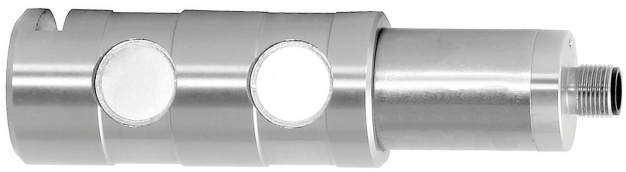
Load pin
With thin-film technology to 200 kN [44,962 lbf]
Models F5301 standard and F53C1 ATEX version

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 ... 5 kN to 0 ... 200 kN [0 ... 1,124 lbf to 0... 44,962 lbf]
- Stainless steel version (corrosion-resistant)
- Integrated amplifier
- High long-term stability, high shock and vibration resistance
- Good reproducibility, simple installation



Load pin, model F5301

Description

Load pins are designed for static and dynamic measurement tasks. They directly replace existing bolts and determine the tension and compression forces in a wide range of applications.

Load pins of this series are mainly used in hoists and crane systems. They also serve as reliable sensors in industrial weighing technology as well as in the field of production automation, mechanical and plant engineering, where they are used in particular in pulleys, cable winches, fork or roller bearings.

Other areas of application include theater and stage construction, where they reliably prevent overloads. The load pins have also proven themselves in the chemical and petrochemical industries. The relevant technical and regional approvals are optionally available.

These load pins are made of high-strength, corrosion resistant stainless steel 1.4542, which is particularly suitable for their application areas.

Besides the standard active current and voltage outputs (4 ... 20 mA, 0 ... 10 V) also digital outputs (CANopen®) are available as output signals. Redundant output signals are possible.

Data sheets showing similar products:
Load pin “Heavy duty” version from 10 kN; models F53x8; see data sheet: FO 51.43
Load pin standard version; model F5280; see data sheet: FO 51.53
Load pin standard version; model F52C8; see data sheet: FO 51.54
Load pin standard version to 10,000 kN; model F5802; see data sheet: FO 51.55

Technical data in accordance with VDI/VDE/DKD 2638

Model	F5301							
Rated force F_{nom} kN	5	10	20	30	50	70	100	200
Rated force F_{nom} lbf	1,124	2,248	4,496	6,744	11,240	15,737	22,481	44,962
Relative linearity error d_{lin} [1]	±1 % F_{nom}							
Relative repeatability error in unchanged mounting position b_{rg}	±0.2 % F_{nom}							
Temperature effect on								
characteristic value TK_c	0.2 % F_{nom}/10 K							
zero signal TK_0	0.2 % F_{nom}/10 K							
Force limit F_L	150 % F_{nom}							
Breaking force F_B	300 % F_{nom}							
Shear force influence d_Q (Signal with 100 % F_{nom} under 90°)	±5 % F_{nom}							
Rated displacement (typ.) s_{nom}	< 0.1 mm [<0.004 in]							
Material of measuring body	Stainless steel corrosion-resistant 1.4542, ultrasonically tested 3.1 material (optional 3.2)							
Rated temperature $B_{T, nom}$	-20 … +80 °C [-4 ... +176 °F]							
Operating temperature $B_{T, G}$	-30 … +80 °C [-22 ... +176 °F]							
Storage temperature $B_{T, S}$	-40 … +85 °C [-40 ... +185 °F]							
Electrical connection	■ Circular connector M12 x 1, 5-pin ■ CANopen® CANopen® circular connector M12 x 1, 5-pin							
Output signal (rated output) C_{nom}	■ 4 … 20 mA, 2-wire ■ 4 … 20 mA, 3-wire ■ 2 x 4 … 20 mA, redundant ■ DC 0 … 10 V, 3-wire ■ 2 x DC 0 … 10 V redundant ■ 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 consumption	■ Current output 4 … 20 mA 2-wire: signal current ■ Current output 4 … 20 mA, 3-wire: < 8 mA ■ Voltage output: < 8 mA ■ CANopen®: < 1 W							
Supply voltage UB	■ DC 9 ... 36 V for current output ■ DC 13 ... 36 V for voltage output ■ DC 9 ... 36 V for CANopen®							
Burden	■ ≤ (UB−10 V)/0.024 A for current output ■ > 10 kΩ for voltage output							
Response time	≤ 2 ms (within 10 ... 90 % F_{nom}) [3]							
Ingress protection (per EN/IEC 60529)								
Unplugged condition	IP66, IP67							
Plugged condition	IP68, IP69, IP69K							
Electrical protection	Reverse polarity protection, overvoltage and short-circuit resistance							
Vibration resistance	20 g, 100 h, 50...150 Hz (in accordance with DIN EN 60068-2-6)							
Shock resistance	DIN EN 55011							
Immunity	In accordance with DIN EN 61326-1/DIN EN 61326-2-3 (optional EMC-strengthened versions)							
Options	Certificates, strength verifications, 3D/CAD files (STEP, IGES) on request							

1) Relative linearity error in accordance with VDI/VDE/DKD 2638 chap. 3.2.6.
2) Protocol in accordance with CiA DS-301 V.402. Device profile DS-404 V. 1.2.
3) Other response times are available on request.

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Technical data in accordance with VDI/VDE/DKD 2638

Model	F53C1 ATEX/IECEx EX ib [1]				F5301 Signal jump			
Rated force F_{nom} kN	5	10	20	30	50	70	100	200
Rated force F_{nom} lbf	1,124	2,248	4,496	6,744	11,240	15,737	22,481	44,962
Relative linearity error d_{lin} [2]	±1 % F_{nom}							
Relative repeatability error in unchanged mounting position b_{rg}	±0.2 % F_{nom}							
Temperature effect on								
characteristic value TK_c	0.2 % F_{nom}/10 K							
zero signal TK_0	0.2 % F_{nom}/10 K							
Force limit F_L	150 % F_{nom}							
Breaking force F_B	300 % F_{nom}							
Shear force influence d_Q (Signal with 100 % F_{nom} under 90°)	±5 % F_{nom}							
Rated displacement (typ.) s_{nom}	< 0.1 mm [<0.004 in]							
Material of measuring body	Stainless steel corrosion-resistant 1.4542, ultrasonically tested 3.1 material (optional 3.2)							
Rated temperature $B_{T, nom}$	-20 … +80 °C [-4 ... +176 °F]							
Operating temperature $B_{T, G}$	Ex II 2G Ex ib IIC T4 Gb -25 °C < Tamb < +85 °C Ex II 2G Ex ib IIC T3 Gb -25 °C < Tamb < +100 °C Ex I M2 Ex ib I Mb -25 °C < Tamb < +85 °C Ex II 2G Ex ib IIC T4 Gb -40 °C < Tamb < +85 °C				-30 … +80 °C [-22 ... +176 °F]			
Storage temperature $B_{T, S}$	-40 … +85 °C [-40 ... +185 °F]							
Electrical connection	■ Circular connector M12 x 1, 4-pin or 5-pin ■ Cable gland							
Output signal (rated output) C_{nom}	■ 4 … 20 mA, 2-wire				■ 4 … 16 mA, 2-wire [3] ■ 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 UB	■ DC 10 ... 30 V for current output				■ DC 9 … 36 V for current output ■ DC 13 ... 36 V for voltage output			
Burden	■ < (UB–10 V)/0,024 A for current output ■ > 10 kΩ for voltage output							
Response time	≤ 2 ms (within 10 ... 90 % F_{nom}) [4]							
Ingress protection (per EN/IEC 60529)	IP67							
Electrical protection	Reverse polarity protection, overvoltage and short-circuit resistance							
Vibration resistance	20 g, 100 h, 50...150 Hz (in accordance with DIN EN 60068-2-6)							
Shock resistance	DIN EN 55011							
Immunity	In accordance with DIN EN 61326-1/DIN EN 61326-2-3 (optional EMC-strengthened versions)							
Options	Certificates, strength verifications, 3D/CAD files (STEP, IGES)							
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 **DNV standard:** DNV-ST-0377 **DNV standard:** DNV-ST-0378							

1) The load pins with ignition protection type “ib” must only be supplied using galvanically-isolated power supplies. Suitable supply isolators are also optionally available e.g. 14255084.
2) Relative linearity error in accordance with VDI/VDE/DKD 2638 chap. 3.2.6.
3) Other signal jumps are available on request.
4) Other response times are available on request.

Approvals

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

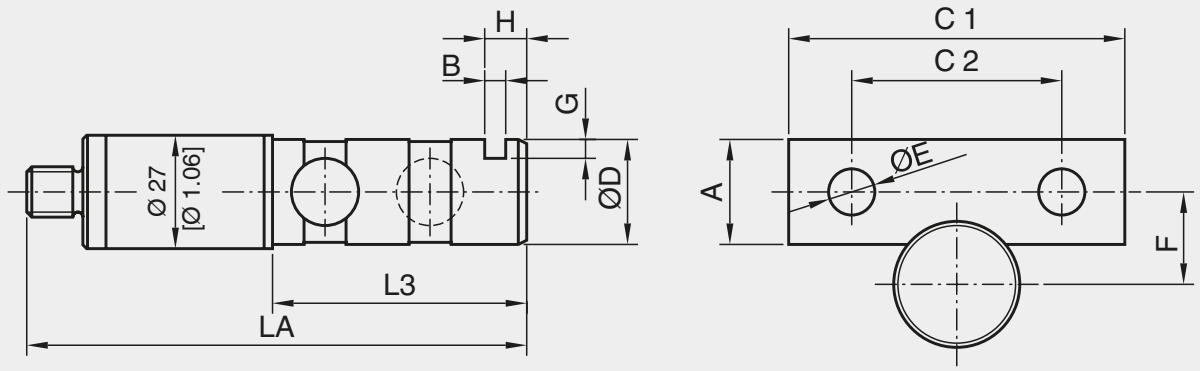
Optional approvals

Logo	Description	Region
Ex	**ATEX directive (option)** Hazardous areas Ex ib 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 [1] -25 °C < T_{amb} < +85 °C Ex II 2G Ex ib IIC T4 Gb -40 °C < T_{amb} < +85 °C	European Union
IEC IECEx	**IECEx (Option)** Hazardous areas Ex ib Ex ib IIC T4/T3 Gb -25 °C < T_{amb} < +85 °C Ex ib IIC T4 Gb -25 °C < T_{amb} < +100 °C Ex ib I Mb [1] -25 °C < T_{amb} < +85 °C Ex ib IIC T4 Gb -40 °C < T_{amb} < +85 °C	International
c UL us	**UL** Component approval	USA and Canada
EAC	**EAC**	Eurasian Economic Community
DNV	**DNV (Option)** Ships, shipbuilding (e.g. offshore)	International

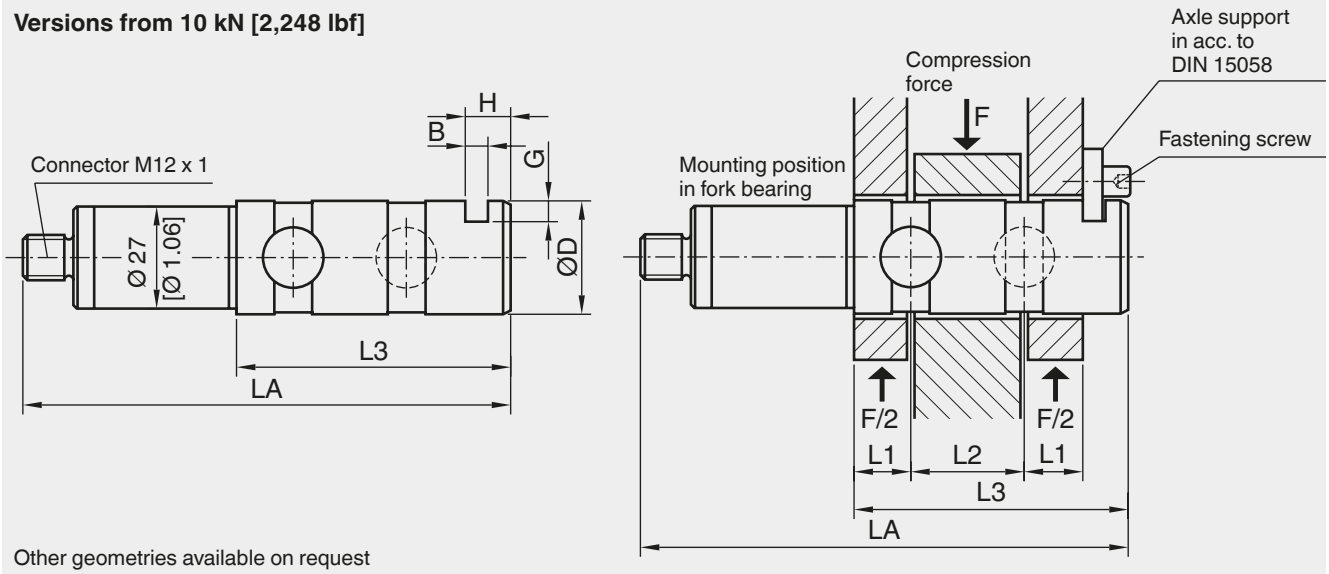
1) Only available with cable connection.

Dimensions in mm [in]

Versions to 10 kN [2,248 lbf]



Versions from 10 kN [2,248 lbf]

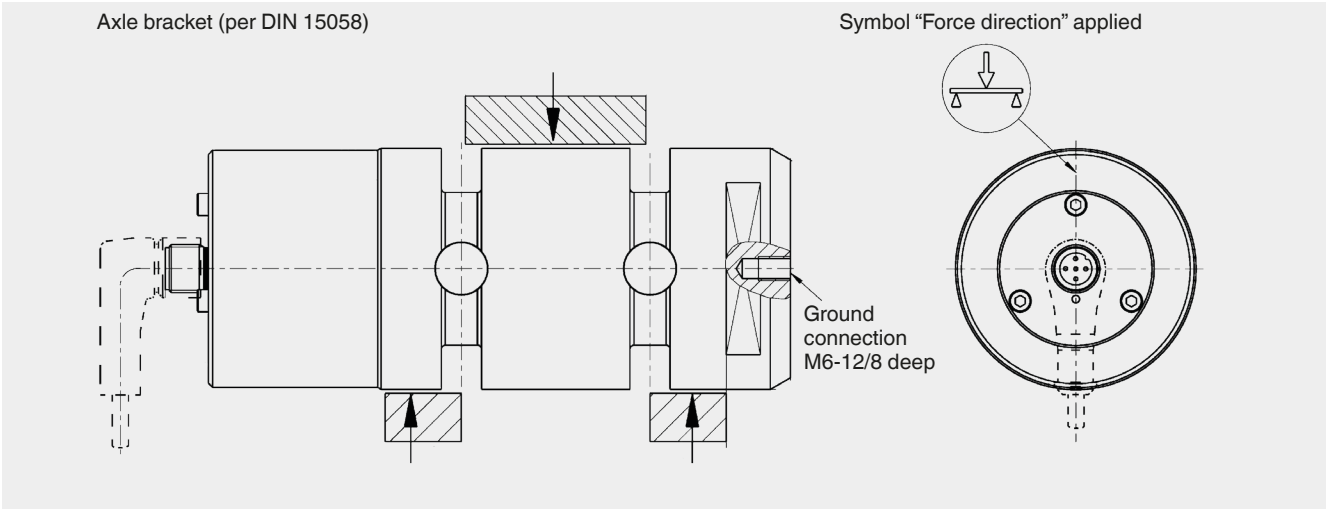


Other geometries available on request

Rated force in kN [lbf]	Dimensions in mm [in]													
	Analogue output, CANopen®	Signal jump												
	LA		ØD **	L1	L2	L3	A	B	C1	C2	ØE	F	G	H
5 [1,124]	115.5 [4.58]	117.5 [4.63]	20 [0.79]	10 [0.4]	20 [0.79]	50.5 [1.98]	20 [0.79]	5 [0.19]	60 [2.36]	36 [1.42]	9 [0.35]	16 [0.63]	4.0 [0.16]	10 [0.4]
10 [2,248]	125.5 [4.94]	127.5 [5.02]	25 [0.98]	12.5 [0.49]	25 [0.98]	60.5 [2.38]	20 [0.79]	5 [0.19]	60 [2.36]	36 [1.42]	9 [0.35]	18 [0.71]	4.5 [0.18]	10 [0.4]
20 [4,496]	135.5 [5.33]	137.5 [5.41]	30 [1.18]	15 [0.59]	30 [1.18]	72.5 [2.85]	25 [0.98]	6 [0.24]	80 [3.15]	50 [1.96]	11 [0.43]	22 [0.87]	5.5 [0.22]	12 [0.47]
30 [6,744]	145.5 [5.73]	147.5 [5.81]	35 [1.37]	17.5 [0.69]	35 [1.38]	82.5 [3.25]	25 [0.98]	6 [0.24]	80 [3.15]	50 [1.96]	11 [0.43]	24 [0.94]	6 [0.24]	12 [0.47]
50 [11,240]	160.5 [6.31]	162.5 [6.40]	40 [1.57]	22.5 [0.89]	40 [1.57]	97.5 [3.84]	25 [0.98]	6 [0.24]	80 [3.15]	50 [1.96]	11 [0.43]	26 [1.02]	6.5 [0.25]	12 [0.47]
100 [22,481]	175.5 [6.90]	177.5 [6.99]	50 [1.96]	23 [0.91]	50 [1.97]	112.5 [4.43]	30 [1.18]	8 [0.24]	100 [3.94]	70 [2.76]	13 [0.51]	33 [1.30]	7 [0.28]	16 [0.63]
200 [44,962]	223.5 [8.80]	225.5 [8.88]	70 [2.75]	35 [1.37]	70 [2.76]	160.5 [6.32]	40 [1.57]	10 [0.24]	140 [5.51]	100 [3.94]	17 [0.67]	45 [1.77]	10 [0.4]	20 [0.79]

** Combination of hole and bolt tolerance zones: H9/f9

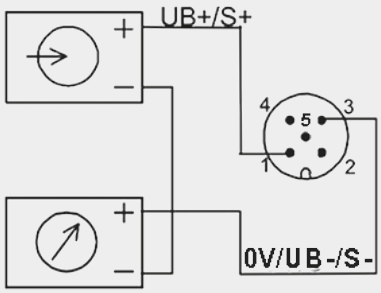
Mounting situation of the load pin



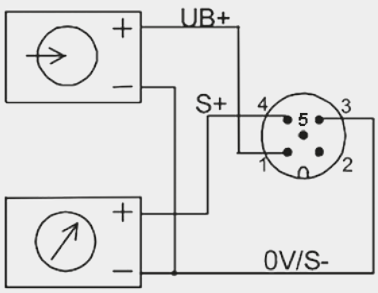
Dimensions: The customer-specific load pin drawing for the specific article number applies above all.

Pin assignment of analogue output

4 ... 20 mA output, 2-wire
Circular connector M12 x 1, 5-pin



0 ... 10 V output, 3-wire
Circular connector M12 x 1, 5-pin



Circular connector M12 x 1, 5-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, 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. item number 14259454

Pin assignment of analogue output for ATEX/IECEx

Circular connector M12 x 1, 4-pin	
	ATEX/IECEx Ex ib 4 … 20 mA, 2-wire
Supply UB+	1
Supply 0V/UB-	3
Signal S+	1
Signal S-	3
Shield ⏚	Case

Cable output		
Cable colour	**ATEX/IECEx Ex d 4 ... 20mA, 2-wire**	**ATEX/IECEx Ex d 4 ... 20mA, 3-wire**
Brown	UB+/S+	UB+
White	-	
Blue	0V/S-	0V/S-
Black	-	S+

Pin assignment of analogue output 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

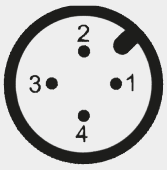
Cable assignment in combination with circular connector M12 x 1, 5-pin		
Cable colour	**2-wire**	**3-wire**
Brown	UB1+/S1+	UB+
White	UB2+/S2+	S1+
Blue	UB1-/S1-	0V/S-
Black	UB2-/S2-	S2+

Only when using standard cable, e.g. 14259454

Pin assignment of analogue output redundant, opposing

Circular connector M12 x 1, 4-pin		
	4 ... 20 mA, 3-wire / 20 … 4 mA, 3-wire (redundant)	
	Connector channel 1	Connector channel 2
Supply UB+	1	1
Supply 0V/UB-	3	3
Signal S+	4	4
Shield ⏚	Case	Case

Circular connector M12 x 1, 5-pin

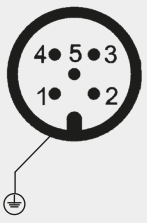


2-connector variant, for example, in combination with ELMS1 overload protection (F53S1).
Version in accordance with requirements for functional safety per 2006/42/EC Machinery Directive.

Pin assignment of analogue output 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

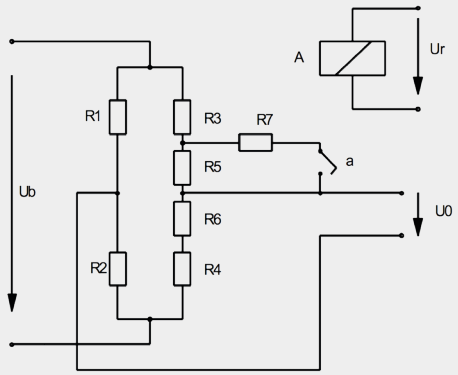
Circular connector M12 x 1, 5-pin



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 the signal jump electronics

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



Circuit diagram of the 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.

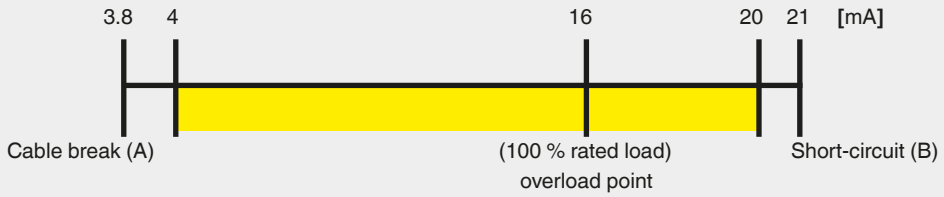
Compliance with functional safety

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:



Signals of the 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.