240-4

Ø -D1 = 12 ... 25 dim. column K

Ø -D2 = 40 ... 80 dim. column E



Dimensions in mm.

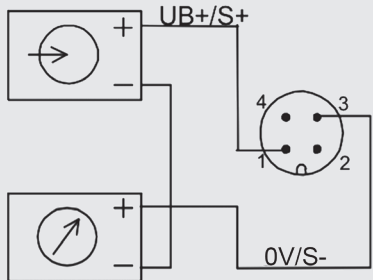
Rated force in kN	H	Minimum screw-in depth T
1, 2, 3, 5	148 ± 3	9.5
10	155 ± 3	9.5
20	219 ± 4	16
30	226 ± 4	16
50	276 ± 4	19.5
100	405 ± 7	31
200	466 ± 13	36
300	568 ± 11	45
500	665 ± 13	51

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
200	3.5	112	35	50 _{-0,012}	56	160	M45 x 3	68	75	216	30	65
300	8.6	160	49	70 _{-0,015}	77.9	200	M56 x 4	80	98	280	42	85
500	12	180	55	80 _{-0,015}	89.4	230	M64 x 4	85	110	320	47	100

Pin assignment analogue output

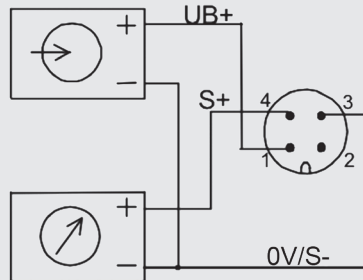
4 ... 20 mA output, 2-wire

Circular connector M12 x 1, 4-pin



0 ... 10 V output, 4 ... 20 mA 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

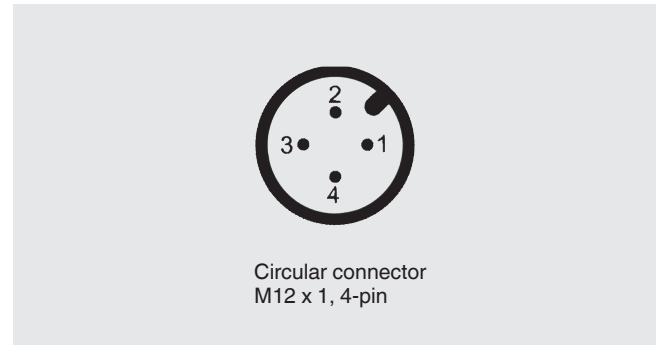
Circular connector M12 x 1, 4-pin			
	4...20 mA 2-wire	4...20 mA 3-wire	0...10 V 3-wire
Supply UB+	1	1	1
Supply 0V/UB-	3	3	3
Relay UR+	2	2	2
Relay UR-	4	3	3
Signal S+	1	4	4
Signal S-	3	3	3
Screen ⊕	Case	Case	Case

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

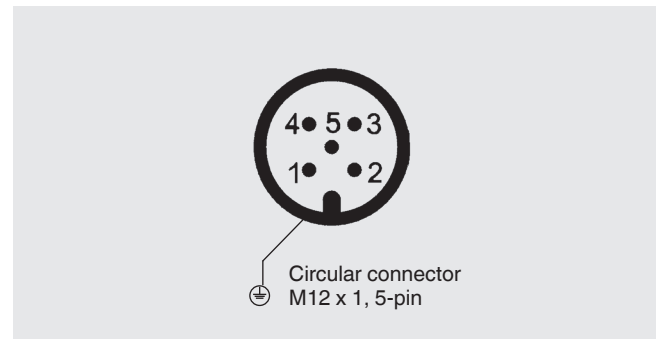
Circular connector M12 x 1, 4-pin		
	4 ... 20 mA / 20 ... 4 mA (redundant)	
	Connector 1	Connector 2
Supply UB+	1	1
Supply 0V/UB-	3	3
Signal channel1	4	-
Signal channel 2	-	4
Screen ⊕	Case	Case



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®

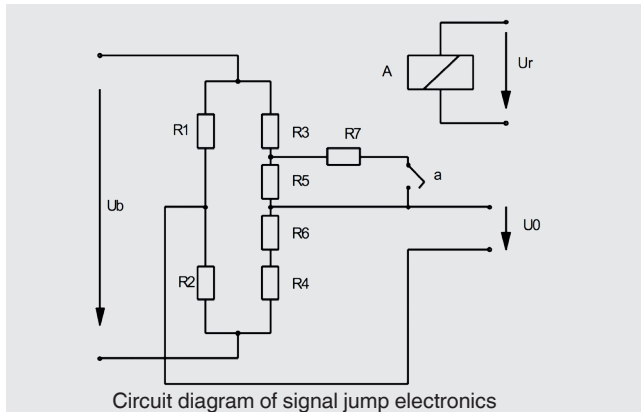
Circular connector M12 x 1, 5-pin	
Screen ⊕	1
Supply UB+ (CAN V+)	2
Supply UB- (CAN GND)	3
Bus-Signal CAN-High	4
Bus-Signal CAN-Low	5



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.

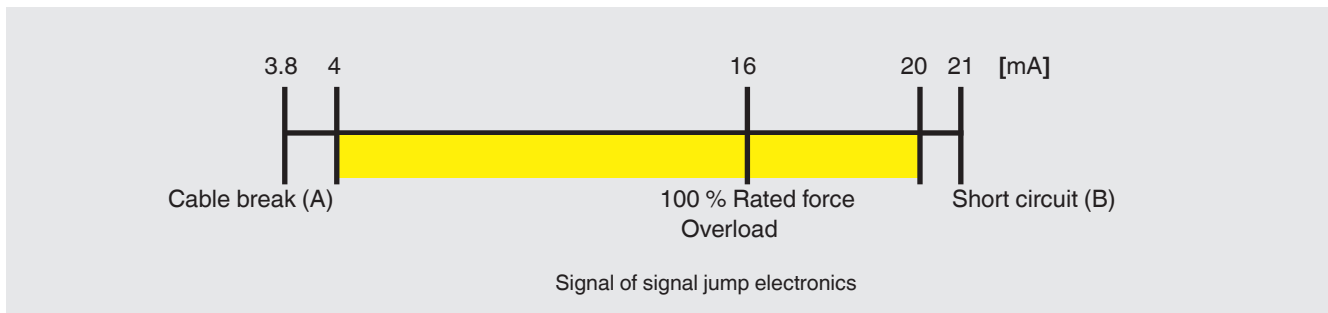
Compliance with functional safety

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.

Ordering information

Model / Rated force / Calibration direction / Connecting thread / Explosion protection / Further approvals, certificates / Relative linearity error / Temperature range / Output signal / Electrical connection / Options

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